

Lot 19



ORANGETOWN TOWN HALL ADDITION AND ALTERATIONS

26 West Orangeburg Road
Orangeburg, NY 10962

CONTRACTS

1G - General Construction

2P - Plumbing

3H - Heating, Ventilation, Air Conditioning

4E - Electrical

PROJECT MANUAL Issued for Bidding

November 9, 2021

LOTHROP ASSOCIATES LLP
333 WESTCHESTER AVE
EAST TERRACE
WHITE PLAINS, NY 10604
(914)741-1115

11/9/2021

SECTION 000101
PROJECT TITLE PAGE

PROJECT MANUAL

FOR

2219-05 ORANGETOWN TOWN HALL ADDITION AND ALTERATIONS

PROJECT NUMBER: 2219-05

TOWN OF ORANGETOWN

26 WEST ORANGEBURG ROAD

ORANGEBURG , NEW YORK 10962

DATE: NOVEMBER 9, 2021

PREPARED BY:

LOTHROP ASSOCIATES LLP ARCHITECTS

333 WESTCHESTER AVENUE

WHITE PLAINS, NY 10604

END OF SECTION

SECTION 000102
PROJECT INFORMATION

PART 1 GENERAL

1.1 PROJECT IDENTIFICATION

- A. Project Name: Orangetown Town Hall Addition and Alterations, located at:
26 West Orangeburg Road.
Orangeburg, New York 10962.
- B. Architect's Project Number: 2219-05.
- C. The Owner, hereinafter referred to as Owner: Town of Orangetown
 - 1. The Owner is exempt from payment of sales tax. No Tax Exemption Number is available. A written letter of tax exempt status can be provided upon written request.
- D. Owner's Project Manager: Ms. Jane Slavin, RA.
 - 1. Department: Planning-Zoning-Administration and Enforcement.
 - 2. Address: 26 West Orangeburg Road.
 - 3. City, State, Zip: Orangeburg, NY 10962.
 - 4. Phone/Fax: (845) 359-8410.
 - 5. E-mail: jslavin@orangetown.com.

1.2 NOTICE TO PROSPECTIVE BIDDERS

- A. These documents constitute an Invitation to Bid to and request for qualifications from General Contractors for the construction of the project described below.

1.3 PROJECT DESCRIPTION

- A. Summary Project Description: Construction of a 3-story addition to the existing Town Hall, including interior alterations, mechanical, plumbing, electrical, fire protection, and associated site work.
- B. Contract Scope: Construction, demolition, renovation, hazardous material removal, facility operations during occupancy, and phasing and sequencing.
- C. Contract Terms: Lump sum (fixed price, stipulated sum).
- D. The currently occupied premises at the project site are open for examination by bidders only during the following days and hours, by appointment only:
 - 1. Monday through Friday: 9 am to 5 pm.

1.4 PROJECT CONSULTANTS

- A. The Architect, hereinafter referred to as Architect: Lothrop Associates LLP Architects.
Contact Mike Berta or Brett Huttman.
 - 1. Address: 333 Westchester Avenue.
 - 2. City, State, Zip: White Plains, NY 10604.
 - 3. Phone/Fax: 914-741-1115, Ext. 258 for Mike Berta, Ext. 310 for Brett Huttman.
 - 4. Mike Berta's E-mail: mberta@lothropassociates.com..

5. Brett Huttman's E-mail: bhuttman@lothropassociates.com

1.5 PROCUREMENT TIMETABLE

- A. Mandatory Pre-Bid Site Tour: November 30, 2021 at 10:00 am.
- B. Last Request for Substitution Due: 8 days prior to due date of bids, December 30, 2021.
- C. Last Request for Information Due: 12 days prior to due date of bids, December 27, 2021 .
- D. Bid Due Date: January 7, 2022, before 11:00 am local time.
- E. Public Bid Opening: January 7, 2022, 1:30 pm local time.
- F. Notice to Proceed: Not later than 7 days after bid due date.
- G. Bids May Not Be Withdrawn Until: 60 days after bid due date.
- H. Contract Time: To be stated in bid documents.
- I. Construction Start Date: To Be Determined following award of contract.
- J. Substantial Completion Date for Base Bid Work: Not later than 540 calendar days from Notice to Proceed.
- K. Substantial Completion Date for Base Bid plus Alternates Work: Not later than 660 calendar days from Notice to Proceed.
- L. Final Completion Date: Not later than 660 calendar days from Notice to Proceed.
- M. The Owner reserves the right to revise the schedule or terminate the entire bid process at any time.

1.6 BID DOCUMENTS

- A. Availability of Documents: Complete sets of bid documents may be obtained:
 - 1. Via electronic transmission from the Architect. Requests shall be made via email.

1.7 BID SECURITY

- A. Bids shall be accompanied by a security deposit as follows:
 - 1. Bid Bond or Certified Check not less than 5 percent of the Bid Amount on AIA A310 Bid Bond Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 000103
PROJECT DIRECTORY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Identification of project team members and their contact information.

1.2 OWNER:

- A. Name: Town of Orangetown.
1. Address Line 1: Office of Planning-Zoning-Administration and Enforcement.
 2. Address Line 2: 26 West Orangeburg Road.
 3. City: Orangeburg.
 4. State: NY.
 5. Zip Code: 10962.
 6. Telephone: (845) 359-8410.
- B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Title: Director of Office of Building, Zoning, Planning, Administration and Enforcement.
 2. Name: Ms. Jane Slavin, RA.
 3. Email: jslavin@orangetown.com.

1.3 CONSULTANTS:

- A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Company Name: Lothrop Associates LLP Architects.
 - a. Address Line 1: 333 Westchester Avenue.
 - b. City: White Plains.
 - c. State: NY.
 - d. Zip Code: 10604.
 - e. Telephone: (914) 941-1115.
 2. Primary Contact:
 - a. Title: Associate Architect.
 - b. Name: Mr. Michael Berta, RA.
 - c. Email: mberta@lothropassociates.com.
 3. Secondary Contact:
 - a. Title: Project Manager
 - b. Name: Mr. Brett Huttman, RA
 - c. Email: bhuttman@lothropassociates.com
- B. Civil Engineering Consultant:
1. Company Name: Tectonic.
 - a. Address Line 1: PO Box 37 70 Pleasant Hill Road.
 - b. City: Mountainville.
 - c. State: NY.

- d. Zip Code: 10953.
 - e. Telephone: (845) 534-5959.
 - 2. Primary Contact:
 - a. Title: Senior Engineer.
 - b. Name: Mr. Louis J. Greco, PE.
 - c. Email: LJGreco@tectonicengineering.com.
- C. Structural Engineering Consultant:
 - 1. Company Name: B Cubed.
 - a. Address Line 1: 6 East Main Street.
 - b. City: Westport.
 - c. State: CT.
 - d. Zip Code: 06880.
 - e. Telephone: (203) 349-5916.
 - 2. Primary Contact:
 - a. Title: Owner.
 - b. Name: Mr. Domenico Antonelli.
 - c. Email: dantonelli@bbb-engineering.com.
- D. Vertical Transportation Consultant:
 - 1. Company Name: Kone Elevator, Inc..
 - a. Address Line 1: 4225 Naperville Road.
 - b. City: Lisle.
 - c. State: IL.
 - d. Zip Code: 60532.
 - e. Telephone: (630) 577-1650.
 - 2. Primary Contact:
 - a. Title: Sr. Sales Consultant.
 - b. Name: Rebekah Wheeler.
 - c. Email: rebekah.wheeler@kone.com.
- E. Mechanical, Electrical, HVAC and Fire Protection Engineering Consultant
 - 1. Company Name: CBK Engineering PC.
 - a. Address Line 1: 44-46 Foster Road, Suite 7.
 - b. City: Hopewell Junction.
 - c. State: NY.
 - d. Zip Code: 12533.
 - e. Telephone: (914) 509-8161.
 - 2. Primary Contact:
 - a. Title: Owner.
 - b. Name: Mr. Mark Velzy, PE .
 - c. Email: cbkengineering@yahoo.com.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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A800	MISCELLANEOUS SITE DETAILS
A801	TEMPORARY ACCESSIBLE RAMP PLAN AND SECTIONS
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A901	ALTERNATE 01 - RE-FINISH AND RE-PLUMB EXISTING TOILET ROOMS
A902	ALTERNATE 01 - RE-FINISH AND RE-PLUMB EXISTING TOILET ROOMS
A903	ALTERNATE 01 - RE-FINISH AND RE-PLUMB EXISTING TOILET ROOMS
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FP-200	BASEMENT FLOOR PLAN AND NOTES
FP-201	LEVEL 01 FLOOR PLAN AND NOTES
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E-103	ELECTRICAL LEVEL 02 PLAN (REMOVALS)
E-201	ELECTRICAL SITE PLAN
E-202	ELECTRICAL BASEMENT LEVEL FLOOR PLAN (POWER)
E-203	ELECTRICAL BASEMENT LEVEL FLOOR PLAN (IT/DATA/SECURITY)
E-204	ELECTRICAL BASEMENT LEVEL FLOOR PLAN (LIGHTING)
E-205	ELECTRICAL BASEMENT LEVEL FLOOR PLAN (LIGHTING CONTROL)
E-206	ELECTRICAL BASEMENT LEVEL FLOOR PLAN (FIRE ALARM)
E-207	ELECTRICAL LEVEL 01 PLAN (POWER)
E-208	ELECTRICAL LEVEL 01 PLAN (IT/DATA/SECURITY)
E-209	ELECTRICAL LEVEL 01 PLAN (LIGHTING)
E-210	ELECTRICAL LEVEL 01 PLAN (LIGHTING CONTROL)
E-211	ELECTRICAL LEVEL 01 PLAN (FIRE ALARM)
E-212	ELECTRICAL LEVEL 02 PLAN (POWER)
E-213	ELECTRICAL LEVEL 02 PLAN (IT/DATA/SECURITY)
E-214	ELECTRICAL LEVEL 02 PLAN (LIGHTING)
E-215	ELECTRICAL LEVEL 02 PLAN (LIGHTING CONTROL)
E-216	ELECTRICAL LEVEL 02 PLAN (FIRE ALARM)
E-217	ELECTRICAL LEVEL 03 PLAN (POWER)
E-218	ELECTRICAL LEVEL 03 PLAN (IT/DATA/SECURITY)
E-219	ELECTRICAL LEVEL 03 PLAN (LIGHTING)
E-220	ELECTRICAL LEVEL 03 PLAN (LIGHTING CONTROL)
E-221	ELECTRICAL LEVEL 03 PLAN (FIRE ALARM)
E-222	ELECTRICAL ROOF PLAN
E-223	ELECTRICAL ROOF PLAN (LIGHTNING PROTECTION)
E-301	ELECTRICAL ONE-LINE DIAGRAM
E-302	ELECTRICAL PART ONE-LINE POWER DIAGRAM, OUTDOOR PLANT FIBER OPTIC DIAGRAM AND KEYED NOTES
E-303	IT/COMMUNICATIONS RISER DIAGRAM
E-304	ELECTRICAL PANEL SCHEDULES
E-305	ELECTRICAL DETAILS
E-306	GENERATOR DETAILS
E-307	IT/DATA SPECIFICATIONS AND DETAILS

END OF SECTION

**SECTION 001113
NOTICE TO BIDDERS**

PROJECT: Orangetown Town Hall Addition and Alterations
26 West Orangeburg Road
Orangeburg, NY 10962

Sealed bids for separate contracts for **ORANGETOWN TOWN HALL ADDITION AND ALTERATIONS** will be received by the Town of Orangetown at the Office of the Town Clerk, located at 26 West Orangeburg Road, Orangeburg, NY 10962, up to and including January 7, 2022 at 11:00 am local time. No bids will be received after 11:00 am. Bids will be publicly opened January 7, 2022 at 1:30 pm local time and read aloud.

Contract No. 1G – General Construction

Contract No. 2P – Plumbing & Fire Protection

Contract No. 3H – Heating-Ventilation-Air Conditioning

Contract No. 4E – Electrical

A Pre-Bid Site Tour will be held at **ORANGETOWN TOWN HALL, 26 WEST ORANGEBURG ROAD, ORANGEBURG, NY** at 10:00 am on November 30, 2021. Attendance by prospective Bidders is **recommended**. Additional site visits will be made available to Bidders, weekdays, by appointment between 9:00 am and 5:00 pm. Contact the Architect's office to make an appointment with one of the contacts listed below. Meetings will begin at the existing main entrance located facing the main public parking lot. All visiting personnel will be responsible for their own safety and personal protective equipment.

The Bid Documents may be obtained at the office of the Architect, Lothrop Associates Architect LLP via electronic transmission only, between the hours of 8:30 am and 5:30 pm, Monday through Friday. Requests for Bid Documents to be made via email only by contacting Brett Huttman or Mike Berta at the email addresses below.

Contact: Brett Huttman at bhuttman@lothropassociates.com or 914-234-8418 or
Mike Berta at mberta@lothropassociates.com or 914-234-8407

Awarded Contractors shall be required to provide the following:

- Bid Bonds equal to 5% of the bid amount on AIA A310 Bid Bond Form.
- Performance and Payment Bonds, each equal to 100% of the Contract amount
- Insurance coverages as specified in the Contract Documents, with the Town and Architect named as additional insureds, and
- Prior to Final Payment, a one-year Maintenance Bond against any defects in workmanship or materials in an amount equal to 10% of the Contract Price at Substantial Completion.

ADDITIONAL BIDDING REQUIREMENTS ARE INCLUDED IN THE INSTRUCTIONS TO BIDDERS

DATED: November 10, 2021

Rosanna M. Sfraga
Town Clerk
Town of Orangetown
Townclerk@orangetown.com
(845) 359-5100 Ext. 5004

END OF SECTION

SECTION 002113
INSTRUCTIONS TO BIDDERS

SUMMARY

1.1 DOCUMENT INCLUDES

- A. Invitation
 - 1. Bid Submission
 - 2. Intent
 - 3. Work Identified in Contract Documents
 - 4. Contract Time
- B. Bid Documents and Contract Documents
 - 1. Definitions
 - 2. Contract Documents Identification
 - 3. Availability
 - 4. Examination
 - 5. Inquiries/Addenda
 - 6. Product/Assembly/System Substitutions
- C. Site Assessment
 - 1. Site Examination
 - 2. Prebid Walkthrough
- D. Qualifications
 - 1. Qualifications
 - 2. Prequalification
 - 3. Subcontractors/Suppliers/Others
- E. Bid Submission
 - 1. Submission Procedure
 - 2. Bid Ineligibility
- F. Bid Enclosures/Requirements
 - 1. Security Deposit
 - 2. Performance Assurance
 - 3. Insurance
 - 4. Bid Form Requirements
 - 5. Fees for Changes in the Work
 - 6. Bid Form Signature
 - 7. Additional Bid Information
 - 8. Selection and Award of Alternates
- G. Offer Acceptance/Rejection
 - 1. Duration of Offer
 - 2. Acceptance of Offer

1.2 RELATED DOCUMENTS

- A. Document 001113 - Advertisement for Bids.
- B. Document 004323 - Alternates Form.

- C. Document 004325 - Substitution Request Form - During Procurement
- D. Document 007300 - Supplementary Conditions:

INVITATION

2.1 BID SUBMISSION

- A. Bids signed and under seal, executed, and dated will be received at the office of the Owner at Orangetown Town Hall, 26 West Orangeburg Road, Orangeburg, NY 10962 before 11:00 a.m. local standard time on the 7th day of January, 2022.
- B. Bids submitted after the above time shall be returned to the bidder unopened.
- C. Submit required Supplements To Bid Forms within 24 hours after closing time for receiving bids.
- D. Bids will be opened publicly at 1:30 pm, two and one half hours after receipt of bids.
- E. Amendments to the submitted offer will be permitted if received in writing prior to bid closing and if endorsed by the same party or parties who signed and sealed the offer.

2.2 INTENT

- A. The intent of this Bid request is to obtain an offer to perform work to complete a 3-story addition, including interior alterations and associated site work project located at 26 West Orangeburg Road, Orangeburg, NY 10962 for a Stipulated Sum contract, in accordance with Contract Documents.

2.3 WORK IDENTIFIED IN THE CONTRACT DOCUMENTS

- A. Work of this proposed Contract comprises building construction, site development, and alterations, including general construction, structural, mechanical, electrical, plumbing, and fire protection Work.
- B. Location: Town of Orangetown Town Hall located at 26 W Orangeburg Road, Orangeburg, NY 10962.

2.4 CONTRACT TIME

- A. Identify Contract Time in the Bid Form. The completion date in the Agreement shall be the Contract Time added to the commencement date.

BID DOCUMENTS AND CONTRACT DOCUMENTS

3.1 DEFINITIONS

- A. Bid Documents: Contract Documents supplemented with Invitation To Bid, Instructions to Bidders, Information Available to Bidders, Bid Form Supplements To Bid Forms and Appendices identified.
- B. Contract Documents: Defined in Section 1.1.1, AIA A201 including issued Addenda.
- C. Bid or Bidding: Act of submitting a bid under seal.
- D. Bid Amount: Monetary sum identified by the Bidder in the Bid Form.

3.2 CONTRACT DOCUMENTS IDENTIFICATION

- A. Contract Documents are identified as Project Number 2219-05, as prepared by Lothrop Associates LLP A who is located at 333 Westchester Avenue, White Plains, NY 10604, and with contents as identified in the Table of Contents.

3.3 AVAILABILITY

- A. Bid Documents may be obtained at the office of Architect via electronic transmission only.
- B. Bid Documents are made available only for the purpose of obtaining bidss for this project. Their use does not grant a license for other purposes.

3.4 EXAMINATION

- A. Upon receipt of Bid Documents verify that documents are complete. Notify Architect should the documents be incomplete.
- B. Immediately notify Architect upon finding discrepancies or omissions in the Bid Documents.

3.5 INQUIRIES/ADDENDA

- A. Direct questions to Brett Huttman, email; bhuttman@lothropassociates.com or Michael Berta, email: mberta@lothropassociates.com.
- B. Addenda may be issued during the bidding period. All Addenda become part of Contract Documents. Include resultant costs in the Bid Amount.
- C. Verbal answers are not binding on any party.
- D. Clarifications requested by bidders must be in writing no later than 12:00 pm on December 27, 2021. The reply will be in the form of an Addendum, a copy of which will be forwarded to known recipients.

3.6 PRODUCT/ASSEMBLY/SYSTEM SUBSTITUTIONS

- A. Substitute products will be considered if submitted as an attachment to the Bid Form. Approval to submit substitutions prior to submission of bids is not required.
- B. In submission of substitutions to products specified, bidders shall include in their bid all changes required in the work and changes to Contract Time and Contract Sum to accommodate such substitutions. A later claim by the bidder for an addition to the Contract Time or Contract Sum because of changes in work necessitated by use of substitutions shall not be considered.
- C. The submission shall provide sufficient information to determine acceptability of such products.
- D. Provide complete information on required revisions to other work to accommodate each proposed substitution.
- E. Provide products as specified unless substitutions are submitted in this manner and accepted.
- F. See Section 016000 - Product Requirements for additional requirements.

SITE ASSESSMENT

4.1 SITE EXAMINATION

- A. Examine the project site before submitting a bid.
- B. The bidder is required to contact Architect at the following address and phone number in order to arrange a date and time to visit the project site: 333 Westchester Ave, White Plains, NY 10604; 914-741-1115.
 - 1. Primary Contact: Michael Berta at ext. 258 or 845-489-1638.
 - 2. Secondary Contact: Brett Huttman at ext. 310 or 845-625-3161.
- C. The currently occupied premises at the project site are open for examination by bidders only during the following hours, by appointment only:
 - 1. Week Days: 9:00 am to 5:00 pm.

4.2 RECOMMENDED PREBID SITE MEETING

- A. A recommended bidders walkthrough is scheduled for 10:00 a.m. on the 30th day of November, 2021 at the location of 26 W Orangeburg Road, Orangeburg, NY 10962.
- B. All potential bidders are invited. It is recommended that all bidding prime contractors attend.
- C. Representatives of Architect will be present.
- D. Summarized minutes of this meeting will be circulated to attendees. These minutes will not form part of Contract Documents.
- E. Information exchanged during the pre-bid site meeting, and relevant to Bidding and the Bid Documents, will be recorded in an Addendum and issued to all registered bidders.

QUALIFICATIONS

5.1 PREQUALIFICATION

- A. Bidders shall complete and submit Qualification Form AIA A305 along with their bids.
- B. Acceptance or rejection of this submittal will be made within 48 hours thereafter.

5.2 SUBCONTRACTORS/SUPPLIERS/OTHERS

- A. Owner reserves the right to reject a proposed subcontractor for reasonable cause.
- B. Refer to General Conditions.

BID SUBMISSION

6.1 SUBMISSION PROCEDURE

- A. Bidders shall be solely responsible for the delivery of their bids in the manner and time prescribed.
- B. Submit three (3) copies of the executed Bid on the Bid Forms provided, signed and sealed with the required security in a sealed opaque envelope, clearly identified with bidder's name,

project name and Owner's name on the outside.

- C. Improperly completed information, irregularities in security deposit, may be cause not to open the Bid Form envelope and declare the bid invalid or informal.

6.2 BID INELIGIBILITY

- A. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may at the discretion of the Owner, be declared unacceptable.
- B. Bid Forms, Appendices, and enclosures that are improperly prepared may, at the discretion of Owner, be rejected.
- C. Failure to provide security deposit, bonding or insurance requirements may, at the discretion of Owner, be waived.

BID ENCLOSURES/REQUIREMENTS

7.1 SECURITY DEPOSIT

- A. Bids shall be accompanied by a security deposit as follows:
 - 1. Bid Bond or Certified Check not less than 5 percent of the Bid Amount on AIA A310 Bid Bond Form.
- B. Endorse the Bid Bond in the name of the Owner as obligee, signed and sealed by the principal (Contractor) and surety.
- C. The security deposit will be returned after delivery to the Owner of the required Performance and Payment Bond(s) by the accepted bidder.
- D. After a bid has been accepted, all securities will be returned to the unsuccessful bidders .
- E. If no contract is awarded, all security deposits will be returned.

7.2 PERFORMANCE ASSURANCE

- A. Accepted Bidder: Provide a Performance and Payment bond as described in 007300 - Supplementary Conditions.
- B. Include the cost of Performance and Payment Bonds in the Bid Amount and identify the cost when requested.

7.3 INSURANCE

- A. Provide an executed "Undertaking of Insurance" on a standard form provided by the insurance company stating their intention to provide insurance to the bidder in accordance with the insurance requirements of Contract Documents.

7.4 BID FORM REQUIREMENTS

- A. Complete all requested information in the Bid Form and Appendices.

7.5 BID FORM SIGNATURE

- A. The Bid Form shall be signed by the bidder, as follows:

1. Sole Proprietorship: Signature of sole proprietor in the presence of a witness who will also sign. Insert the words "Sole Proprietor" under the signature. Affix seal.
2. Partnership: Signature of all partners in the presence of a witness who will also sign. Insert the word "Partner" under each signature. Affix seal to each signature.
3. Corporation: Signature of a duly authorized signing officer(s) in their normal signatures. Insert the officer's capacity in which the signing officer acts, under each signature. Affix the corporate seal. If the bid is signed by officials other than the president and secretary of the company, or the president/secretary/treasurer of the company, a copy of the by-law resolution of their board of directors authorizing them to do so, must also be submitted with the Bid Form in the bid envelope.
4. Joint Venture: Each party of the joint venture shall execute the Bid Form under their respective seals in a manner appropriate to such party as described above, similar to the requirements of a Partnership.

7.6 ADDITIONAL BID INFORMATION

- A. The lowest bidder will be requested to complete the Supplements To Bid Forms within 24 hours after submission of bids.
- B. Submit the following Supplements concurrent with bid submission:
 1. Document 004323 - Alternates Form: Include the cost variation to the Bid Amount applicable to the Work described in Section 012300 - Alternates.
 2. Document 004325 - Substitution Request Form - During Procurement.

7.7 SELECTION AND AWARD OF ALTERNATES

- A. Indicate variation of bid price for Alternates listed on the Bid Form. Unless otherwise indicated, indicate Alternates as a difference in bid price by adding to or deducting from the base bid price.
- B. Bids will be evaluated on the base bid price. After determination of a successful bidder, consideration will be given to Alternates and bid price adjustments.

BID ACCEPTANCE/REJECTION

8.1 DURATION OF BIDS

- A. Bids shall remain open to acceptance and shall be irrevocable for a period of sixty (60) days after the receipt of bids.

8.2 ACCEPTANCE OF BIDS

- A. Owner reserves the right to accept or reject any or all bids.
- B. After acceptance by Owner, Architect on behalf of Owner, will issue to the successful bidder, a written Bid Acceptance.

END OF SECTION

SECTION 003100
AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.1 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:
- B. Site and Utility Survey: Entitled Topographical Survey of Orangetown Town Hall, dated December 8, 2019.
 - 1. This survey identifies grade elevations prepared primarily for the use of Architect in establishing new grades and identifying natural water shed.
- C. Geotechnical Report: Entitled Geotechnical Investigation Proposed Addition to Orangetown Town Hall, dated March 8, 2021.
 - 1. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
 - 2. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.
- D. Hazardous Material Survey: Entitled Limited HAZMAT Survey Report; Orangetown Town Hall, dated September 16, 2020.
- E. Existing Conditions Photos: Entitled Orangetown Town Hall Addition and Alterations Photobook, dated July 9, 2021.
 - 1. This survey includes a photographic record of existing conditions visible.

1.2 SUSTAINABILITY CERTIFICATION INFORMATION

- A. Owner has begun the process of certifying the project with United States Green Building Council.
 - 1. See Section 013566.05 for Project Sustainability Goals Credit Summary.

1.3 PERMITS

- A. Owner has obtained the following permits and/or approvals, that are required to be secured prior to commencement of construction work on this project:
 - 1. Zoning Board of Appeals approvals.
 - 2. Planning commission approvals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 OBTAINMENT OF PERMITS

- A. Contractor to obtain all required permits for the work, at no cost to Owner:

- B. Building Permit Procedures: When required to obtain a permit:
1. Complete and file permit application(s) with appropriate agency.
 2. Pay required fees.
 3. Advise Architect if submission of modified documents is necessary to have the authorities having jurisdiction complete the plan review and approval process. Submit modified documents expeditiously.
 4. Do not commence execution of any item of work for which a permit has not been obtained.

END OF SECTION

SECTION 004000
PROCUREMENT FORMS AND SUPPLEMENTS

PART 1 GENERAL

- 1.1 Contractor is responsible for obtaining a valid license to use all copyrighted documents specified but not included in the Project Manual.
- 1.2 FORMS
- A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in the procurement requirements.
 - B. Substitution Request Form (During Procurement): CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage).
 - C. Bid Form: Section 004100 - Bid Form.
 - D. Procurement Form Supplements:
 - 1. Bid Security Form: AIA A310.
 - 2. Alternates Form: Section 004323 - Alternates Form.
 - 3. Wage Rates Form: Department of Labor, WD-10 Davis-Bacon Wage Survey.
 - 4. Proposed Schedule of Values Form: AIA G703.
 - E. Representations and Certifications:
 - 1. Bidder's Qualifications: AIA A305.
- 1.3 REFERENCE STANDARDS
- A. AIA A305 - Contractor's Qualification Statement 2020.
 - B. AIA A310 - Bid Bond 2010.
 - C. AIA G703 - Continuation Sheet 1992.
 - D. CSI/CSC Form 1.5C - Substitution Request (During the Bidding/Negotiating Stage) Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 004100.01
BID FORM

THE PROJECT AND THE PARTIES

TO:

Town of Orangetown (Owner)
26 West Orangeburg Road
Orangeburg, New York 10962

FOR: GENERAL CONSTRUCTION CONTRACT No. 1G

Project: 2219-05 Orangetown Town Hall Addition and Alterations

Architect's Project Number: 2219-05
26 West Orangeburg Road
Orangeburg, New York 10962

DATE: _____ (Bidder to enter date)

SUBMITTED BY: (Bidder to enter name and address)

Bidder's Full Name _____
Address _____
City, State, Zip _____

OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Bid Documents prepared by Lothrop Associates, LLP Architects for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

_____ dollars
(\$ _____), in lawful money of the United States of America.

We have included the required security deposit as required by the Instruction to Bidders.

We have included the required performance assurance bonds in the Bid Amount as required by the Instructions to Bidders.

The cost of the required performance assurance bonds is _____ dollars
(\$ _____), in lawful money of the United States of America.

All applicable federal taxes are included and State of New York taxes are included in the Bid Sum1 }.

All Cash and Contingency Allowances described in Section 012100 - Allowances are included in the Bid Sum.

ACCEPTANCE

This offer shall be open to acceptance and is irrevocable for thirty days from the bid closing date.

If this bid is accepted by Owner within the time period stated above, we will:

1. Execute the Agreement within seven days of receipt of Notice of Award.
2. Furnish the required bonds within seven days of receipt of Notice of Award.
3. Commence work within seven days after written Notice to Proceed of this bid.

If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

In the event our bid is not accepted within the time stated above, the required security deposit shall be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

CONTRACT TIME

If this Bid is accepted, we will:

Complete the Work in _____ calendar weeks from Notice to Proceed.
(Bidder to enter number of weeks.)

UNIT PRICES

The following are Unit Prices for specific portions of the Work as listed. The following is the list of Unit Prices:

ITEM DESCRIPTION - UNIT QUANTITY - UNIT PRICE - ITEM VALUE

Unit Price #1: Mechanical Rock Removal - In-place cubic yard removed - - \$

Unit Price #2: Additional Remedial Excavation - In-place cubic yard volume - - \$

Unit Price #3: Additional Roadway Replacement - per square foot - - \$

B. Unit Price #1 General Requirements:

1. Provide all labor, materials, equipment, and services necessary to satisfactorily complete the work in this item: as specified in the Contract Documents, as detailed in Section 312000, as required to deliver a completed project, and in a manner acceptable to the Owner's Representative.
2. Rock fragments from this activity shall be removed from the site and disposed by the General Contractor.
3. This item will be measured for payment prior to removal by the in-place cubic yard removed.

C. Unit Price #2 General Requirements:

1. Provide all labor, materials, equipment, and services to satisfactorily complete the work in this item: as shown on the drawings and specified in Division 31, as required to deliver a completed project, and in a manner acceptable to the Owner's

- Representative.
2. Note E.3 on drawing C-100 and Section 312000 may disclose additional areas of weak subgrade beyond what is already included in the Contract.
 3. Included in Additional Remedial Excavation shall be the excavation and disposal of rejected subgrade soils, furnishing and placement of compacted subbase to the required line and grade, and re-proofing the completed work.
 4. Additional Remedial Excavation shall be measured by the in-place cubic yard volume.
- D. Unit Price #3 General Requirements:
1. Provide all labor, materials, equipment, and services necessary to satisfactorily complete the work of this item: as shown on the drawings and specified in Division 31, as required to deliver a completed project, and in a manner acceptable to the Owner's Representative.
 2. Additional hot mix asphalt pavement will be directed at locations identified by the Owner's Representative beyond what is already included in the Contract.
 3. Included in Additional Roadway Replacement shall be the sawcutting, excavation and disposal of existing pavement and subbase; furnishing and placement of compacted subbase to the required line and grade; and furnishing and placement of compacted hot mix asphalt binder and surface course to the required line and grade.
 4. Thicknesses shall be in accordance with the heavy section as shown on detail 5/C-201.
 5. Additional Roadway Replacement shall be measured for payment on a square foot basis.

CHANGES TO THE WORK

- E. When Architect establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will be:
1. _____ percent overhead and profit on the net cost of our own Work;
 2. _____ percent on the cost of work done by any Subcontractor.
- F. On work deleted from the Contract, our credit to Owner shall be Architect-approved net cost plus _____ of the overhead and profit percentage noted above.

ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

1. Addendum # _____ Dated _____.

BID FORM SUPPLEMENTS

- G. The following information is included with Bid submission:
1. Unit Prices: Unit Price #1 for Mechanical Rock Removal, Unit Price #2 for Additional Remedial Excavation, and Unit Price #3 for Additional Roadway Replacement .
 2. Alternates: 01, 02, 03, 04, 05 AND C-1.
 3. Lead times for materials and equipment for all major portions of the work including, but not limited to, the following:
 - a. Structural steel
 - b. Reinforcing steel
 - c. Storefront, windows, and glazing
 - d. Exterior Insulation Finish System (EIFS)

- e. Doors, frames, and hardware
- f. Roofing
- g. Waterproofing
- h. Insulation
- i. Wood, wood blocking, and wood panels
- j. Floor, wall, and ceiling finishes
- k. Metal stud framing
- l. Gypsum wall board, sheathing, and accessories
- m. Elevator
- n. Stairs

H. The following Supplements are attached to this Bid Form and are considered an integral part of this Bid Form:

- 1. Document 004323 - Alternates Form: Include the cost variations to the Bid Sum applicable to the Work as described in Section 012300 - Alternates.
- 2. Qualification Form AIA A305 - Contractor's Qualification Form.
- 3. Substitution Request Form - CSI/CSC Form 1.5C - During Procurement

BID FORM SIGNATURE(S)

The Corporate Seal of

(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

(Authorized signing officer, Title)

(Seal)

(Authorized signing officer, Title)

If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF SECTION

SECTION 004100.02
BID FORM

THE PROJECT AND THE PARTIES

TO:

Town of Orangetown (Owner)
26 West Orangeburg Road
Orangeburg, New York 10962

FOR: PLUMBING CONTRACT No. 2P

Project: 2219-05 Orangetown Town Hall Addition and Alterations

Architect's Project Number: 2219-05
26 West Orangeburg Road
Orangeburg, New York 10962

DATE: _____ (Bidder to enter date)

SUBMITTED BY: (Bidder to enter name and address)

Bidder's Full Name _____
Address _____
City, State, Zip _____

OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Bid Documents prepared by Lothrop Associates LLP Architects for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

_____ dollars
(\$ _____), in lawful money of the United States of America.

We have included the required security deposit as required by the Instruction to Bidders.

We have included the required performance assurance bonds in the Bid Amount as required by the Instructions to Bidders.

1. The cost of the required performance assurance bonds is _____ dollars
(\$ _____), in lawful money of the United States of America.

All applicable federal taxes are included and State of New York taxes are included in the Bid Sum.

All Cash and Contingency Allowances described in Section 012100 - Allowances are included in the Bid Sum.

ACCEPTANCE

This offer shall be open to acceptance and is irrevocable for thirty days from the bid closing date.

If this bid is accepted by Owner within the time period stated above, we will:

2. Execute the Agreement within seven days of receipt of Notice of Award.
3. Furnish the required bonds within seven days of receipt of Notice of Award.
4. Commence work within seven days after written Notice to Proceed of this bid.

If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

In the event our bid is not accepted within the time stated above, the required security deposit shall be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

CONTRACT TIME

If this Bid is accepted, we will:

Complete the Work in _____ calendar weeks from Notice to Proceed.
(Bidder to enter number of weeks.)

CHANGES TO THE WORK

- B. When Architect establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will be:
1. _____ percent overhead and profit on the net cost of our own Work;
 2. _____ percent on the cost of work done by any Subcontractor.
- C. On work deleted from the Contract, our credit to Owner shall be Architect-approved net cost plus _____ of the overhead and profit percentage noted above.

ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum # _____ Dated _____.

BID FORM SUPPLEMENTS

- D. The following information is included with Bid submission:
1. Alternates: 01, 02, 03, 04, 05 AND C-1.
 2. Lead times for materials and equipment for all major portions of the work including, but not limited to, the following:
 - a. Plumbing fixtures and piping
- E. The following Supplements are attached to this Bid Form and are considered an integral part of this Bid Form:

1. Document 004323 - Alternates Form: Include the cost variations to the Bid Sum applicable to the Work as described in Section 012300 - Alternates.
2. Qualification Form AIA A305 - Contractor's Qualification Form.
3. Substitution Request Form - CSI/CSC Form 1.5C - During Procurement

BID FORM SIGNATURE(S)

The Corporate Seal of

(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

(Authorized signing officer, Title)

(Seal)

(Authorized signing officer, Title)

If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF SECTION

SECTION 004100.03
BID FORM

THE PROJECT AND THE PARTIES

TO:

Town of Orangetown (Owner)
26 West Orangeburg Road
Orangeburg, New York 10962

FOR: HVAC CONTRACT No. 3H

Project: 2219-05 Orangetown Town Hall Addition and Alterations

Architect's Project Number: 2219-05
26 West Orangeburg Road
Orangeburg, New York 10962

DATE: _____ (Bidder to enter date)

SUBMITTED BY: (Bidder to enter name and address)

Bidder's Full Name _____
Address _____
City, State, Zip _____

OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Bid Documents prepared by Lothrop Associates, LLP Architects for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

_____ dollars
(\$ _____), in lawful money of the United States of America.

We have included the required security deposit as required by the Instruction to Bidders.

We have included the required performance assurance bonds in the Bid Amount as required by the Instructions to Bidders.

The cost of the required performance assurance bonds is _____ dollars
(\$ _____), in lawful money of the United States of America.

All applicable federal taxes are included and State of New York taxes are included in the Bid Sum.

All Cash and Contingency Allowances described in Section 012100 - Allowances are included in the Bid Sum.

ACCEPTANCE

This offer shall be open to acceptance and is irrevocable for thirty days from the bid closing date.

If this bid is accepted by Owner within the time period stated above, we will:

1. Execute the Agreement within seven days of receipt of Notice of Award.
2. Furnish the required bonds within seven days of receipt of Notice of Award.
3. Commence work within seven days after written Notice to Proceed of this bid.

If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

In the event our bid is not accepted within the time stated above, the required security deposit shall be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

CONTRACT TIME

If this Bid is accepted, we will:

Complete the Work in _____ calendar weeks from Notice to Proceed.
(Bidder to enter number of weeks.)

CHANGES TO THE WORK

- B. When Architect establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will be:
1. _____ percent overhead and profit on the net cost of our own Work;
 2. _____ percent on the cost of work done by any Subcontractor.
- C. On work deleted from the Contract, our credit to Owner shall be Architect-approved net cost plus _____ of the overhead and profit percentage noted above.

ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum # _____ Dated _____.

BID FORM SUPPLEMENTS

- D. The following information is included with Bid submission:
1. Alternates: 01, 02, 03, 04, 05, AND C-1.
 2. Lead times for materials and equipment for all major portions of the work including, but not limited to, the following:
 - a. Mechanical equipment
- E. The following Supplements are attached to this Bid Form and are considered an integral part of this Bid Form:

1. Document 004323 - Alternates Form: Include the cost variations to the Bid Sum applicable to the Work as described in Section 012300 - Alternates.
2. Qualification Form AIA A305 - Contractor's Qualification Form.
3. Substitution Request Form - CSI/CSC Form 1.5C - During Procurement

BID FORM SIGNATURE(S)

The Corporate Seal of

(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

(Authorized signing officer, Title)

(Seal)

(Authorized signing officer, Title)

If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF SECTION

SECTION 004100.04
BID FORM

THE PROJECT AND THE PARTIES

TO:

Town of Orangetown (Owner)
26 West Orangeburg Road
Orangeburg, New York 10962

FOR: ELECTRICAL CONTRACT No. 4E

Project: 2219-05 Orangetown Town Hall Addition and Alterations

Architect's Project Number: 2219-05
26 West Orangeburg Road
Orangeburg, New York 10962

DATE: _____ (Bidder to enter date)

SUBMITTED BY: (Bidder to enter name and address)

Bidder's Full Name _____
Address _____
City, State, Zip _____

OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders and the Bid Documents prepared by Lothrop Associates, LLP Architects for the above mentioned project, we, the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

_____ dollars
(\$ _____), in lawful money of the United States of America.

We have included the required security deposit as required by the Instruction to Bidders.

We have included the required performance assurance bonds in the Bid Amount as required by the Instructions to Bidders.

The cost of the required performance assurance bonds is _____ dollars
(\$ _____), in lawful money of the United States of America.

All applicable federal taxes are included and State of New York taxes are included in the Bid Sum.

All Cash and Contingency Allowances described in Section 012100 - Allowances are included in the Bid Sum.

ACCEPTANCE

This offer shall be open to acceptance and irrevocable for thirty days from the bid closing date.

If this bid is accepted by Owner within the time period stated above, we will:

1. Execute the Agreement within seven days of receipt of Notice of Award.
2. Furnish the required bonds within seven days of receipt of Notice of Award.
3. Commence work within sevendays after written Notice to Proceed of this bid.

If this bid is accepted within the time stated, and we fail to commence the Work or we fail to provide the required Bond(s), the security deposit shall be forfeited as damages to Owner by reason of our failure, limited in amount to the lesser of the face value of the security deposit or the difference between this bid and the bid upon which a Contract is signed.

In the event our bid is not accepted within the time stated above, the required security deposit shall be returned to the undersigned, in accordance with the provisions of the Instructions to Bidders; unless a mutually satisfactory arrangement is made for its retention and validity for an extended period of time.

CONTRACT TIME

If this Bid is accepted, we will:

Complete the Work in _____ calendar weeks from Notice to Proceed.
(Bidder to enter number of weeks.)

CHANGES TO THE WORK

- B. When Architect establishes that the method of valuation for Changes in the Work will be net cost plus a percentage fee in accordance with General Conditions, our percentage fee will be:
1. _____ percent overhead and profit on the net cost of our own Work;
 2. _____ percent on the cost of work done by any Subcontractor.
- C. On work deleted from the Contract, our credit to Owner shall be Architect-approved net cost plus _____ of the overhead and profit percentage noted above.

ADDENDA

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum # _____ Dated _____.

BID FORM SUPPLEMENTS

- D. The following information is included with Bid submission:
1. Unit Prices:
 2. Alternates: 01, 02, 03, 04, 05, AND C-1.
 3. Lead times for materials and equipment for all major portions of the work including, but not limited to, the following:
 - a. Electrical fixtures, wiring, and devices
- E. The following Supplements are attached to this Bid Form and are considered an integral part of this Bid Form:

1. Document 004323 - Alternates Form: Include the cost variations to the Bid Sum applicable to the Work as described in Section 012300 - Alternates.
2. Qualification Form AIA A305 - Contractor's Qualification Form.
3. Substitution Request Form - CSI/CSC Form 1.5C - During Procurement

BID FORM SIGNATURE(S)

The Corporate Seal of

(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

(Authorized signing officer, Title)

(Seal)

(Authorized signing officer, Title)

- 2.2 If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF SECTION

SECTION 004323
ALTERNATES FORM

PARTICULARS

- 1.1 THE FOLLOWING IS THE LIST OF ALTERNATES REFERENCED IN THE BID SUBMITTED BY:
- 1.2 (Bidder) _____
- 1.3 TO (Owner): Town of Orangetown
- 1.4 Dated _____ and which is an integral part of the Bid Form.

ALTERNATES LIST

- 2.1 THE FOLLOWING AMOUNTS SHALL BE ADDED TO OR DEDUCTED FROM THE BID AMOUNT. REFER TO SECTION 012300 - Alternates.

ALTERNATE # 01: ADD / (DEDUCT) \$ _____

ALTERNATE # 02: ADD / (DEDUCT) \$ _____

ALTERNATE # 03: ADD / (DEDUCT) \$ _____

ALTERNATE # 04: ADD / (DEDUCT) \$ _____

ALTERNATE # 05: ADD / (DEDUCT) \$ _____

ALTERNATE #06: ADD/ (DEDUCT) \$ _____

ALTERNATE # C-1: ADD / (DEDUCT) \$ _____

END OF SECTION

SECTION 005000
CONTRACTING FORMS AND SUPPLEMENTS

PART 1 GENERAL

- 1.1 Contractor is responsible for obtaining a valid license to use all copyrighted documents specified but not included in the Project Manual.
- 1.2 AGREEMENT AND CONDITIONS OF THE CONTRACT
 - A. See Section 005200 - Agreement Form for the Agreement form to be executed.
 - B. See Section 007200 - General Conditions for the General Conditions.
 - C. The Agreement is based on AIA A101.
 - D. The General Conditions are based on AIA A201.
- 1.3 FORMS
 - A. Use the following forms for the specified purposes unless otherwise indicated elsewhere in Contract Documents.
 - B. Bond Forms:
 - 1. Bid Bond Form: AIA A310.
 - 2. Performance and Payment Bond Form: AIA A312.
 - C. Post-Award Certificates and Other Forms:
 - 1. Submittal Transmittal Letter Form: AIA G810.
 - 2. Certificate of Insurance Form: ACORD Certificate of Insurance 25.
 - a. Supplemental Attachment: AIA G715
 - 3. Sustainable Design Reporting - LEED v4: See Section 013329.02.
 - 4. Schedule of Values Form: AIA G703.
 - 5. Application for Payment Forms: AIA G702 with AIA G703 (for Contractors).
 - D. Clarification and Modification Forms:
 - 1. Architect's Supplemental Instructions Form: AIA G710.
 - 2. Construction Change Directive Form: AIA G714.
 - 3. Change Order Form: AIA G701.
 - E. Closeout Forms:
 - 1. Certificate of Substantial Completion Form: AIA G704.
 - 2. Contractor's Affidavit of Release of Liens Form: AIA G706A
 - 3. Consent of Surety to Final Payment Form: AIA G707.
- 1.4 REFERENCE STANDARDS
 - A. AIA A101 - Standard Form of Agreement Between Owner and Contractor where the basis of Payment is a Stipulated Sum 2017.
 - B. AIA A201 - General Conditions of the Contract for Construction 2017.
 - C. AIA A310 - Bid Bond 2010.

- D. AIA A312 - Performance Bond and Payment Bond 2010.
- E. AIA G701 - Change Order 2017.
- F. AIA G702 - Application and Certificate for Payment 1992.
- G. AIA G703 - Continuation Sheet 1992.
- H. AIA G704 - Certificate of Substantial Completion 2017.
- I. AIA G706A - Contractor's Affidavit of Release of Liens 1994.
- J. AIA G707 - Consent of Surety to Final Payment 1994.
- K. AIA G715 - Supplemental Attachment for ACORD Certificate of Insurance 25 2017.
- L. AIA G710 - Architect's Supplemental Instructions 2017.
- M. AIA G714 - Construction Change Directive 2017.
- N. AIA G810 - Transmittal Letter 2001.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 005200
AGREEMENT FORM

PART 1 GENERAL

1.1 FORM OF AGREEMENT

1.2 The Agreement to be executed is attached following this page.

1.3 RELATED REQUIREMENTS

- A. Section 007200 - General Conditions.
- B. Section 007300 - Supplementary Conditions.
- C. Section 014216 - Definitions.




PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)


END OF SECTION

DRAFT AIA® Document A101® – 2017

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the «» day of «» in the year «»
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«[Town of Orangetown](#) »«»
«[26 West Orangeburg Road](#) »
«[Orangeburg, NY](#) »
«[109062](#) »


and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«[Orangetown Town Hall Addition and Alterations](#)»
«[26 West Orangeburg Road](#) »
«[Orangeburg, NY 10962](#) »

The Architect:
(Name, legal status, address and other information)

«[Lothrop Associates LLP Architects](#) »«»
«[333 Westchester Avenue](#) »
«[White Plains, NY](#) »
«[10604](#) »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

The parties should complete A101®-2017, Exhibit A, Insurance and Bonds, contemporaneously with this Agreement. AIA Document A201®-2017, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

ELECTRONIC COPYING of any portion of this AIA® Document to another electronic file is prohibited and constitutes a violation of copyright laws as set forth in the footer of this document.

TABLE OF ARTICLES

- 1 THE CONTRACT DOCUMENTS
- 2 THE WORK OF THIS CONTRACT
- 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION
- 4 CONTRACT SUM
- 5 PAYMENTS
- 6 DISPUTE RESOLUTION
- 7 TERMINATION OR SUSPENSION
- 8 MISCELLANEOUS PROVISIONS
- 9 ENUMERATION OF CONTRACT DOCUMENTS

EXHIBIT A INSURANCE AND BONDS

ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement, and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be:

(Check one of the following boxes.)

[☐] The date of this Agreement.

[☐] A date set forth in a notice to proceed issued by the Owner.

[☐] Established as follows:

(Insert a date or a means to determine the date of commencement of the Work.)

[☐]

If a date of commencement of the Work is not selected, then the date of commencement shall be the date of this Agreement.

§ 3.2 The Contract Time shall be measured from the date of commencement of the Work.

§ 3.3 Substantial Completion

§ 3.3.1 Subject to adjustments of the Contract Time as provided in the Contract Documents, the Contractor shall achieve Substantial Completion of the entire Work:

(Check one of the following boxes and complete the necessary information.)

[« »] Not later than « » (« ») calendar days from the date of commencement of the Work.

[« »] By the following date: « »

§ 3.3.2 Subject to adjustments of the Contract Time as provided in the Contract Documents, if portions of the Work are to be completed prior to Substantial Completion of the entire Work, the Contractor shall achieve Substantial Completion of such portions by the following dates:

Portion of Work	Substantial Completion Date
« »	

§ 3.3.3 If the Contractor fails to achieve Substantial Completion as provided in this Section 3.3, liquidated damages, if any, shall be assessed as set forth in Section 4.5.

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » (\$ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 Alternates

§ 4.2.1 Alternates, if any, included in the Contract Sum:

Item	Price
« »	

§ 4.2.2 Subject to the conditions noted below, the following alternates may be accepted by the Owner following execution of this Agreement. Upon acceptance, the Owner shall issue a Modification to this Agreement. *(Insert below each alternate and the conditions that must be met for the Owner to accept the alternate.)*

Item	Price	Conditions for Acceptance
« »		

§ 4.3 Allowances, if any, included in the Contract Sum: *(Identify each allowance.)*

Item	Price
« »	

§ 4.4 Unit prices, if any: *(Identify the item and state the unit price and quantity limitations, if any, to which the unit price will be applicable.)*

Item	Units and Limitations	Price per Unit (\$0.00)
« »		

§ 4.5 Liquidated damages, if any: *(Insert terms and conditions for liquidated damages, if any.)*

« »

§ 4.6 Other: *(Insert provisions for bonus or other incentives, if any, that might result in a change to the Contract Sum.)*

« »

ARTICLE 5 PAYMENTS

§ 5.1 Progress Payments

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the amount certified to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Architect after the application date fixed above, payment of the amount certified shall be made by the Owner not later than « » (« ») days after the Architect receives the Application for Payment.

(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form, and supported by such data to substantiate its accuracy, as the Architect may require. This schedule of values shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 In accordance with AIA Document A201™–2017, General Conditions of the Contract for Construction, and subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

§ 5.1.6.1 The amount of each progress payment shall first include:

- .1 That portion of the Contract Sum properly allocable to completed Work;
- .2 That portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction, or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing; and
- .3 That portion of Construction Change Directives that the Architect determines, in the Architect's professional judgment, to be reasonably justified.

§ 5.1.6.2 The amount of each progress payment shall then be reduced by:

- .1 The aggregate of any amounts previously paid by the Owner;
- .2 The amount, if any, for Work that remains uncorrected and for which the Architect has previously withheld a Certificate for Payment as provided in Article 9 of AIA Document A201–2017;
- .3 Any amount for which the Contractor does not intend to pay a Subcontractor or material supplier, unless the Work has been performed by others the Contractor intends to pay;
- .4 For Work performed or defects discovered since the last payment application, any amount for which the Architect may withhold payment, or nullify a Certificate of Payment in whole or in part, as provided in Article 9 of AIA Document A201–2017; and
- .5 Retainage withheld pursuant to Section 5.1.7.

§ 5.1.7 Retainage

§ 5.1.7.1 For each progress payment made prior to Substantial Completion of the Work, the Owner may withhold the following amount, as retainage, from the payment otherwise due:

(Insert a percentage or amount to be withheld as retainage from each Application for Payment. The amount of retainage may be limited by governing law.)

« »

§ 5.1.7.1.1 The following items are not subject to retainage:
(Insert any items not subject to the withholding of retainage, such as general conditions, insurance, etc.)

<< >>

§ 5.1.7.2 Reduction or limitation of retainage, if any, shall be as follows:
(If the retainage established in Section 5.1.7.1 is to be modified prior to Substantial Completion of the entire Work, including modifications for Substantial Completion of portions of the Work as provided in Section 3.3.2, insert provisions for such modifications.)

<< >>

§ 5.1.7.3 Except as set forth in this Section 5.1.7.3, upon Substantial Completion of the Work, the Contractor may submit an Application for Payment that includes the retainage withheld from prior Applications for Payment pursuant to this Section 5.1.7. The Application for Payment submitted at Substantial Completion shall not include retainage as follows:
(Insert any other conditions for release of retainage upon Substantial Completion.)

<< >>

§ 5.1.8 If final completion of the Work is materially delayed through no fault of the Contractor, the Owner shall pay the Contractor any additional amounts in accordance with Article 9 of AIA Document A201–2017.

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 Final Payment

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

- .1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Article 12 of AIA Document A201–2017, and to satisfy other requirements, if any, which extend beyond final payment; and
- .2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

<< >>

§ 5.3 Interest

Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

(Insert rate of interest agreed upon, if any.)

<< >> % << >>

ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 Initial Decision Maker

The Architect will serve as the Initial Decision Maker pursuant to Article 15 of AIA Document A201–2017, unless the parties appoint below another individual, not a party to this Agreement, to serve as the Initial Decision Maker.

(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

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§ 6.2 Binding Dispute Resolution

For any Claim subject to, but not resolved by, mediation pursuant to Article 15 of AIA Document A201–2017, the method of binding dispute resolution shall be as follows:

(Check the appropriate box.)

[☐] Arbitration pursuant to Section 15.4 of AIA Document A201–2017

[☐] Litigation in a court of competent jurisdiction

[☐] Other (*Specify*)

☐

If the Owner and Contractor do not select a method of binding dispute resolution, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2017.

§ 7.1.1 If the Contract is terminated for the Owner's convenience in accordance with Article 14 of AIA Document A201–2017, then the Owner shall pay the Contractor a termination fee as follows:

(Insert the amount of, or method for determining, the fee, if any, payable to the Contractor following a termination for the Owner's convenience.)

☐

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2017.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2017 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 The Owner's representative:

(Name, address, email address, and other information)

«[Ms. Jane Slavin, RA](#)»
«[26 West Orangeburg Road](#)»
«[Orangeburg, NY 10962](#)»
«[Email: jslavin@orangetown.com](#)»
«[Phone: 845-359-8410](#)»

☐

§ 8.3 The Contractor's representative:

(Name, address, email address, and other information)

☐

☐

☐

☐

☐

☐

§ 8.4 Neither the Owner's nor the Contractor's representative shall be changed without ten days' prior notice to the other party.

§ 8.5 Insurance and Bonds

§ 8.5.1 The Owner and the Contractor shall purchase and maintain insurance as set forth in AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum, Exhibit A, Insurance and Bonds, and elsewhere in the Contract Documents.

§ 8.5.2 The Contractor shall provide bonds as set forth in AIA Document A101™–2017 Exhibit A, and elsewhere in the Contract Documents.

§ 8.6 Notice in electronic format, pursuant to Article 1 of AIA Document A201–2017, may be given in accordance with AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, if completed, or as otherwise set forth below:

(If other than in accordance with AIA Document E203–2013, insert requirements for delivering notice in electronic format such as name, title, and email address of the recipient and whether and how the system will be required to generate a read receipt for the transmission.)

<< >>

§ 8.7 Other provisions:

<< >>

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 This Agreement is comprised of the following documents:

- .1 AIA Document A101™–2017, Standard Form of Agreement Between Owner and Contractor
- .2 AIA Document A101™–2017, Exhibit A, Insurance and Bonds
- .3 AIA Document A201™–2017, General Conditions of the Contract for Construction
- .4 AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, dated as indicated below:
(Insert the date of the E203-2013 incorporated into this Agreement.)

<< >>

.5 Drawings

Number

Title

Date

<< >>

.6 Specifications

Section

Title

Date

Pages

<< >>

.7 Addenda, if any:

Number

Date

Pages

<< >>

Portions of Addenda relating to bidding or proposal requirements are not part of the Contract Documents unless the bidding or proposal requirements are also enumerated in this Article 9.

.8 Other Exhibits:

(Check all boxes that apply and include appropriate information identifying the exhibit where required.)

[<< >>] AIA Document E204™–2017, Sustainable Projects Exhibit, dated as indicated below:
(Insert the date of the E204-2017 incorporated into this Agreement.)

<< >>

[« »] The Sustainability Plan:

Title	Date	Pages
« »		

[« »] Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages
« »			

.9 Other documents, if any, listed below:

(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201™-2017 provides that the advertisement or invitation to bid, Instructions to Bidders, sample forms, the Contractor's bid or proposal, portions of Addenda relating to bidding or proposal requirements, and other information furnished by the Owner in anticipation of receiving bids or proposals, are not part of the Contract Documents unless enumerated in this Agreement. Any such documents should be listed here only if intended to be part of the Contract Documents.)

« »

This Agreement entered into as of the day and year first written above.

« »

OWNER (Signature)

« »« »

(Printed name and title)

« »

CONTRACTOR (Signature)

« »« »

(Printed name and title)

SECTION 007200
GENERAL CONDITIONS

FORM OF GENERAL CONDITIONS

- 1.1 The General Conditions applicable to this contract is attached following this page.

RELATED REQUIREMENTS

- 2.1 SECTION 007300 - Supplementary Conditions.
- 2.2 SECTION 014216 - Definitions.

END OF SECTION

DRAFT AIA® Document A201® – 2017

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

«[Orangetown Town Hall Addition and Alterations](#)»

« »

THE OWNER:

(Name, legal status and address)

«[Town of Orangetown](#)» « »

«[26 West Orangeburg Road, Orangeburg, NY 10962](#) »

THE ARCHITECT:

(Name, legal status and address)

«[Lothrop Associates LLP Architects](#)» « »

«[333 Westchester Avenue, White Plains, NY 10604](#) »

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- 13 MISCELLANEOUS PROVISIONS
- 14 TERMINATION OR SUSPENSION OF THE CONTRACT
- 15 CLAIMS AND DISPUTES

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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ARTICLE 1 GENERAL PROVISIONS

§ 1.1 Basic Definitions

§ 1.1.1 The Contract Documents

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

§ 1.1.2 The Contract

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

§ 1.1.3 The Work

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 1.1.4 The Project

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

§ 1.1.5 The Drawings

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

§ 1.1.6 The Specifications

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

§ 1.1.7 Instruments of Service

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 1.1.8 Initial Decision Maker

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

§ 1.2 Correlation and Intent of the Contract Documents

§ 1.2.1 The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 1.2.1.1 The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

§ 1.2.2 Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade.

§ 1.2.3 Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

§ 1.3 Capitalization

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

§ 1.4 Interpretation

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service

§ 1.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 1.5.2 The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

§ 1.6 Notice

§ 1.6.1 Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

§ 1.6.2 Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

§ 1.7 Digital Data Use and Transmission

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

§ 1.8 Building Information Models Use and Reliance

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or relying party's sole risk

and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

ARTICLE 2 OWNER

§ 2.1 General

§ 2.1.1 The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

§ 2.1.2 The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

§ 2.2 Evidence of the Owner's Financial Arrangements

§ 2.2.1 Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

§ 2.2.2 Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

§ 2.2.3 After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

§ 2.2.4 Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

§ 2.3 Information and Services Required of the Owner

§ 2.3.1 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 2.3.2 The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

§ 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity, except to the extent required by Section 6.1.3.

§ 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

ARTICLE 3 CONTRACTOR

§ 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

§ 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These

obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

§ 3.2.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

§ 3.3 Supervision and Construction Procedures

§ 3.3.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences, and procedures, and for coordinating all portions of the Work under the Contract. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

§ 3.3.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

§ 3.3.3 The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

§ 3.4 Labor and Materials

§ 3.4.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 3.4.2 Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

§ 3.4.3 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not properly skilled in tasks assigned to them.

§ 3.5 Warranty

§ 3.5.1 The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

§ 3.5.2 All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

§ 3.6 Taxes

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 3.7 Permits, Fees, Notices and Compliance with Laws

§ 3.7.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 3.7.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

§ 3.7.3 If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 3.7.4 Concealed or Unknown Conditions

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect determines that the conditions at the site are not materially different from those indicated in the Contract Documents and that no change in the terms of the Contract is justified, the Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

§ 3.7.5 If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

§ 3.8 Allowances

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

§ 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

§ 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

§ 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner, and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

§ 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals, by the Architect's approval thereof.

§ 3.12.9 The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples, or similar submittals, to revisions other than those requested by the Architect on previous submittals. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or

certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 3.12.10.2 If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

§ 3.13 Use of Site

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 3.14 Cutting and Patching

§ 3.14.1 The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

§ 3.14.2 The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or Separate Contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

§ 3.15 Cleaning Up

§ 3.15.1 The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

§ 3.15.2 If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

§ 3.16 Access to Work

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

§ 3.17 Royalties, Patents and Copyrights

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

§ 3.18 Indemnification

§ 3.18.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for

whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

§ 3.18.2 In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 shall not be limited by a limitation on amount or type of damages, compensation, or benefits payable by or for the Contractor or a Subcontractor under workers' compensation acts, disability benefit acts, or other employee benefit acts.

ARTICLE 4 ARCHITECT

§ 4.1 General

§ 4.1.1 The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

§ 4.1.2 Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

§ 4.2 Administration of the Contract

§ 4.2.1 The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

§ 4.2.2 The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 4.2.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 4.2.4 Communications

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

§ 4.2.5 Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

ARTICLE 5 SUBCONTRACTORS

§ 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term "Sub-subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

§ 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

§ 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

§ 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor's rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

§ 6.2 Mutual Responsibility

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.

§ 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

ARTICLE 7 CHANGES IN THE WORK

§ 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

§ 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

§ 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;
- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

§ 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

ARTICLE 8 TIME

§ 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

§ 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

ARTICLE 9 PAYMENTS AND COMPLETION

§ 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

§ 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

§ 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials

and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

§ 9.3.3 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

§ 9.4 Certificates for Payment

§ 9.4.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

§ 9.4.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 9.5 Decisions to Withhold Certification

§ 9.5.1 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 9.5.2 When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

§ 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

§ 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

§ 9.8 Substantial Completion

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 9.8.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 9.8.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

§ 9.8.4 When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 9.8.5 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 9.9 Partial Occupancy or Use

§ 9.9.1 The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

§ 9.9.2 Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work.

§ 9.9.3 Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

§ 9.10 Final Completion and Final Payment

§ 9.10.1 Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

§ 9.10.3 If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

§ 9.10.4 The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

§ 9.10.5 Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY

§ 10.1 Safety Precautions and Programs

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

§ 10.2 Safety of Persons and Property

§ 10.2.1 The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury, or loss to

- .1 employees on the Work and other persons who may be affected thereby;
- .2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor, a Subcontractor, or a Sub-subcontractor; and
- .3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

§ 10.2.2 The Contractor shall comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, bearing on safety of persons or property or their protection from damage, injury, or loss.

§ 10.2.3 The Contractor shall implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings

against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 10.2.4 When use or storage of explosives or other hazardous materials or equipment, or unusual methods are necessary for execution of the Work, the Contractor shall exercise utmost care and carry on such activities under supervision of properly qualified personnel.

§ 10.2.5 The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property insurance required by the Contract Documents) to property referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 3.18.

§ 10.2.6 The Contractor shall designate a responsible member of the Contractor's organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

§ 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

§ 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.

§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property

(other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

§ 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

ARTICLE 11 INSURANCE AND BONDS

§ 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

§ 11.1.4 Notice of Cancellation or Expiration of Contractor's Required Insurance. Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

§ 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

§ 11.2.2 Failure to Purchase Required Property Insurance. If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to

provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance. Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

§ 11.3 Waivers of Subrogation

§ 11.3.1 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

§ 11.3.2 If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

§ 11.5 Adjustment and Settlement of Insured Loss

§ 11.5.1 A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

§ 11.5.2 Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner

shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

ARTICLE 12 UNCOVERING AND CORRECTION OF WORK

§ 12.1 Uncovering of Work

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time.

§ 12.1.2 If a portion of the Work has been covered that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

§ 12.2 Correction of Work

§ 12.2.1 Before Substantial Completion

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

§ 12.2.2 After Substantial Completion

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

§ 12.2.2.2 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 12.2.2.3 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

§ 12.2.4 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for

correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

§ 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

ARTICLE 13 MISCELLANEOUS PROVISIONS

§ 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

§ 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

§ 13.3 Rights and Remedies

§ 13.3.1 Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

§ 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor and promptly delivered to the Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

§ 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

§ 14.2 Termination by the Owner for Cause

§ 14.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.3 Suspension by the Owner for Convenience

§ 14.3.1 The Owner may, without cause, order the Contractor in writing to suspend, delay or interrupt the Work, in whole or in part for such period of time as the Owner may determine.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall be made to the extent

- .1 that performance is, was, or would have been, so suspended, delayed, or interrupted, by another cause for which the Contractor is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

§ 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

ARTICLE 15 CLAIMS AND DISPUTES

§ 15.1 Claims

§ 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

§ 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

§ 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

§ 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

§ 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

§ 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

§ 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

§ 15.2 Initial Decision

§ 15.2.1 Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker

and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

§ 15.2.2 The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

§ 15.2.3 In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

§ 15.2.4 If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

§ 15.2.6 Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

§ 15.2.6.1 Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

§ 15.2.7 In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

§ 15.2.8 If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

§ 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

§ 15.4.4.3 The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

SECTION 007300
SUPPLEMENTARY CONDITIONS

PART 1 GENERAL

1.1 SUMMARY

- A. These Supplementary Conditions amend and supplement the General Conditions defined in Document 007200 - General Conditions and other provisions of Contract Documents as indicated below. Provisions that are not so amended or supplemented remain in full force and effect.
- B. The terms used in these Supplementary Conditions that are defined in the General Conditions have the meanings assigned to them in the General Conditions.

1.2 RELATED SECTIONS

- A. Section 005000 - Contracting Forms and Supplements.
- B. Section 014216 - Definitions.

1.3 REFERENCE STANDARDS

- A. AIA A503 - Guide for Supplementary Conditions, including Amendments to AIA Documents A201, the 2017 Owner-Contractor Agreements, and the 2019 Owner-Construction Manager as Constructor Agreements 2019.

1.4 MODIFICATIONS TO GENERAL CONDITIONS

- A. Performance and Payment Bond: Each equal to 100% of the Contract amount.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 011000
SUMMARY

PART 1 GENERAL

1.1 PROJECT

- A. Project Name: 2219-05 Orangetown Town Hall Addition and Alterations
- B. Owner's Name: Town of Orangetown.
- C. Architect's Name: Lothrop Associates LLP Architects.
- D. Additional Project contact information is specified in Section 000103 - Project Directory.
- E. The Project consists of the construction of a new addition to, and interior alterations of, the existing Town Hall facility of the Town of Orangetown, New York..
- F. The Project will also consist of the construction of a new Exit Stair (ST-3) and exterior building facade along the entire south end of the existing Town Hall facility, after the removal of the original 1959 Town Hall building by the Owner. This work is anticipated to be completed within a 6 month period following Substantial Completion of the new addition.

1.2 CONTRACT DESCRIPTION

- A. Contract Type: Multiple prime contracts, each based on a Stipulated Price as described in Document 005000 - Contracting Forms and Supplements.
- B. The work of each separate prime contract is identified in this section and on Drawings.

1.3 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of demolition and removal work is indicated on drawings and specified in Section 024100.
- B. Scope of alterations work is indicated on drawings.
- C. Plumbing: Alter existing system and add new construction, keeping existing in operation.
- D. HVAC: Alter existing system and add new construction, keeping existing in operation.
- E. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.
- F. Fire Suppression Sprinklers: Alter existing system and add new construction, keeping existing in operation.
- G. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
- H. Telephone: Alter existing system and add new construction, keeping existing in operation.
- I. Security System: Alter existing system and add new construction, keeping existing in operation.

1.4 WORK BY OWNER

- A. Existing Building Demolition: Owner will contract for demolition of the existing 1959 original Town Hall structure and removal of its foundations. The site will be backfilled at the removed foundations and filled to existing grade elevation. The time frame for this demolition work is yet to be determined, but is anticipated to occur within a 6 month period following Substantial Completion of this Workn.
- B. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Substantial Completion. Some items include:
 - 1. Movable cabinets.
 - 2. Furnishings.
 - 3. Small equipment.

1.5 FUTURE WORK

- A. Provide for all material and labor for the future installation of work along the south end of the existing Town Hall facility, following demolition of the original 1959 Town Hall building by the Owners' Demolition Contractor.

1.6 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.7 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
 - 3. Use of site and premises by the public.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Existing building spaces may not be used for storage.
- E. Time Restrictions:
 - 1. Limit conduct of especially noisy exterior work to the hours of 6:00 pm to 6:00 am..
- F. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the building is unoccupied.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.

3. Prevent accidental disruption of utility services to other facilities.

1.8 WORK SEQUENCE

- A. Construct Work in sequenced stages as indicated on the drawings during the construction period. The project is anticipated to be sequenced in (4) sequential stages to allow for continuous Owner occupancy of the existing buildings during construction of this work, and subsequent Owner occupancy of the new work when complete.
- B. Coordinate construction schedule and operations with Owner.

1.9 SPECIFICATION SECTIONS APPLICABLE TO ALL CONTRACTS

- A. Unless otherwise noted, all provisions of the sections listed below apply to all contracts. Specific items of work listed under individual contract descriptions constitute exceptions.
- B. Section 000103 - Project Directory.
- C. Section 012000 - Price and Payment Procedures.
- D. Section 012100 - Allowances.
- E. Section 012300 - Alternates.
- F. Section 013000 - Administrative Requirements.
- G. Section 013329.02 - Sustainable Design Reporting - LEED v4.
- H. Section 014000 - Quality Requirements.
- I. Section 014216 - Definitions.
- J. Section 015000 - Temporary Facilities and Controls.
- K. Section 016000 - Product Requirements.
- L. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- M. Section 017000 - Execution and Closeout Requirements.
- N. Section 017800 - Closeout Submittals.

1.10 CONTRACT NO. 1G - GENERAL CONSTRUCTION

- A. Division 01 - General Requirements:
 1. Specification sections listed above.
 2. Section 017000: Basic project engineering and layout.
 3. Section 015000: Utility services to point of delivery indicated, and installation of meters.
 4. Section 015000: Payment of costs of temporary utilities and services consumed.
 5. Section 015000: Temporary heating, cooling, and ventilating.
 6. Section 015000: Provide debris receptacles, remove debris from site.
 7. Section 015000: Erosion control structures.
 8. Section 017000: Final cleaning.
- B. Provide all Work except Work specifically assigned to other contractors in this Section.

1.11 CONTRACT NO. 2P - PLUMBING

- A. Specification sections listed above as applicable to all contracts.
 - 1. Section 015000: Temporary water installation.
 - 2. Section 015000 - Temporary Facilities and Controls: Temporary sanitary facilities.
- B. Division 07 - Thermal and Moisture Protection:
 - 1. Section 078400 - Firestopping: Firestopping of piping penetrations.
- C. Division 08 - Openings:
 - 1. Section 083100 - Access Doors and Panels: Access doors and panels.
- D. Division 21 - Sprinkler: All sections identified.
- E. Division 22 - Plumbing: All sections identified.

1.12 CONTRACT NO. 3H - HEATING, VENTILATING, AND AIR CONDITIONING

- A. Specification sections listed above as applicable to all contracts.
- B. Division 23 - Heating, Ventilating, and Air Conditioning: All sections identified.

1.13 CONTRACT NO. 4E - ELECTRICAL

- A. Specification sections listed above as applicable to all contracts.
 - 1. Section 015000: Temporary electricity installation.
 - 2. Section 015000: Temporary lighting.
- B. Division 07 - Thermal and Moisture Protection:
 - 1. Section 078400 - Firestopping: Firestopping of wire and conduit penetrations.
- C. Division 26 - Electrical: All sections identified.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012000
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Change procedures.

1.2 RELATED REQUIREMENTS

- A. Section 005000 - Contracting Forms and Supplements: Forms to be used.
- B. Section 013329.02 - Sustainable Design Reporting - LEED v4: Projects seeking sustainability certification.

1.3 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- D. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.4 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Percentage of Completion.
 - 9. Balance to Finish.
 - 10. Retainage.
- E. Execute certification by signature of authorized officer.

- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- H. Submit one electronic and three hard-copies of each Application for Payment.
- I. Include the following with the application:
 - 1. Transmittal letter as specified for submittals in Section 013000.
 - 2. Construction progress schedule, revised and current as specified in Section 013000.
 - 3. Partial release of liens from major subcontractors and vendors.
 - 4. Sustainable design documentation applicable to work for which application is being made; see Section 013329.02 for projects seeking LEED v4 certification.
 - 5. Affidavits attesting to off-site stored products.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.5 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.
- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 - 2. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- E. Substantiation of Costs: Provide full information required for evaluation.
 - 1. On request, provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 - 2. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- G. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- H. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- I. Promptly enter changes in Project Record Documents.

1.6 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 017000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012100
ALLOWANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cash allowances.
- B. Contingency allowance.
- C. Inspecting and testing allowances.
- D. Payment and modification procedures relating to allowances.

1.2 RELATED REQUIREMENTS

- A. Section 012000 - Price and Payment Procedures: Additional payment and modification procedures.

1.3 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or subcontractor, less applicable trade discounts, less cost of delivery to site , less applicable taxes .
- B. Costs Not Included in Cash Allowances: Product delivery to site and handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing.
- C. Architect Responsibilities:
 - 1. Consult with Contractor for consideration and selection of products, suppliers , and installers.
 - 2. Select products in consultation with Owner and transmit decision to Contractor.
 - 3. Prepare Change Order.
- D. Contractor Responsibilities:
 - 1. Assist Architect in selection of products, suppliers , and installers.
 - 2. Obtain proposals from suppliers and installers and offer recommendations.
 - 3. On notification of which products have been selected, execute purchase agreement with designated supplier and installer.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.

1.4 CONTINGENCY ALLOWANCE

- A. Contractor's costs for products, delivery, installation, labor, insurance, payroll, taxes, bonding, equipment rental, overhead and profit will be included in Change Orders authorizing expenditure of funds from this Contingency Allowance.
- B. At closeout of Contract, funds remaining in Contingency Allowance will be credited to Owner by Change Order.

1.5 INSPECTING AND TESTING ALLOWANCES

- A. Costs Included in Inspecting and Testing Allowances: Cost of engaging an inspecting or testing agency; execution of inspecting and tests; and reporting results.
- B. Costs Not Included in the Inspecting and Testing Allowances:
 - 1. Costs of incidental labor and facilities required to assist inspecting or testing agency.
 - 2. Costs of testing services used by Contractor separate from Contract Document requirements.
 - 3. Costs of retesting upon failure of previous tests as determined by Architect.
- C. Payment Procedures:
 - 1. Submit one copy of the inspecting or testing firm's invoice with next application for payment.
 - 2. Pay invoice on approval by Architect.
- D. Differences in cost will be adjusted by Change Order.

1.6 ALLOWANCES SCHEDULE

- A. Section 101400 - Signage: Include the stipulated sum of \$25,000.00 for purchase and delivery of building signage, which includes interior and exterior, building-mounted, signage. Site signage is part of the base bid work and is not included in this allowance.
- B. Contingency Allowance: Include the stipulated sum/price of \$500,000.00 for use upon Owner's instructions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012300
ALTERNATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Description of Alternates.

1.2 RELATED REQUIREMENTS

- A. Document 002113 - Instructions to Bidders: Instructions for preparation of pricing for Alternates.
- B. Document 004323 - Alternates Form: List of Alternates as supplement to Bid Form.
- C. Document 005200 - Agreement Form: Incorporating monetary value of accepted Alternates.

1.3 ACCEPTANCE OF Alternates

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.4 SCHEDULE OF Alternates

- A. Alternate No. 01 - Re-finish and Re-plumb Existing Toilet Rooms as indicated on Drawings A900 through A903.
- B. Alternate No. 02 - Fit-out of New Third Floor Toilet Rooms as indicated on Drawing A904.
 - 1. Base Bid Item: Base bid to include partitions, doors, plumbing stub-ups, ceiling, lighting, HVAC, and life safety devices.
 - 2. Alternate Item: Alternate items include plumbing fixtures and finishes.
- C. Alternate No. 03 - Folding Partition at Lobby 100 in lieu of Aluminum and Glass Doors and Frames as indicated on Drawings A905.
 - 1. Alternate Item: Section 102226 - Operable Partitions and Drawing number A905, including structural support.
- D. Alternate No. 04 - New Conference Tables as indicated on Furniture Tag Legend.
 - 1. Base Bid Item: Base bid to include the relocation and installation of (2) existing conference tables.
 - 2. Alternate Item: Alternate items include the purchase and installation of new conference tables as scheduled.
- E. Alternate No. 05 - Vehicle Charging Stations as indicated on drawings.
 - 1. Base Bid Item: Base bid to include conduit and electrical infrastructure with stub-ups for future purchase and installation of charging station.
 - 2. Alternate Item: Alternate items include the purchase and installation of vehicle charging stations.

- F. Alternate No. 06 - Provide alternating tread device as a substitute for (2) roof access ship's ladders as indicated on drawing A114(B).
 - 1. Base Bid Item: Base bid to include ship's ladders for roof access ladders as shown on plans.
 - 2. Alternate Item: Provide (2) alternating tread devices in lieu of ship's ladders in locations as indicated on drawing A114(B). See Specification Section 055133.23 for specification of alternating tread stair.
- G. Alternate No. C-1 - Mill and Overlay Police Department Parking Areas as indicated on drawing C-101.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012500 SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.2 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Submittal procedures, coordination.
- B. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.
- C. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Restrictions on emissions of indoor substitute products.

1.3 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

1.4 REFERENCE STANDARDS

- A. CSI/CSC Form 13.1A - Substitution Request (After the Bidding/Negotiating Phase) Current Edition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.

5. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 1. Forms indicated in the Project Manual are adequate for this purpose, and must be used.
- E. Limit each request to a single proposed substitution item.
 1. Submit an electronic document, combining the request form with supporting data into single document.

3.2 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submittal Form (after award of contract):
 1. Submit substitution requests by completing CSI/CSC Form 13.1A - Substitution Request. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 3. Bear the costs engendered by proposed substitution of:
 - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
- D. Substitutions will not be considered under one or more of the following circumstances:
 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
 2. Without a separate written request.
 3. When acceptance will require revisions to Contract Documents.

3.3 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.

3.4 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.

END OF SECTION

SECTION 013000
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electronic document submittal service.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Contractor's daily reports.
- G. Progress photographs.
- H. Coordination drawings.
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Requests for Interpretation (RFI) procedures.
- L. Submittal procedures.

1.2 RELATED REQUIREMENTS

- A. Section 007200 - General Conditions: Duties of the Construction Manager.
- B. Section 013329.02 - Sustainable Design Reporting - LEED v4: Reporting related to sustainability certification project procedures.
- C. Section 016000 - Product Requirements: General product requirements.
- D. Section 017000 - Execution and Closeout Requirements: Additional coordination requirements.
- E. Section 017800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.3 REFERENCE STANDARDS

- A. AIA G716 - Request for Information 2004.
- B. AIA G810 - Transmittal Letter 2001.

1.4 PROJECT COORDINATOR

- A. Project Coordinator: To Be Determined.

- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for vehicular and equipment access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 011000 - Summary.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Project Coordinator shall be solely responsible for distributing all necessary project information to each applicable Prime Contractor including, but not limited to, documents, drawings, specifications, sketches, schedules, etc.
- H. Make the following types of submittals to Architect through the Project Coordinator:
 - 1. Requests for Interpretation.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Design data.
 - 6. Manufacturer's instructions and field reports.
 - 7. Applications for payment and change order requests.
 - 8. Progress schedules.
 - 9. Coordination drawings.
 - 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 - 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect are required to use this service.
 - 3. It is Contractor's responsibility to submit documents in allowable format.
 - 4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
 - 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such

- software capability is provided by the service provider.
- 6. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
- 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.
- C. Submittal Service: The selected service is:
 - 1. Submittal Exchange (tel: 1-800-714-0024): www.submittalexchange.com.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
- E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.2 PRECONSTRUCTION MEETING

- A. Schedule meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 - 5. Submission of initial Submittal schedule.
 - 6. Designation of personnel representing the parties to Contract, Owner and Architect.
 - 7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 8. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.3 SITE MOBILIZATION MEETING

- A. Project Coordinator will schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's superintendent.
 - 5. Major subcontractors.
- C. Agenda:
 - 1. Use of premises by Owner and Contractor.

2. Owner's requirements.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and building layout.
6. Security and housekeeping procedures.
7. Schedules.
8. Application for payment procedures.
9. Procedures for testing.
10. Procedures for maintaining record documents.
11. Requirements for start-up of equipment.
12. Inspection and acceptance of equipment put into service during construction period.

- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.4 PROGRESS MEETINGS

- A. Project Coordinator will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

- B. Attendance Required:

1. Contractor.
2. Owner.
3. Architect.
4. Special consultants.
5. Contractor's superintendent.
6. Major subcontractors.

- C. Agenda:

1. Review minutes of previous meetings.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to work.

- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.5 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.

- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule.
- E. Submit updated schedule with each Application for Payment.

3.6 DAILY CONSTRUCTION REPORTS

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. In addition to transmitting electronically a copy to Owner and Architect, submit two printed copies at weekly intervals.
- C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
 - 1. Date.
 - 2. High and low temperatures, and general weather conditions.
 - 3. Safety, environmental, or industrial relations incidents.
 - 4. Meetings and significant decisions.
 - 5. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
 - 6. Testing and/or inspections performed.
 - 7. Signature of Contractor's authorized representative.

3.7 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
 - 1. Excavations in progress.
 - 2. Foundations in progress and upon completion.
 - 3. Structural framing in progress and upon completion.
 - 4. Enclosure of building, upon completion.
 - 5. Final completion, minimum of ten (10) photos.
- E. Views:
 - 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 - 2. Consult with Architect for instructions on views required.
 - 3. Provide factual presentation.
 - 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
 - 5. Point of View Sketch: Provide sketch identifying point of view of each photograph.

- F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email.
 2. File Naming: Include project identification, date and time of view, and view identification.
 3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
 4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 5. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.8 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

3.9 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 2. Prepare in a format and with content acceptable to Owner.
 - a. Use AIA G716 - Request for Information .
 3. Prepare using software provided by the Electronic Document Submittal Service.
 4. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
 - a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 016000 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).

3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
 4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
 - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date, and requested reply date.
 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 2. Note dates of when each request is made, and when a response is received.
 3. Highlight items requiring priority or expedited response.
 4. Highlight items for which a timely response has not been received to date.
- G. Review Time: Architect will respond and return RFIs to Contractor within ten business days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.

4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.10 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 1. Coordinate with Contractor's construction schedule and schedule of values.
 2. Format schedule to allow tracking of status of submittals throughout duration of construction.
 3. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 4. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.11 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 1. Product data.
 2. Shop drawings.
 3. Samples for selection.
 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.

3.12 SUBMITTALS FOR INFORMATION

- A. When the following are specified in individual sections, submit them for information:
 1. Design data.
 2. Sustainability design submittals and reports.
 3. Certificates.
 4. Test reports.
 5. Inspection reports.
 6. Manufacturer's instructions.
 7. Manufacturer's field reports.
 8. Other types indicated.
- B. Submit for Architect's knowledge as contract administrator or for Owner.

3.13 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.
- B. Submit Final Correction Punch List for Substantial Completion.

- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 017800 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for Owner's benefit during and after project completion.

3.14 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.15 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Use a separate transmittal for each item.
 - 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 - 3. Transmit using approved form.
 - a. Use Form AIA G810.
 - 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 - 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Deliver submittals to Architect at business address.
 - 8. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
 - 9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 - 10. Provide space for Contractor and Architect review stamps.
 - 11. When revised for resubmission, identify all changes made since previous submission.

12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 14. Submittals not requested will not be recognized or processed.
- B. Product Data Procedures:
1. Submit only information required by individual specification sections.
 2. Collect required information into a single submittal.
 3. Submit concurrently with related shop drawing submittal.
 4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 2. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
1. Transmit related items together as single package.
 2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
- 3.16 SUBMITTAL REVIEW
- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
1. Items for which no action was taken:

- a. "Received" - to notify the Contractor that the submittal has been received for record only.
- 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 013329.02
SUSTAINABLE DESIGN REPORTING - LEED V4

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General requirements for sustainable design reporting.
 - 1. This project intends to be constructed using procedures and documentation complying with the federally mandated "Guiding Principles" (GP), Third Party Certification (TPC) requirements (if applicable), UFC 1-200-02, High Performance and Sustainable Building Requirements, and other requirements identified in this specification.
 - 2. The project is designed and will be constructed as a "LEED Equivalent" project. LEED practices, procedures, and products are to be followed and used, however, reporting requirements are limited. Contractor shall provide documentation for reporting only as requested by the Owner or the Architect for record or verification.
 - 3. Contractor shall collect and maintain sustainable design and construction documentation as indicated in each specification section, and shall provide such documentation when requested.

1.2 REPORTING REQUIREMENTS

- A. Free-standing furniture and furnishings are not included in the Contract, unless otherwise indicated.
- B. Contractor must familiarize himself with the relevant reporting requirements and provide the necessary information and instruction to all subcontractors and installers.

1.3 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: General submittal requirements.
- B. Section 013329.04 - Material Content Form: Form with checklist for documenting product content, emissions, health effects, sources, and costs.
- C. Section 013566.05 - Project Sustainability Goal Credit Summary - LEED v4.
- D. Section 016000 - Product Requirements.
- E. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- F. Section 017419 - Construction Waste Management and Disposal.

1.4 DEFINITIONS

- A. Definitions in this Article are in addition to sustainable design definitions directly related to products, as listed in Section - 016000 - Product Requirements.
- B. Indoor Air Quality (IAQ) Management Plan: Plan developed by the Contractor to provide a healthy indoor environment for workers and building occupants during construction. Plan must meet or exceed the recommendations of SMACNA (OCC) 'IAQ Guidelines for Occupied Buildings Under Construction'.

- C. Life Cycle Assessment (LCA): Compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.
- D. Material Cost: The dollar value of materials being provided to the site, after Contractor mark-ups, including transportation costs, taxes, fees, and shop labor, but excluding field equipment and field labor costs.

1.5 PRODUCT REPORTING SCOPE

- A. General: Product reporting scope for the purpose of achieving the selected sustainability certification level is limited to those items directly affecting ability to achieve targeted credits.
 - 1. Environmental Product Declarations (EPD): Documentation complying with definition and quality requirements in Section 016000 - Product Requirements.
 - a. Provide for at least 20 different permanently installed products sourced from at least five different manufacturers that meet the sustainable design certification program criteria.
 - 2. Multi-Attribute Product Certifications: Documentation complying with definition and quality requirements in Section 016000 - Product Requirements.
 - a. Provide quantity and cost data for materials and products for which certifications are publicly available.
 - b. Include information for products sourced (extracted, manufactured, purchased) within 100 miles distance from project site.
- B. LEED Product Reporting Scope (for MR and EQ Credits): May include any of the products specified in Divisions 2 through 14, 31, and 32, and the following:
 - 1. All paints, coatings, adhesives, and sealants that are used but not specified.
 - 2. Composite wood that is permanently installed but not specified.
 - 3. Plumbing and HVAC piping and pipe insulation.
 - 4. Plumbing fixtures and trim.
 - 5. Electrical conduit and lighting fixture housings.

1.6 REFERENCE STANDARDS

- A. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction 2007.
- B. USGBC LEED v4-BD+C - LEED v4 for Building Design and Construction 2018.
- C. USGBC LEED v4-ID+C - LEED v4 for Interior Design and Construction 2018.

1.7 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for additional submittal procedures requirements.
- B. Sustainable Design Documentation: The scope of required documentation is specified in this section and in applicable individual specification sections.
- C. LEED v4 Prerequisites and Credits - Documentation is required for the following items:
 - 1. New Product Documentation:
 - a. Materials and Resources: Use the Building Product Disclosure and Optimization (BPDO) Calculator spreadsheet software available from USGBC to track and document materials and products purchases and use. Use for documentation of USGBC LEED v4-BD+C and USGBC LEED v4-ID+C MR Credits.

- b. Building Product Disclosure and Optimization - Environmental Product Declarations.
 - 1) Submit information for the required number and sources of Environmental Product Declarations complying with LEED reporting requirements.
 - 2) Submit third-party certifications for permanently installed products which demonstrate environmental impact reduction below industry average.
 - c. Building Product Disclosure and Optimization - Sourcing of Raw Materials.
 - 1) Raw Materials' Suppliers self-declared reports on sourcing and extracting, or, preferably, third-party verified corporate sustainability reports (CSR).
 - d. Building Product Disclosure and Optimization - Material Ingredients.
 - 1) Material Ingredient Reporting: Use, as is appropriate:
 - a) Manufacturers' inventories of ingredients.
 - 2) Manufacturer's Supply Chain Optimization: Use sourcing documentation demonstrating compliance with stated requirements.
 - e. Indoor Environmental Quality - Low-emitting Materials: Use the Low-Emitting Materials Calculator spreadsheet software (available from USGBC) to track and document materials and products purchases and use. Use for documentation of USGBC LEED v4-BD+C and USGBC LEED v4-ID+C EQ Credits.
- 2. Waste Disposal Management: Periodic reports quantifying diversion of construction waste away from landfills and incineration facilities.
 - a. Include information on percentage of diverted material and number of material streams.
 - 3. Volume Calculations: When required to document EQ Credit Low-Emitting Materials, Option 1, submit volume calculations for the following items:
 - a. Interior paints and coatings applied on site.
 - 1) General Emissions Evaluation for paints and coatings applied to walls, floors, and ceilings.
 - 2) VOC content requirements for wet applied products.
 - b. Interior adhesives and sealants applied on site (including flooring adhesive).
 - 1) General Emissions Evaluation.
 - 2) VOC content requirements for wet applied products.
 - 4. Flooring: Submit general emissions evaluation information for all flooring materials.
 - 5. Composite wood: Submit composite wood evaluation information for all materials not covered by another product category.
 - 6. Ceilings, walls, thermal, and acoustic insulation: Submit general emissions evaluation for all products.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROCEDURES

- A. Submit sustainable design documentation required of Contractor, using procedures defined under Submittals for Information in Section 013000.
- B. Submit extra copy of sustainable design documentation to Architect for transmittal to Sustainable Design Consultant, unless otherwise indicated.
- C. Where an item of sustainable design documentation is specified, fill out and submit electronically the appropriate form(s), and/or use appropriate software.

1. Fill out one line for each different brand name product and each different manufacturer of a lot of commodity products.
 2. Where required attachments are specified, attach the documentation.
 3. Mark each blank with the appropriate information; use "ATT" for items attached; if any item is not relevant use the code "NR"; if any item is not available use the code "NA".
- D. Each form must be signed by the entity capable of certifying the information.
1. Certification signatures must be made by an officer of the company.
 2. For products, certification must be made by the manufacturer not the supplier.
 3. For custom fabricated products, certification by the fabricator is acceptable.
- E. Submit the completed forms in accordance with the requirements of Section 013000, as information submittals.
1. Give each form a unique submittal number.
 2. Do not combine sustainable design documentation with product data or shop drawing submittals.
- F. Submit forms applicable to work for which application for payment is being made, either prior to or concurrent with application for payment; payment will not be made until relevant forms have been submitted.
- G. For work covered by multiple applications for payment, the initial submittal of a form is sufficient for subsequent applications unless the nature of the product has changed.

END OF SECTION

SECTION 013329.04
MATERIAL CONTENT FORM

PROJECT NAME: 2219-05 ORANGETOWN TOWN HALL ADDITION AND ALTERATIONS;
NO.: 2219-05.

- 1.1 Applicable Specification Section Number(s) _____
- 1.2 Product Name: _____ (brand name, model number, etc.)
- 1.3 Manufacturer Name: _____ www. _____
- 1.4 Source Location: _____ (if processed at multiple locations, attach a description; see Section 016000)

PRODUCT CONTENT

- 2.1 Total Weight: _____ pounds per _____ (unit).
- 2.2 Environmental Product Declaration (EPD) _____ is attached or _____ is not available.
- 2.3 _____ % Solid Wood, Wood Chip, and Wood Fiber Content, by weight.
- A. _____ Product is FSC-trademarked.
- B. _____ FSC Chain-of-Custody certificate number is _____
- C. _____ SFI Certified _____ ATFS Certified _____ SFM Certified.
- 2.4 _____ % Other Bio-Based Content, by weight; sourced from a SAN-certified farm.
- 2.5 _____ % Steel Content, by weight.
- A. _____ Steel Mill Source is: _____
- B. _____ Mill letter describing mill process and typical re-used steel content is attached.

- 2.6 _____ % PRE-CONSUMER (POST-INDUSTRIAL) RECYCLED CONTENT, BY weight, OTHER THAN STEEL.
- 2.7 _____ % Post-Consumer Recycled Content, by weight, other than steel.
- 2.8 _____ Zero Lead Content.
- 2.9 _____ Zero Asbestos Content.
- 2.10 _____ Zero intentionally added methylene chloride or perchloroethylene (paints and coatings).
- 2.11 _____ Zero intentionally added cadmium (paints and coatings).

EMISSIONS AND HEALTH

- 3.1 Health Product Declaration (HPD) _____ is attached or _____ is not available.
- 3.2 _____ Formaldehyde: Complying with CARB Composite Wood Regulation for ULEF or no added formaldehyde resin.
- 3.3 _____ LOW-EMITTING MATERIAL MEETING REQUIREMENTS OF CAL (CDPH SM), PRIVATE OFFICE SCENARIO.
- 3.4 Wet-Applied Products:
- 3.5 _____ VOC content meeting SCAQMD Rule 1113.
- 3.6 _____ VOC Content: Meeting CARB 2007, SCM for Architectural Coatings.
- 3.7 _____ VOC content meets SCAQMD Rule 1168.
- 3.8 _____ OTHER VOC CONTENT TEST REPORTs; SEE SECTION 013329.02 - Sustainable Design Reporting - LEED v4.

CERTIFIED BY: (MANUFACTURER)

- 4.1 _____ Documentation of all claims made above is attached.
- 4.2 Print Name: _____
- 4.3 Signature: _____
- 4.4 Title: _____ (officer of company), Date: _____

COST CERTIFICATION

5.1 Total Installed Material Cost of This Product: \$ _____

5.2 No. of Units Installed: _____ Total Volume Installed: _____ (wet-applied products)

5.3 CERTIFIED BY: (Contractor)

A. Print Name: _____

B. Signature: _____

C. Title: _____ (officer of company), Date: _____

END OF SECTION

SECTION 013566.05
PROJECT SUSTAINABILITY GOAL CREDIT SUMMARY - LEED V4

PART 1 GENERAL

1.1 PROJECT INFORMATION

- A. Project Name: 2219-05 Orangetown Town Hall Addition and Alterations.
- B. City: Orangeburg.
- C. State: New York.

1.2 PROJECT GOALS

- A. This project has been designed to achieve the LEED Certified (minimum 40 points) rating as defined in USGBC LEED v4-BD+C for New Construction.
 - 1. This project is pursuing MR: Building Product Disclosure and Optimization (BPDO) category credit(s) for Environmental Product Declarations, Sourcing of Raw Materials, and Materials Ingredients.
 - a. To achieve Environmental Product Declarations category points, project has targeted successful completion of requirements of Option 1, Environmental Product Declaration path and Option 2, Multi-Attribute Optimization path.
 - b. To achieve Sourcing of Raw Materials category points, project has targeted successful completion of requirements of Option 1, Raw Material Source and Extraction Reporting path and Option 2, Leadership Extraction Practices path.
 - c. To achieve Material Ingredients category points, project has targeted successful completion of requirements of Option 1, Material Ingredient Reporting path, Option 2, Material Ingredient Optimization path, and Option 3, Product Manufacturer Supply Chain Optimization path.
 - 2. This project is also pursuing EQ: Low-Emitting Materials credit(s) using the Product Category Calculations Method and Budget Calculation Method.

1.3 RELATED REQUIREMENTS

- A. Section 013329.02 - Sustainable Design Reporting - LEED v4 for Contractor's reporting responsibilities.
- B. Section 013566.12 - Sustainability Certification Project Procedures - LEED v4 for Contractor's procedural responsibilities.

1.4 DEFINITIONS

- A. Sustainability Rating System: United States Green Building Council's LEED v4 for New Construction.
- B. Required: Achievement of this credit is essential for certification of this project.
- C. Preferred: Achievement of this credit would be desirable but is not mandatory.
- D. Not Required: Achievement of this credit is not expected or not possible for this project.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - CREDIT SUMMARY

3.1 GENERAL

- A. Credit - Not Required- 1 point - Integrative Process.

3.2 LOCATION AND TRANSPORTATION (LT)

- A. LT Credit - Not Required- New Construction (8 to 16) Points - LEED for Neighborhood Development Location. Projects attempting this credit are not eligible to earn points under other Location and Transportation credits.

3.3 SUSTAINABLE SITES (SS)

- A. SS Prerequisite - Required - No points - Construction Activity Pollution Prevention.
1. During Construction:
 - a. Preventive measures and remediation are specified in Section 015713.
 - b. Dust control and basic surface drainage are specified in Section 017000.
 - c. Preventive measures prescribed by state law will be followed.
 2. Permanent erosion and sedimentation prevention features will be provided:
 - a. Grading for sediment traps and retention ponds is specified in Section 312200.
 - b. Riprap is specified in Section 313700.
 - c. Turf (for lawns) is specified in Section 329219 (seeding).
 - d. Plants are specified in Section 329300.
- B. SS Credit - Required- 1 point - Site Assessment - Building Design and Construction projects.
1. The project team assessed site conditions before design to evaluate sustainable options.
- C. SS Credit - Required - 1 to 3 points - Rainwater Management - Building Design and Construction projects.
1. The project reduces runoff volume and improves water quality in a manner that meets the criteria for this Credit.
- D. SS Credit - Not Required - 1 to 2 points - Site Development - Protect or Restore Habitat - Building Design and Construction projects.
- E. SS Credit - Preferred - 1 point - Open Space - Building Design and Construction projects.
- F. SS Credit - Required - 1 to 2 points - Heat Island Reduction - Building Design and Construction projects.
1. The project minimizes effects on microclimates and human and wildlife habitats by reducing heat islands.
 - a. Option 1 - Combination of measures meeting criteria of the Credit is used to achieve claimed number of points.
 - 1) High-Reflectance Roof - Using roof materials with required minimum solar reflectance index values.
 - a) White thermoplastic sheet roofing meeting the requirements is specified in Section 075400.
- G. SS Credit - Required - 1 point - Light Pollution Reduction - Building Design and Construction projects.

1. Appropriate exterior lighting fixtures are specified in Section 265600.
2. Lighting control devices for automatic control of lighting are specified in Section 260923.

3.4 WATER EFFICIENCY (WE)

- A. WE Prerequisite - Required - No points - Outdoor Water Use Reduction - Building Design and Construction projects.
 1. Option 1 - Irrigation is not required for the project.
- B. WE Prerequisite - Required - No points - Indoor Water Use Reduction.
 1. Appropriate high efficiency and/or waterless fixtures are specified in Section 224000.
- C. WE Prerequisite - Required - No points - Building-Level Water Metering - Building Design and Construction projects.
 1. Permanent water meters for potable water are specified in Section 220519.
- D. WE Credit - Required - 1 to 2 points - Outdoor Water Use Reduction - Building Design and Construction projects.
 1. Option 2 - Landscaping that requires irrigation is included in this project. Mitigating design features include:
 - a. Plants that do not require much irrigation are specified in Section 329300.
 - b. Non-potable water (rainwater) is used for irrigation:
 - 1) Collection surfaces are flat roofs specified in Section 075423.
 - 2) Tanks are specified in Section 334000.
 - 3) Storm drainage piping is specified in Section 334000.
- E. WE Credit - Required - 1 to 7 Points - Indoor Water Use Reduction.
 1. Appropriate high efficiency and/or waterless fixtures are specified in Section 224000.
- F. WE Credit - Not Required - 1 to 2 points - Cooling Tower Water Use - Building Design and Construction projects.
- G. WE Credit - Required - 1 point - Water Metering - Building Design and Construction projects.
 1. The project includes permanent water metering specified in Section 220519 for the following two or more water subsystems:
 - a. Irrigation is specified in Section 328423.
 - b. Indoor plumbing fittings and fixtures are specified in Section 224000.
 - c. Domestic hot water piping is specified in Section 221005.

3.5 ENERGY & ATMOSPHERE (EA)

- A. EA Prerequisite - Required - No points - Fundamental Commissioning and Verification.
 1. Requirement for commissioning performed by and under the supervision of an independent commissioning authority is included in the Contract Documents.
 2. General commissioning criteria are specified in Section 019113.
 3. The commissioning authority's responsibilities are specified in Section 019114 for Contractor's information only.
 4. Commissioning of HVAC is specified in Section 230800.
- B. EA Prerequisite - Required - No points - Minimum Energy Performance - Building Design and Construction projects.
 1. The building envelope, HVAC, lighting, etc., have been designed to meet the criteria for this prerequisite.

- C. EA Prerequisite - Required - No points - Building-Level Energy Metering - Building Design and Construction projects.
 - 1. Continuous metering systems that meet the credit criteria are to be provided.
 - a. Plumbing metering devices are specified in Section 220519.
 - b. General HVAC monitoring and metering devices are specified in Section 230913.
 - c. HVAC piping system metering devices are specified in Section 230519.
- D. EA Prerequisite - Required - No points - Fundamental Refrigerant Management.
 - 1. New equipment: No CFC-based refrigerants are used in any equipment. Non-CFC refrigerants are specified in the following sections:
- E. EA Credit - Not Required - Optimize Energy Performance - Building Design and Construction projects.
- F. EA Credit - Preferred - 1 to 3 points - Renewable Energy Production - Building Design and Construction projects.
- G. EA Credit - Not Required - 2 to 6 points - Enhanced Commissioning - Building Design and Construction projects.
- H. EA Credit - Required - 1 point - Enhanced Refrigerant Management.
 - 1. Option 1 - No Refrigerants or Low-Impact Refrigerants: The project meets the criteria for this Credit.
 - 2. No Halon is used in any equipment or extinguishing system.
 - 3. HVAC:
 - a. New equipment: No HCFC-based refrigerants are used in any equipment. Non-HCFC refrigerants are specified in the following section(s):
- I. EA Credit - Required - 1 point - Advanced Energy Metering - Building Design and Construction projects.
 - 1. Continuous advanced energy metering systems that meet the Credit criteria will be provided.
 - a. Plumbing metering devices are specified in Section 220519.
 - b. General HVAC monitoring and metering devices are specified in Section 230913.
 - c. HVAC piping system metering devices are specified in Section 230519.
 - d. Building automation system integrating advanced metering and control systems is specified in Section 230923.
- J. EA Credit - Not Required - 1 to 2 points - Demand Response - Building Design and Construction projects.
- K. EA Credit - Required - 1 to 2 points - Green Power and Carbon Offsets - Building Design and Construction projects.
 - 1. The Owner intends to enter, or has already entered into, a contract for electricity from renewable sources, but that is not part of this construction contract.

3.6 MATERIALS & RESOURCES

- A. MR Prerequisite - Required - No points - Storage & Collection of Recyclables.
 - 1. Bins, waste cans, can crushers, etc., are considered furnishings and are therefore not part of the construction contract.
- B. MR Prerequisite - Required - No points - Construction and Demolition Waste Management Planning.
 - 1. Waste diversion goals have been established for the project.

- C. MR Credit - Preferred - 2 to 6 points - Building Life-Cycle Impact Reduction.
 - 1. Procedures for alterations and selective demolition are specified Section 017000.
 - 2. Partial demolition is specified in Section 024100.
- D. MR Credit - Preferred - Interiors Life-Cycle Impact Reduction.
 - 1. Option 1 - Interior Reuse - 2 points: The projects meets the criteria for this Credit.
 - a. Procedures for alterations and selective demolition are specified Section 017000.
 - b. Partial demolition is specified in Section 024100.
 - 2. Option 2 - Furniture Reuse - 1 point: The project meets the criteria for this Credit.
- E. MR Credit - Required - 1 to 2 points - Building Product Disclosure and Optimization - Environmental Product Declarations.
 - 1. Option 1 - Environmental Product Declaration (EPD): To achieve Environmental Product Declarations category points, project has targeted successful completion of requirements of this Option.
- F. MR Credit - Required - 1-2 points - Building Product Disclosure and Optimization - Sourcing of Raw Materials.
 - 1. Option 1 - Raw Material Source and Extraction Reporting: To achieve Sourcing of Raw Materials category points, project has targeted successful completion of requirements of this Option.
- G. MR Credit - Required - 1 to 2 points - Building Product Disclosure and Optimization - Material Ingredients - Building Design and Construction projects.
 - 1. Option 1 - Material Ingredient Reporting: To achieve Material Ingredients category points, project has targeted successful completion of requirements of this Option.
- H. MR Credit - Required - Construction and Demolition Waste Management.
 - 1. Option 1 - Diversion.
 - a. Construction procedures and measurement of diverted waste are specified in Section 017419. This section requires the Contractor to perform the measurement and computation.
 - b. Waste prevention and disposal procedures specific to certain types of work are specified in many sections.

3.7 INDOOR ENVIRONMENTAL QUALITY

- A. EQ Prerequisite - Required - No points - Minimum Indoor Air Quality (IAQ) Performance - Building Design and Construction projects.
 - 1. Option 1 - The building ventilation system will provide the minimum outdoor ventilation rate prescribed by ASHRAE Std 62.1-2010.
 - 2. Requirements for monitoring of mechanically-ventilated spaces that meet the criteria for this prerequisite are specified in Section 230913.
 - 3. The overall design solution is implemented in the drawings and many sections of the specifications.
- B. EQ Prerequisite - Required - No points - Environmental Tobacco Smoke (ETS) Control.
 - 1. Owner intends to prohibit smoking in the building.
 - a. Owner will provide signage indicating no-smoking policy.
 - 2. Designated exterior smoking areas are located at least 25 feet away from entries, outdoor air intakes, and operable windows.
- C. EQ Credit - Required - 1 point - Construction IAQ Management Plan.
 - 1. The Contractor is required to develop and implement and indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building.

- D. EQ Credit - Required - 1 to 2 points - Indoor Air Quality Assessment.
1. Option 1 - Flush-out. Depending on the construction progress and adherence by the Contractor to the approved construction schedule, Flush-out may take one of the following paths:
 - a. Path 1 - Before Occupancy: Contractor is required to perform a full building flush-out prior to occupancy; specified in Section 015719.
- E. EQ Credit - Required - 1 to 3 points - Low-Emitting Materials.
1. Product criteria and reporting criteria for VOC-restricted products are specified in Section 016116.
 2. Prohibited Content Installer Certification form is included as Section 013329.07.
 3. Option 1 - Product Category Calculations. The project uses this option to meet the criteria for the claimed number of points for these Credits.
 - a. Interior paints and coatings applied on site. Calculated by volume.
 - b. Interior adhesives and sealants applied on site (including flooring adhesive). Calculated by volume
 - c. Flooring. 100 percent.
 - d. Composite Wood. 100 percent not covered by other product categories.
 - e. Ceilings, walls, thermal, and acoustic insulation. 100 percent. Healthcare, Schools projects include additional insulation requirements.
 4. The following products are used in this project and meet the specified VOC restrictions criteria for this Credit:
 - a. All adhesives used on the project, whether explicitly specified or not, are considered VOC-restricted products.
 - b. Thermal insulation for ceilings and walls; specified in Section 072100 - Thermal Insulation.
 - c. Firestopping sealants; specified in Section 078400.
 - d. Architectural joint sealants; specified in Section 079200.
 - e. The following Flooring products are used in this project and will comply with the specified VOC restrictions:
 - 1) Resilient flooring and base; specified in Section 096500.
 - f. Carpet tile; specified in Section 096813.
 - g. Adhesives used in connection with carpet systems.
 - h. Interior paints and stains are specified in Section 099123.
 - 1) Water-based paints or solvent-based paints with VOC content meeting the credit criteria are used for all interior opaque applications.
 - 2) Other coatings, such as stains and clear finishes, are specified to meet the most stringent of federal EPA, state, or local criteria.
 - i. Duct sealers and sealants; specified in Section 233100.
- F. EQ Credit - Required - 1 to 2 points - Interior Lighting.
1. Option 1 - Lighting control: The project provides controls meeting the criteria for this Credit.
 - a. Lighting control devices are specified in Section 260923.
- G. EQ Credit - Required - 1 point - Thermal Comfort.
1. Thermal Comfort Design.
 - a. Option 1 - ASHRAE Std 55-2010. The project has been designed to meet criteria for this Credit.
 2. HVAC Controls: Controls will be provided for at least 50 percent of individual occupant spaces.
 - a. Direct-digital HVAC control system is specified in Section 230923.
- H. EQ Credit - Preferred - 1 to 3 points - Daylight.

1. Option 3 - Measurement: The project will verify that illuminance levels that meet the criteria for these Credits have been achieved.
 2. The overall design solution is implemented in the drawings with light-admitting materials specified in many sections of the specifications, including, but not limited to:
 - a. Aluminum windows specified in Section 085113.
 - b. Metal-framed skylights specified in Section 086300.
- I. EQ Credit - Required - 1 to 2 points - Quality Views.
1. The project design provides views meeting the Credit criteria.
- J. EQ Credit - Required - 1 to 2 points - Acoustic Performance.
1. The project design achieves HVAC maximum background noise levels restrictions meeting criteria for these Credits.
 2. The project design includes STC class ratings meeting criteria for this Credit as applicable to walls, partitions, and floor-ceiling assemblies.
 3. The project design achieves reverberation time restrictions for this Credit as applicable to included building types and space types.
- 3.8 INNOVATION (IN)
- A. IN Credit - Preferred - 1 to 5 points - Innovation.
1. Option 1 - Design of the project achieves significant, measurable environmental performance using a strategy not addressed in the LEED green building rating system.
- B. IN Credit - Required - 1 point - LEED Accredited Professional.
1. At least one principal participant of the project team is a LEED Accredited Professional with a specialty appropriate to the project, including the following persons:
 - a. Mark Porterfield.
- 3.9 REGIONAL PRIORITY (RP)
- A. RP Credit - Preferred - 4 points - Region Specific Environmental Priority : North-East Region.

END OF SECTION

SECTION 014000
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. Testing and inspection agencies and services.
- D. Contractor's construction-related professional design services.
- E. Contractor's design-related professional design services.
- F. Control of installation.
- G. Mock-ups.
- H. Tolerances.
- I. Manufacturers' field services.
- J. Defect Assessment.

1.2 RELATED REQUIREMENTS

- A. Section 012100 - Allowances: Allowance for payment of testing services.
- B. Section 014216 - Definitions.

1.3 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants 2008 (Reapproved 2019).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation 2017.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry 2019.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction 2019.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection 2021.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing 2021.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components 2016.
- H. IAS AC89 - Accreditation Criteria for Testing Laboratories 2020.

1.4 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.
- B. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
 - 1. Design Services Types Required:
 - a. Construction-Related: Services Contractor needs to provide in order to carry out the Contractor's sole responsibilities for construction means, methods, techniques, sequences, and procedures.
 - b. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- C. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

1.5 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary stairs or steps required for construction access only.
 - 5. Temporary hoist(s) and rigging.

1.6 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Interpretation to Architect if the criteria indicated are not sufficient to perform required design services.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
 - 1. Structural Design of Formwork: As described in Section 031000 - Concrete Forming and Accessories.
 - 2. Concrete Mix Design: As described in Section 033000 - Cast-in-Place Concrete. No specific designer qualifications are required.
 - 3. Structural Design of Steel Connections: As described in Section 051200 - Structural Steel Framing.
 - 4. Structural Design of Steel Connections: As described in Section 052100 - Steel Joist Framing.

5. Structural Design of Steel Decking: As described in Section 053100 - Steel Decking.
6. Structural Design of Metal Framing: As described in Section 054000 - Cold-Formed Metal Framing.
7. Structural Design of Metal Fabrications: As described in Section 055000 - Metal Fabrications.
8. Structural Design of Stairs: As described in Section 055100 - Metal Stairs.
9. Structural Design of Railings: As described in Section 055213 - Pipe and Tube Railings.
10. Structural Design: Include calculations for resisting wind loads, physical characteristics, resulting dimensional limitations as described in Section 086300 - Metal-Framed Skylights.
11. Design of Structural Components: As described in Section 142100 - Electric Traction Elevators.
12. Sprinkler Layout: Coordinate with ceiling installation, detailed pipe layout, and hydraulic calculations as described in Section 211300 - Fire-Suppression Sprinkler Systems.
13. System Design: As described in Section 230923 - Direct-Digital Control System for HVAC.
14. Structural Calculations and Design: As described in Section 323223 - Segmental Retaining Walls

1.7 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 2. Include required product data and shop drawings.
 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- D. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.

- g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
- E. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
- 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
- 1. Submit report in duplicate within 30 days of observation to Architect for information.
 - 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

1.8 Quality Assurance

- A. Testing Agency Qualifications:
- 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Contractor's Quality Control (CQC) Plan:
- 1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
 - 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
 - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
 - 1) Management and control of documents and records relating to quality.
 - 2) Communications.
 - 3) Coordination procedures.
 - 4) Resource management.
 - 5) Process control.
 - 6) Inspection and testing procedures and scheduling.
 - 7) Control of noncomplying work.
 - 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
 - 9) Control of testing and measuring equipment.
 - 10) Project materials certification.

- 11) Managerial continuity and flexibility.
 - c. Owner will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.
 - d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. Owner's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. Owner reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.
- D. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

1.9 REFERENCES AND STANDARDS

- A. Obtain copies of standards where required by product specification sections.
- B. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.10 Testing and Inspection Agencies and Services

- A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 012100; see Section 012100 and applicable sections for description of services included in allowance.
- B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, and ASTM D3740.
 - 2. Inspection agency: Comply with requirements of ASTM D3740 and ASTM E329.
 - 3. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
 - 4. Laboratory: Authorized to operate in the State in which the Project is located.
 - 5. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
 - 6. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.

- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

3.2 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- D. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- E. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- F. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- G. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

3.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.4 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.

2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.
- 3.5 MANUFACTURERS' FIELD SERVICES
- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- 3.6 DEFECT ASSESSMENT
- A. Replace Work or portions of the Work not complying with specified requirements.

END OF SECTION

SECTION 014100 REGULATORY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY of Reference Standards

- A. Regulatory requirements applicable to this project are the following:
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- C. 29 CFR 1910 - Occupational Safety and Health Standards current edition.
- D. State of New York amendments to some or all of the following.
- E. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- F. ICC (IFC) - International Fire Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. ICC (IPC) - International Plumbing Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ICC (IMC) - International Mechanical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. ICC (IFGC) - International Fuel Gas Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. ICC (IECC) - International Energy Conservation Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. ICC (IPMC) - International Property Maintenance Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.2 RELATED REQUIREMENTS

- A. Section 014000 - Quality Requirements.

1.3 QUALITY ASSURANCE

- A. Contractor's Designer Qualifications: Refer to Section - 014000 - Quality Requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 014216
DEFINITIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

1.2 DEFINITIONS

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 014219
REFERENCE STANDARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements relating to referenced standards.
- B. Reference standards full title and edition date.

1.2 RELATED REQUIREMENTS

- A. Document 007200 - General Conditions: Reference standards.

1.3 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with the reference standard of date of issue specified in this section, except where a specific date is established by applicable code.
- C. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.1 AIA -- THE AMERICAN INSTITUTE OF ARCHITECTS

- A. AIA A503 - Guide for Supplementary Conditions, including Amendments to AIA Documents A201, the 2017 Owner-Contractor Agreements, and the 2019 Owner-Construction Manager as Constructor Agreements 2019.

2.2 ASTM A Series -- ASTM INTERNATIONAL

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

2.3 ASTM D Series -- ASTM INTERNATIONAL

- A. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).

- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity 2021.
- 2.4 ASTM E Series -- ASTM INTERNATIONAL
- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
 - B. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage 2007, with Editorial Revision (2014).
- 2.5 AWPAA -- AMERICAN WOOD-PRESERVERS' ASSOCIATION
- A. AWPAA U1 - Use Category System: User Specification for Treated Wood 2018.
- 2.6 SDI -- STEEL DECK INSTITUTE
- A. SDI (QA/QC) - Standard for Quality Control and Quality Assurance for Installation of Steel Deck 2017.
- 2.7 UL -- UNDERWRITERS LABORATORIES INC.
- A. UL (FRD) - Fire Resistance Directory Current Edition.
- 2.8 WWPAA -- WESTERN WOOD PRODUCTS ASSOCIATION
- A. WWPAA G-5 - Western Lumber Grading Rules 2017.

END OF SECTION

SECTION 014533
CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Code-required special inspections.
- B. Testing services incidental to special inspections.
- C. Submittals.
- D. Manufacturers' field services.
- E. Fabricators' field services.

1.2 RELATED REQUIREMENTS

- A. Document 003100 - Available Project Information: Soil investigation data.
- B. Document 007200 - General Conditions: Inspections and approvals required by public authorities.
- C. Section 012100 - Allowances: Allowance for payment of testing services.
- D. Section 013000 - Administrative Requirements: Submittal procedures.
- E. Section 014000 - Quality Requirements.
- F. Section 014219 - Reference Standards.
- G. Section 016000 - Product Requirements: Requirements for material and product quality.

1.3 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authority having jurisdiction.
- B. IAS: International Accreditation Service, Inc.
- C. NIST: National Institute of Standards and Technology.

1.4 DEFINITIONS

- A. Code or Building Code: ICC (IBC) NYS-2020, Building Code of New York State, including all applicable Amendments and Supplements and specifically, Chapter 17- Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. Special Inspection:
 - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract

- Documents and the referenced standards.
2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.5 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete 2019, with Errata (2021).
- B. AISC 360 - Specification for Structural Steel Buildings 2016 (Revised 2021).
- C. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field 2021a.
- D. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete 2017.
- E. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction 2019.
- F. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection 2021.
- G. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing 2021.
- H. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.
- I. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.
- J. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage 2007, with Editorial Revision (2014).
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- L. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel 2018.
- M. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel 2018.
- N. IAS AC89 - Accreditation Criteria for Testing Laboratories 2020.
- O. IAS AC291 - Accreditation Criteria for Special Inspection Agencies 2017.
- P. ICC (IBC) NYS-2020 - Building Code of New York State 2020.
- Q. SDI (QA/QC) - Standard for Quality Control and Quality Assurance for Installation of Steel Deck 2017.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.

2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
- C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency is required to:
1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 3. Submit certification that Testing Agency is acceptable to AHJ.
- D. Manufacturer's Qualification Statement: Manufacturer is required to submit documentation of manufacturing capability and quality control procedures. Include documentation of AHJ approval.
- E. Fabricator's Qualification Statement: Fabricator is required to submit documentation of fabrication facilities and methods as well as quality control procedures. Include documentation of AHJ approval.
- F. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to the AHJ.
1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of special inspection.
 - h. Date of special inspection.
 - i. Results of special inspection.
 - j. Compliance with Contract Documents.
 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- G. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator's facility, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to AHJ.
- H. Test Reports: After each test or inspection, promptly submit at least two copies of report; one to Architect and one to AHJ.
- I. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, in quantities specified for Product Data.
1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- J. Manufacturer's Field Reports: Submit reports to Architect and AHJ.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.
- K. Fabricator's Field Reports: Submit reports to Architect and AHJ.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.

1.7 SPECIAL INSPECTION AGENCY

- A. Owner will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
- C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.8 TESTING AND INSPECTION AGENCIES

- A. Owner may employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not required by the building code.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.9 QUALITY ASSURANCE

- A. Special Inspection Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
 - 2. Accredited by IAS according to IAS AC291.
- B. Testing Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
 - 2. Accredited by IAS according to IAS AC89.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

- A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
 - 1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.2 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION

- A. Structural Steel: Comply with quality assurance inspection requirements of ICC (IBC).
- B. Cold-Formed Steel Deck: Comply with quality assurance inspection requirements of SDI (QA/QC).

- C. Open-Web Joists and Joist Girders: Comply with requirements of ICC (IBC), Table 1705.2.3.
 - 1. End Connections - Welding or Bolted: Comply with requirements of SJI 100; periodic.
 - 2. Bridging - Horizontal or Diagonal:
 - a. Standard Bridging: Comply with requirements of SJI 100; periodic.
 - b. Bridging That Differs From the SJI Specifications: Periodic inspection.
- D. High-Strength Bolt, Nut and Washer Material:
 - 1. Verify identification markings comply with ASTM standards specified in the approved contract and to AISC 360, Section A3.3; periodic.
 - 2. Submit manufacturer's certificates of compliance; periodic.
- E. High-Strength Bolting Installation: Verify items listed below comply with AISC 360, Section M2.5.
 - 1. Snug tight joints; periodic.
- F. Structural Steel and Cold Formed Steel Deck Material:
 - 1. Structural Steel: Verify identification markings comply with AISC 360, Section M3.5; periodic.
 - 2. Other Steel: Verify identification markings comply with ASTM standards specified in the approved Contract Documents; periodic.
 - 3. Submit manufacturer's certificates of compliance and test reports; periodic.
- G. Weld Filler Material:
 - 1. Verify identification markings comply with AWS standards specified in the approved Contract Documents and to AISC 360, Section A3.5; periodic.
 - 2. Submit manufacturer's certificates of compliance; periodic.
- H. Welding:
 - 1. Structural Steel and Cold Formed Steel Deck:
 - a. Complete and Partial Joint Penetration Groove Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
 - b. Multipass Fillet Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
 - c. Single Pass Fillet Welds Less than 5/16 inch Wide: Verify compliance with AWS D1.1/D1.1M; periodic.
 - d. Plug and Slot Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
 - e. Single Pass Fillet Welds 5/16 inch or Greater: Verify compliance with AWS D1.1/D1.1M; continuous.
 - f. Floor and Roof Deck Welds: Verify compliance with AWS D1.3/D1.3M; continuous.
 - 2. Reinforcing Steel: Verify items listed below comply with AWS D1.4/D1.4M and ACI 318, Section 3.5.2.
 - a. Verification of weldability; periodic.
 - b. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames as well as boundary elements of special structural walls of concrete and shear reinforcement; continuous.
 - c. Shear reinforcement; continuous.
 - d. Other reinforcing steel; periodic.
- I. Steel Frame Joint Details: Verify compliance with approved Contract Documents.
 - 1. Details, bracing and stiffening; periodic.
 - 2. Member locations; periodic.
 - 3. Application of joint details at each connection; periodic.

3.3 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION

- A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved Contract Documents and ACI 318, Sections 3.5 and 7.1 through 7.7; periodic.
- B. Reinforcing Steel Welding: Verify compliance with AWS D1.4/D1.4M and ACI 318, Section 3.5.2; periodic.
- C. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved Contract Documents and ACI 318, Sections 8.1.3 and 21.2.8 prior to and during placement of concrete; continuous.
- D. Anchors Installed in Hardened Concrete: Verify compliance with ACI 318, Sections 3.8.6, 8.1.3, and 21.2.8; periodic.
- E. Design Mix: Verify plastic concrete complies with the design mix in approved Contract Documents and with ACI 318, Chapter 4 and 5.2; periodic.
- F. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M and ACI 318, Sections 5.6 and 5.8 and record the following, continuous:
 - 1. Slump.
 - 2. Air content.
 - 3. Temperature of concrete.
- G. Concrete and Shotcrete Placement: Verify application techniques comply with approved Contract Documents and ACI 318, Sections 5.9 and 5.10; continuous.
- H. Specified Curing Temperature and Techniques: Verify compliance with approved Contract Documents and ACI 318, Sections 5.11 through 5.13; periodic.
- I. Concrete Strength in Situ: Verify concrete strength complies with approved Contract Documents and ACI 318, Section 6.2, for the following.
- J. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI 318, Section 6.1.1; periodic.
- K. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials comply with the quality standards of ACI 318, the AHJ will require that the Special Inspector verify compliance with the appropriate standards and criteria in ACI 318, Chapter 3.

3.4 SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION

- A. Masonry Structures Subject to Special Inspection:
 - 1. Empirically designed masonry, glass unit masonry and masonry veneer in structures designated as "essential facilities".
 - 2. Engineered masonry in structures classified as "low hazard..." and "substantial hazard to human life in the event of failure".
- B. Verify each item below complies with approved Contract Documents and the applicable articles of TMS 402/602.
 - 1. Inspections and Approvals:
 - a. Verify compliance with the required inspection provisions of the approved Contract Documents; periodic.
 - b. Verify approval of submittals required by Contract Documents; periodic.

2. Compressive Strength of Masonry: Verify compressive strength of masonry units prior to start of construction unless specifically exempted by code; periodic.
3. Slump Flow and Visual Stability Index (VSI): Verify compliance as self consolidating grout arrives on site; continuous.
4. Joints and Accessories: When masonry construction begins, verify:
 - a. Proportions of site prepared mortar; periodic.
 - b. Construction of mortar joints; periodic.
 - c. Location of reinforcement, connectors, prestressing tendons, anchorages, etc; periodic.
5. Structural Elements, Joints, Anchors, Protection: During masonry construction, verify:
 - a. Size and location of structural elements; periodic.
 - b. Type, size and location of anchors, including anchorage of masonry to structural members, frames or other construction; periodic.
 - c. Size, grade and type of reinforcement, anchor bolts and prestressing tendons and anchorages; periodic.
 - d. Welding of reinforcing bars; continuous.
6. Grouting Preparation: Prior to grouting, verify:
 - a. Grout space is clean; periodic.
 - b. Correct placement of reinforcing, connectors, prestressing tendons and anchorages; periodic.
 - c. Correctly proportioned site prepared grouts and prestressing grout for bonded tendons; periodic.
 - d. Correctly constructed mortar joints; periodic.
7. Preparation of Grout Specimens, Mortar Specimens and Prisms: Observe preparation of specimens; periodic.

3.5 SPECIAL INSPECTIONS FOR SOILS

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
 1. Design bearing capacity of material below shallow foundations; periodic.
 2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
 3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
 4. Subgrade, prior to placement of compacted fill verify proper preparation; periodic.
- B. Testing: Classify and test excavated material; periodic.

3.6 SPECIAL INSPECTIONS FOR EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)

- A. Verify water resistive barrier coating applied over sheathing complies with ASTM E2570/E2570M.

3.7 SPECIAL INSPECTIONS FOR FIRE RESISTANT PENETRATIONS AND JOINTS

- A. Verify penetration firestops in accordance with ASTM E2174.
- B. Verify fire resistant joints in accordance with ASTM E2393.

3.8 SPECIAL INSPECTIONS FOR WIND RESISTANCE

- A. Cold-Formed Steel Light Frame Construction:

1. Field welding; periodic.
 2. Screw attachment, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic
- B. Wind Resisting Components:
1. Roof covering, roof deck, and floor framing connections; periodic.
 2. Exterior wall covering and wall connections to roof and floor diaphragms and framing; periodic.
- C. Structural Observations for Wind Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

3.9 OTHER SPECIAL INSPECTIONS

- A. Provide for special inspection of work that, in the opinion of the AHJ, is unusual in nature.
- B. For the purposes of this section, work unusual in nature includes, but is not limited to:
1. Construction materials and systems that are alternatives to materials and systems prescribed by the building code.
 2. Unusual design applications of materials described in the building code.
 3. Materials and systems required to be installed in accordance with the manufacturer's instructions when said instructions prescribe requirements not included in the building code or in standards referenced by the building code.
- C. Alternative Test Procedures: Where approved rules and standards do not exist, test materials and assemblies as required by AHJ or provide AHJ with documentation of quality and manner in which those materials and assemblies are used.

3.10 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

- A. Special Inspection Agency shall:
1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified reference standards.
 3. Ascertain compliance of materials and products with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests or inspections specified.
- B. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- C. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.11 TESTING AGENCY DUTIES AND RESPONSIBILITIES

- A. Testing Agency Duties:
1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.

4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests or inspections specified.
- B. Limits on Testing or Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the work.
- C. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.
- D. Contractor will pay for re-testing required because of non-compliance with specified requirements.

3.12 CONTRACTOR DUTIES AND RESPONSIBILITIES

- A. Contractor Responsibilities, General:
1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
 2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to work to be tested or inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
 - c. To facilitate tests or inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
 5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- B. Contractor Responsibilities, Wind Force-Resisting System and Wind Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and Owner prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.

3.13 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES

- A. When specified in individual specification sections, require material suppliers, assembly fabricators, or product manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, to test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
1. Observer subject to approval of Architect.
 2. Observer subject to approval of Owner.

- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

END OF SECTION

SECTION 015000
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Dewatering
- B. Temporary utilities.
- C. Temporary telecommunications services.
- D. Temporary sanitary facilities.
- E. Temporary Controls: Barriers, enclosures, and fencing.
- F. Security requirements.
- G. Vehicular access and parking.
- H. Waste removal facilities and services.
- I. Project identification sign.
- J. Field offices.

1.2 REFERENCE STANDARDS

1.3 Dewatering

- A. The dewatering system shall be designed by a New York State Licensed Professional Engineer, and it should be designed to ensure that dewatering does not result in any loss of soil.
- B. Provide temporary means and methods for dewatering all temporary facilities and controls, and throughout construction as needed to divert runoff from the proposed construction limits.
- C. Provide dewatering measures to prevent loosening or migration of the subgrade soils. Perform dewatering measures to maintain the water level at least one foot below the deepest excavation.
- D. Employ sump pits and pumps as may be required for dewatering measures. The operation of sumps directly in the footing excavations is not permitted. Sump pits should be placed at least one foot outside of foundation excavations for every one foot below the foundation subgrade elevation that is excavated.
- E. Maintain temporary facilities in operable condition.

1.4 TEMPORARY UTILITIES

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. Existing facilities may not be used.

1.5 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - 2. Telephone Land Lines: One line, minimum; one handset per line.
 - 3. Internet Connections: Minimum of one; Cable modem or faster.
 - 4. Email: Account/address reserved for project use.

1.6 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.7 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.8 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.9 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.10 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

- C. Paint surfaces exposed to view from Owner-occupied areas.

1.11 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.

1.12 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- F. Provide one parking space for Architect use.

1.13 WASTE REMOVAL

- A. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT IDENTIFICATION

- A. Provide project identification sign of design, construction, and location approved by Owner.
- B. No other signs are allowed without Owner permission except those required by law.

1.15 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.16 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 015713
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.2 RELATED REQUIREMENTS

- A. Section 013329.02 - Sustainable Design Reporting - LEED v4: Submittal requirements for sustainable design documentation.
- B. Section 015000 - Temporary Facilities and Controls: Dewatering During Construction
- C. Section 311000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- D. Section 312000 - Earth Moving: Permanent grade changes for erosion control.
- E. Section 312500 - Erosion and Sedimentation Control: Permanent erosion and sedimentation control
- F. Section 329200 - Turf and Grasses: Permanent turf and grasses for erosion control.
- G. Section 329300 - Plants: Permanent plantings for erosion control.

1.3 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus 2021.
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity 2021.
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles 2015.
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles 2015a.
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile 2021a.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples 2017 (Reapproved 2021).

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Sustainable Design Documentation: Submit documentation required in this section in accordance with requirements specified in Section 013329.02.
- C. Erosion and Sedimentation Control Plan:
 - 1. Submit within 2 weeks after Notice to Proceed.
 - 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - e. Other information required by law.
 - f. Format required by law is acceptable, provided any additional information specified is also included.
 - 3. Obtain the approval of the Plan by authorities having jurisdiction.
 - 4. Obtain the approval of the Plan by Owner.
- D. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- E. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Mulch: Use one of the following:
 - 1. Straw or hay.
 - 2. Wood waste, chips, or bark.
 - 3. Erosion control matting or netting.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Bales: Air dry, rectangular straw bales.
 - 1. Cross Section: 14 by 18 inches, minimum.
 - 2. Bindings: Wire or string, around long dimension.
- D. Bale Stakes: One of the following, minimum 3 feet long:
 - 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 - 2. Wood, 2 by 2 inches in cross section.
- E. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:

1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491/D4491M.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
 6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
 8. Manufacturers:
 - a. TenCate; 70 gram, Woven PP Silt Fence: www.tencate.com.
 - b. Propex Geosynthetics; Geotex 2130: www.geotextile.com.
 - c. Substitutions: See Section 016000 - Product Requirements.
- F. Silt Fence Posts: One of the following, minimum 5 feet long:
1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 2. Hardwood, 2 by 2 inches in cross section.
- G. Gravel: See Section 321123 for aggregate.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.2 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.3 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
1. Width: As required; 20 feet, minimum.
 2. Length: 50 feet, minimum.
 3. Provide at each construction entrance from public right-of-way.
 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.

- c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 - 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
 - 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
- I. Temporary Seeding: Use where temporary vegetated cover is required.

3.4 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
 - 1. Excavate minimum of 6 inches.
 - 2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
 - 3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.
- B. Silt Fences:
 - 1. Store and handle fabric in accordance with ASTM D4873/D4873M.
 - 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.
 - 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 - 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 - 5. Install with top of fabric at nominal height and embedment as specified.
 - 6. Embed bottom of fabric in a trench on the upslope side of fence, with 2 inches of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
 - 7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 - 8. Fasten fabric to wood posts using one of the following:
 - a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
 - 9. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.

10. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- C. Straw Bale Rows:
1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
 2. Install bales so that bindings are not in contact with the ground.
 3. Embed bales at least 4 inches in the ground.
 4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
 5. Fill gaps between ends of bales with loose straw wedged tightly.
 6. Place soil excavated for trench against bales on the upslope side of the row, compacted.
- D. Mulching Over Large Areas:
1. Dry Straw and Hay: Apply 2-1/2 tons per acre; anchor using dull disc harrow or emulsified asphalt applied using same spraying machine at 100 gallons of water per ton of mulch.
 2. Wood Waste: Apply 6 to 9 tons per acre.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- E. Mulching Over Small and Medium Areas:
1. Dry Straw and Hay: Apply 4 to 6 inches depth.
 2. Wood Waste: Apply 2 to 3 inches depth.
 3. Erosion Control Matting: Comply with manufacturer's instructions.
- F. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.
 5. Incorporate fertilizer into soil before seeding.
 6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
 7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
 8. Repeat irrigation as required until grass is established.

3.5 MAINTENANCE

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.

- D. Straw Bale Rows:
 - 1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
 - 2. Remove silt deposits that exceed one-half of the height of the bales.
 - 3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Place sediment in appropriate locations on site; do not remove from site.

3.6 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 015719
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality after construction.
- B. Building flush-out after construction and before occupancy.
- C. Testing indoor air quality before commencement of construction; existing building areas only.
- D. Testing indoor air quality after completion of construction.

1.2 PROJECT GOALS

- A. See Section 013566.05 - Project Sustainability Goal Credit Summary - LEED v4, for overall project goals relating to environment and energy.
- B. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
 - 1. Cleaning of ductwork is not contemplated under this Contract.
 - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
 - 3. Establish condition of existing ducts and equipment prior to start of alterations.
- C. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
 - 1. Furnish products meeting the specifications.
 - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.3 RELATED REQUIREMENTS

- A. Section 014000 - Quality Requirements: Testing and inspection services.
- B. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- C. Section 230593 - Testing, Adjusting, and Balancing for HVAC: Testing HVAC systems for proper air flow rates, adjustment of dampers and registers, and settings for equipment.

1.4 REFERENCE STANDARDS

- A. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology) 2016.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers 2017, v1.2.
- C. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air 1990.

- D. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air 1999.
- E. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction 2007.

1.5 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.

PART 3 EXECUTION

3.1 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
 - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
 - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
 - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area.
- D. Use of HVAC equipment and ductwork for ventilation during construction is not permitted:
 - 1. Provide temporary ventilation equivalent to 1.5 air changes per hour, minimum.
 - 2. Exhaust directly to outside.
 - 3. Seal HVAC air inlets and outlets immediately after duct installation.
- E. Do not store construction materials or waste in mechanical or electrical rooms.
- F. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
 - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
 - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 - 3. Clean tops of doors and frames.
 - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.

5. Clean return plenums of air handling units.
 6. Remove intake filters last, after cleaning is complete.
- G. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- H. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

3.2 BUILDING FLUSH-OUT

- A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
- B. Perform building flush-out before occupancy.
- C. Do not start flush-out until:
1. All construction is complete.
 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
 4. New HVAC filtration media have been installed.
- D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
 2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
 3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
 4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
 - a. Begin ventilation at least three hours prior to daily occupancy.
 - b. Continue ventilation during all occupied periods.
 - c. Provide minimum outside air volume of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater.
- E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.3 AIR CONTAMINANT TESTING

- A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.
- B. Perform air contaminant testing before starting construction, as base line for evaluation of post-construction testing.
- C. Perform air contaminant testing before occupancy.
- D. Do not start air contaminant testing until:
1. All construction is complete, including interior finishes.
 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 3. New HVAC filtration media have been installed.
- E. Indoor Air Samples: Collect from spaces representative of occupied areas:

1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
 2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
 3. Collect samples from height from 36 inches to 72 inches above floor.
 4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
 5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
 6. When retesting the same building areas, take samples from at least the same locations as in first test.
- F. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.
- G. Analyze air samples and submit report.
- H. Air Contaminant Concentration Limits:
1. Formaldehyde: Not more than 27 parts per billion.
 2. PM10 Particulates: Not more than 50 micrograms per cubic meter.
 3. Total Volatile Organic Compounds (TVOCs): Not more than 500 micrograms per cubic meter.
 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: Allowable concentrations listed in Table 4-1.
 5. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.
- I. Air Contaminant Concentration Test Methods:
1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6.
 2. Particulates: EPA 600/4-90/010 Method IP-10.
 3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
 5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.
- J. If air samples show concentrations higher than those specified, ventilate with 100 percent outside air and retest at no cost to Owner, or conduct full building flush-out specified above.

END OF SECTION

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General product requirements.
- B. Re-use of existing products.
- C. Transportation, handling, storage and protection.
- D. Product option requirements.
- E. Substitution limitations.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

1.2 RELATED REQUIREMENTS

- A. Section 012500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 013329.02 - Sustainable Design Reporting - LEED v4: Reporting requirements.
- C. Section 013566.12 - Sustainability Certification Project Procedures - LEED v4: Requirements for LEED v4 procedures.
- D. Section 014000 - Quality Requirements: Product quality monitoring.
- E. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- F. Section 017419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

1.3 REFERENCE STANDARDS

- A. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute Current Edition.
- B. EN 15804 - Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products 2014.
- C. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action Current Edition.
- D. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action Current Edition.
- E. ISO 14025 - Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures 2006 (Confirmed 2020).
- F. ISO 14040 - Environmental management - Life cycle assessment - Principles and framework 2006 (Amended 2020).

- G. ISO 14044 - Environmental management - Life cycle assessment - Requirements and guidelines 2006 (Amended 2020).
- H. ISO 21930 - Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services 2017.

1.4 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.
- D. Sustainable Design Submittals: Items necessary to document use of sustainable construction materials, products, and practices.
 - 1. See Section 013566.12 for Contractor's procedures necessary for achievement of targeted LEED v4 sustainability certification level.
 - 2. See Section 013329.02 for Contractor's reporting necessary for achievement of targeted LEED v4 certification level.

1.5 QUALITY ASSURANCE

- A. Cradle-to-Cradle Certified: End use product certified Cradle-to-Cradle v2 Basic or Cradle-to-Cradle v3 Bronze, minimum, as evidenced by C2C (DIR).
- B. Environmental Product Declaration (EPD): Publicly available, critically reviewed life cycle analysis having at least a cradle-to-gate scope.
 - 1. Good: Product-specific; compliant with ISO 14044.
 - 2. Better: Industry-wide, generic; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
 - 3. Best: Commercial-product-specific; compliant with ISO 21930, or with ISO 14044, ISO 14040, ISO 14025, and EN 15804; Type III third-party certification with external verification, in which the manufacturer is recognized as the program operator.
 - 4. Where demonstration of impact reduction below industry average is required, submit both industry-wide and commercial-product-specific declarations; or submit at least 5 declarations for products of the same type by other manufacturers in the same industry.
- C. GreenScreen Chemical Hazard Analysis: Ingredients of 100 parts-per-million or greater evaluated using GreenScreen (METH).
 - 1. Good: GreenScreen (LIST) evaluation to identify Benchmark 1 hazards; a Health Product Declaration includes this information.
 - 2. Better: GreenScreen Full Assessment.
 - 3. Best: GreenScreen Full Assessment by GreenScreen Licensed Profiler.
 - 4. Acceptable Evidence: GreenScreen report.
- D. Health Product Declarations (HPD): Complete, published declaration with full disclosure of known hazards, prepared using one of the HPDC (HPD-OLT) online tools.

PART 2 PRODUCTS

2.1 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.

2.2 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. See Section 014000 - Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
 - 1. Made using or containing CFC's or HCFC's.
 - 2. Made of wood from newly cut old growth timber.
 - 3. Containing lead, cadmium, or asbestos.
- D. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 016116.
 - 2. If wet-applied, have lower VOC content, as defined in Section 016116.
 - 3. Are extracted, harvested, and/or manufactured closer to the location of the project.
 - 4. Have longer documented life span under normal use.
 - 5. Result in less construction waste. See Section 017419
 - 6. Are made of vegetable materials that are rapidly renewable.
 - 7. Are made of recycled materials.
 - 8. If made of wood, are made of sustainably harvested wood, wood chips, or wood fiber.
 - 9. If bio-based, other than wood, are or are made of Sustainable Agriculture Network certified products.
 - 10. Are Cradle-to-Cradle Certified.
 - 11. Have a published Environmental Product Declaration (EPD).
 - 12. Have a published Health Product Declaration (HPD).
 - 13. Have a published GreenScreen Chemical Hazard Analysis.
 - 14. Have a published Manufacturer's Inventory of Chemical Content.

2.3 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.4 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.1 SUBSTITUTION LIMITATIONS

- A. See Section 012500 - Substitution Procedures.

3.2 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.3 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 017419.
 - 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

- G. For exterior storage of fabricated products, place on sloped supports above ground.
- H. Provide off-site storage and protection when site does not permit on-site storage or protection.
 - 1. Execute a formal supplemental agreement between Owner and Contractor allowing off-site storage, for each occurrence.
- I. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- J. Comply with manufacturer's warranty conditions, if any.
- K. Do not store products directly on the ground.
- L. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- M. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- N. Prevent contact with material that may cause corrosion, discoloration, or staining.
- O. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- P. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

SECTION 016116
VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Requirements for VOC-Content-Restricted products.
- B. Requirement for installer certification that they did not use any non-compliant products.

1.2 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Submittal procedures.

1.3 DEFINITIONS

- A. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
 - 3. Other products when specifically stated in the specifications.
- B. Interior of Building: Anywhere inside the exterior weather barrier.
- C. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- D. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.

1.4 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings 2005 (Reapproved 2018).
- C. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2007.
- D. SCAQMD 1113 - Architectural Coatings 1977 (Amended 2016).
- E. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Sustainable Design Reporting: Submit evidence of compliance.

1. Refer to Section 013329.02 - Sustainable Design Reporting - LEED v4.
- D. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.

1.6 QUALITY ASSURANCE

- A. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.1 MATERIALS

- A. VOC-Content-Restricted Products: VOC content not greater than required by the following:
 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
 2. Joint Sealants: SCAQMD 1168 Rule.
 3. Paints and Coatings: Each color; most stringent of the following:
 - a. 40 CFR 59, Subpart D.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- J. General requirements for maintenance service.

1.2 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 013000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- C. Section 014000 - Quality Requirements: Testing and inspection procedures.
- D. Section 015000 - Temporary Facilities and Controls: Temporary exterior enclosures.
- E. Section 015000 - Temporary Facilities and Controls: Temporary interior partitions.
- F. Section 015713 - Temporary Erosion and Sediment Control: Additional erosion and sedimentation control requirements.
- G. Section 017419 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- H. Section 017800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- I. Section 019113 - General Commissioning Requirements: Contractor's responsibilities in regard to commissioning.
- J. Section 078400 - Firestopping.
- K. Individual Product Specification Sections:
 - 1. Advance notification to other sections of openings required in work of those sections.

2. Limitations on cutting structural members.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 1. On request, submit documentation verifying accuracy of survey work.
 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 3. Submit surveys and survey logs for the project record.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.
 1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences. Include design drawings and calculations for bracing and shoring.
 2. Identify demolition firm and submit qualifications.
 3. Include a summary of safety procedures.
- D. Cutting and Patching: Submit written request in advance (minimum 3 working days) of cutting or alteration that affects:
 1. Structural integrity of any element of Project.
 2. Integrity of weather exposed or moisture resistant element.
 3. Efficiency, maintenance, or safety of any operational element.
 4. Visual qualities of sight exposed elements.
 5. Work of Owner or separate Contractor.
 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Alternatives to cutting and patching.
 - f. Effect on work of Owner or separate Contractor.
 - g. Written permission of affected separate Contractor.
 - h. Date and time work will be executed.
- E. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.4 QUALIFICATIONS

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,
- B. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.
- C. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

1.5 PROJECT CONDITIONS

- A. Perform dewatering activities, as required, for the duration of the project.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- C. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- D. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers.
 - 2. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
 - 3. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.
- E. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- F. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.6 COORDINATION

- A. See Section 011000 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.

- H. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.3 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.

- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.4 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Control datum for survey is that established by Owner provided survey.
- E. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- F. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- G. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- H. Utilize recognized engineering survey practices.
- I. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- J. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- K. Periodically verify layouts by same means.
- L. Maintain a complete and accurate log of control and survey work as it progresses.

3.5 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.6 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 .
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 - 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 - 4. Verify that abandoned services serve only abandoned facilities.
 - 5. Remove abandoned pipe, ducts, conduits, and equipment , including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.

- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
 - 1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
 - 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
 - 3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
 - 4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish. General Contractor shall be responsible for all finish patching required by the project. Each trade shall be responsible for rough patching required by their work. Rough patching shall include, but not be limited to, gypsum board and associated framing, taping, spackling, caulking, fire and smoke penetration sealant and backer, concrete, etcetera.
- I. Refinish existing surfaces as indicated:
 - 1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 - 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

3.7 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Each prime trade shall be responsible for his own cutting and patching as necessary for the proper installation of the work. The General Contractor shall be responsible for all finish patching for the project.
- D. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.

- E. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- F. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- H. Restore work with new products in accordance with requirements of Contract Documents.
- I. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- J. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 078400, to full thickness of the penetrated element.
- K. Patching:
 - 1. Each trade is responsible for rough patching required by their work. Rough patching shall include, but not be limited to, substrate and framing (where applicable), tape and spackle, caulking, fire and smoke penetration sealant and backer, concrete, etcetera. General Contractor shall finish patched surfaces to match finish that existed prior to cutting and patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit. The General Contractor shall be responsible for all finish patching of the work.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.8 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.9 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

- F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate with requirements of Section 019113 - General Commissioning Requirements.
- B. Coordinate schedule for start-up of various equipment and systems.
- C. Notify Architect and Owner seven days prior to start-up of each item.
- D. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- E. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- F. Verify that wiring and support components for equipment are complete and tested.
- G. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- H. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- I. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

- G. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.
- B. Testing, adjusting, and balancing HVAC systems: See Section 230593 - Testing, Adjusting, and Balancing for HVAC.

3.13 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
 - 1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- B. Use cleaning materials that are nonhazardous.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect and Owner.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.1 WASTE MANAGEMENT REQUIREMENTS

- A. Owner requires that this project generate the least amount of trash and waste possible.
- B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood.
 - 5. Land clearing debris, including brush, branches, logs, and stumps; see Section 311000 - Site Clearing for use options.
 - 6. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - 7. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (<http://flooring.dupont.com>) and Interface (www.interfaceinc.com) conduct reclamation programs.
 - 8. Rigid foam insulation.
 - 9. Acoustical ceiling tile and panels.
- E. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, incineration, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.
- F. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.
- G. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.2 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

- B. Section 013566.12 - Sustainability Certification Project Procedures - LEED v4: Procedures for sustainable design documentation.
- C. Section 015000 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- D. Section 016000 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- E. Section 017000 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.
- F. Section 311000 - Site Clearing: Handling and disposal of land clearing debris.

1.3 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.
- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Sustainable Design Submittals: Submit Waste Management Plan and Waste Disposal Reports in accordance with procedures specified in Section 013566.12 - Sustainability Certification Project Procedures - LEED v4.
- C. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
- D. Waste Management Plan: Include the following information:
 - 1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
 - 2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
 - 3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
 - 4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
 - 5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
 - 6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.
- E. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 - 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - 2. Submit Report on a form acceptable to Owner.
 - 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 4. Incinerator Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project delivered to incinerators.
 - c. State the identity of incinerators, total amount of fees paid to incinerator, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - 5. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.

- b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
6. Material Reused on Project: Include the following information for each:
 - a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
7. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

- A. See Section 016000 - Product Requirements for substitution submission procedures.
- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 016000:
 1. Relative amount of waste produced, compared to specified product.
 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
 3. Proposed disposal method for waste product.
 4. Markets for recycled waste product.

PART 3 EXECUTION

3.1 WASTE MANAGEMENT PROCEDURES

- A. See Section 013000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 015000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 016000 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 017000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 - 1. Prebid meeting.
 - 2. Preconstruction meeting.
 - 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
 - 1. Provide containers as required.
 - 2. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 - 3. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 017800
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.2 RELATED REQUIREMENTS

- A. Section 007200 - General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 017000 - Execution and Closeout Requirements: Contract closeout procedures.
- D. Individual Product Sections: Specific requirements for operation and maintenance data.
- E. Individual Product Sections: Warranties required for specific products or Work.

1.3 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 3. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed shop drawings, product data, and samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Approved revisions.
 - 6. Details not on original Contract drawings.
 - 7. As-built drawings must be submitted in PDF and AutoCAD .dwg format, 2020 or newer.

3.2 OPERATION AND MAINTENANCE DATA

- A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- C. Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.3 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:

1. Product data, with catalog number, size, composition, and color and texture designations.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.4 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 1. Include HVAC outdoor and exhaust air damper calibration strategy.
 - a. Include provisions which ensure that full closure of dampers can be achieved.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

- N. Include test and balancing reports.
- O. Additional Requirements: As specified in individual product specification sections.

3.5 ASSEMBLY OF ELECTRONIC OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into electronic format (PDF preferable) manuals for Owner's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
- B. Cover: Identify each manual with title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- C. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- D. Tables of Contents: List every item, category or section, using the same identification as in the file; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- E. Text: Manufacturer's standard printed data, or Arial font.
- F. Drawings: Provide in PDF electronic format. Bind in with text.
- G. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Copy of warranties and bonds.
 - 4. Design Data: Include design data furnished by the Architect, if necessary.

3.6 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include copies of each in operation and maintenance manuals, indexed separately on Table of Contents.

END OF SECTION

SECTION 019113
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
- C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.
- D. The Commissioning Authority is employed by Owner.

1.2 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Building envelope:
 - 1. Thermal and moisture integrity.
 - 2. Air tightness.
- C. Elevating and conveying systems.
- D. Fire Protection Systems.
- E. Plumbing Systems:
 - 1. Water heaters.
 - 2. Booster pumps.
 - 3. Landscape irrigation.
- F. HVAC System, including:
 - 1. Major and minor equipment items.
 - 2. Piping systems and equipment.
 - 3. Ductwork and accessories.
 - 4. Terminal units.
 - 5. Control system.
 - 6. Sound control devices.
 - 7. Vibration control devices.

- 8. Variable frequency drives.
 - G. Integrated Automation.
 - H. Electrical Systems:
 - 1. Power quality.
 - 2. Emergency power systems.
 - 3. Lighting controls other than manual switches.
 - I. Electronic Safety and Security:
 - 1. Security system, including doors and hardware.
 - 2. Fire and smoke alarms.
 - J. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
 - K. Indoor Air Quality Procedures: The Commissioning Authority will coordinate; Contractor will execute; see Section 015719 - Temporary Environmental Controls.
- 1.3 RELATED REQUIREMENTS
- A. Section 013329.02 - Sustainable Design Reporting - LEED v4: Reporting requirements relating to commissioning.
 - B. Section 015719 - Temporary Environmental Controls: Precautions and procedures; smoking room testing; building flush-out.
 - C. Section 017800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.
 - D. Section 019114 - Commissioning Authority Responsibilities.
- 1.4 REFERENCE STANDARDS
- A. ASTM E1827 - Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door 2011 (Reapproved 2017).
 - B. PEI (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests Current Edition.
- 1.5 SUBMITTALS
- A. See Section 013000 - Administrative Requirements, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
 - 5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
 - B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
 - 1. Manufacturer's product data, cut sheets, and shop drawings.

2. Manufacturer's installation instructions.
 3. Startup, operating, and troubleshooting procedures.
 4. Fan and pump curves.
 5. Factory test reports.
 6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
 3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.1 COMMISSIONING PLAN

- A. Commissioning Authority has prepared the Commissioning Plan.
1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.

- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D. Commissioning Schedule:
 - 1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
 - 2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
 - 3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 - 4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.2 STARTUP PLANS AND REPORTS

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

3.3 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
 - 1. No sampling of identical or near-identical items is allowed.
 - 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 - 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.
 - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
 - f. Sensor and actuator calibration information.
 - 4. PECE (Samples) found at <http://www.peci.org/library/mcpgs.htm> indicate anticipated level of detail for Prefunctional Checklists.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
 - 1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.

2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
 3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
 4. If any Checklist line item is not relevant, record reasons on the form.
 5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
 6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
 7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in Contract Documents.
 2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
 4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.4 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
 2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning

Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.

3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.

E. Functional Test Procedures:

1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
 - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
3. PECEI (Samples) found at <http://www.peci.org/library/mcpgs.htm> indicated anticipated level of detail for Functional Tests.

- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.5 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
 1. Verify that sensor location is appropriate and away from potential causes of erratic operation.

2. Verify that sensors with shielded cable are grounded only at one end.
 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg.
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.

6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
 - I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
 1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.
- 3.6 TEST PROCEDURES - GENERAL
- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
 - B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
 - C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
 1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 2. Sampling is not allowed for:
 - a. Major equipment.
 - b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
 - D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
 - E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
 - F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
 - G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
 - H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.

- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
 - 1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 - 2. Other points will be monitored by the Commissioning Authority using dataloggers.
 - 3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
 - 4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
 - 5. Graphical output is desirable and is required for all output if the system can produce it.
 - 6. Monitoring may be used to augment manual testing.

3.7 BUILDING ENVELOPE COMMISSIONING

- A. General: Comply with the following procedural requirements:
 - 1. ASTM E1827 Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door.
- B. Verify that the building envelope has been sufficiently completed for testing to commence.
- C. Conduct ongoing inspections as construction progresses to document satisfactory installation conditions related to thermal and moisture integrity of the building envelope that become concealed upon completion of construction.
- D. Submit a detailed narrative of proposed pressure test procedures prior to the test. Include a plan view showing proposed installation locations (personnel doors or other similar openings) for blower doors (or flexible ducts for trailer-mounted fans, if used).
- E. Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed the specified requirements.
- F. Determine location and nature of undesirable air leakage pathways using methods specified in ASTM E1186-17 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
- G. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
 - 1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.8 OPERATION AND MAINTENANCE MANUALS

- A. See Section 017800 - Closeout Submittals for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 019114
COMMISSIONING AUTHORITY RESPONSIBILITIES

PART 1 GENERAL

1.1 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is specified.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.
- C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
- D. The Commissioning Authority is to be employed by Owner.
- E. The scope of commissioning activities is defined in Section 019113 - General Commissioning Requirements.

1.2 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - The HVAC&R Technical Requirements for the Commissioning Process 2007, with Errata (2012).
- B. CSI/CSC MF - Masterformat 2016.

1.3 SUBMITTALS

- A. Commissioning Plan:
 - 1. Submit preliminary draft for review by Owner and Architect within 30 days after commencement of Commissioning Authority contract.
 - 2. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.
- B. List of Prefunctional Checklists to be developed:
 - 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 - 2. Submit final list not more than 60 days after start of construction.
- C. Prefunctional Checklists:

1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- D. List of Functional Test procedures to be developed:
1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit final list not more than 60 days after start of construction.
- E. Functional Test Procedures:
1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- F. Training Plan.
- G. Recommissioning Manual: Submit within 60 days after receipt of Owner's instructions to proceed with preparation.
- H. Commissioning Process Record: Submit to Contractor for inclusion with O&M manuals. Include, at a minimum the following:
1. Issues Log
 2. Construction Checklists
 3. CxA Site Visit and Cx Team Meeting Minutes
 4. Summary Report
- I. Final Commissioning Report: Submit to Owner. Include the following:
1. A statement that systems have been completed in accordance with Contract Documents, and that the systems are performing in accordance with the final Owner's project requirements document.
 2. Identification and discussion of any substitutions, compromises, or variances between the final design intent, Contract Documents and as-built conditions.
 3. Description of components and systems that exceed Owner's project requirements and those which do not meet the requirements and why.
 4. Summary of issues, both resolved and unresolved, and any recommendations for resolution of remaining items.

1.4 QUALITY ASSURANCE

- A. Commissioning Firm Qualifications: Firm experienced in commissioning assemblies and systems specified to be included in scope of work of this Section, and certified by one or more of the following organizations.
1. AABC Commissioning Group (ACG), for commissioning of HVAC Systems and Special Ventilation Systems.
 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for commissioning of HVAC Systems
 3. Building Commissioning Association (BCA) for commissioning of HVAC Systems
- B. Commissioning Plan: Prepare a plan that provides direction for commissioning tasks during construction phase of the project. Include, at a minimum, the following content at the level of detail appropriate to project scope and complexity:
1. General project information.
 2. List of team members.
 3. Team members' roles and responsibilities
 4. Description of the goals of the plan.

5. Abbreviations and definitions used in the document.
6. Scope of commissioning activities.
7. Proposed overall schedule, tied to project construction schedule.
8. General management plan.
9. Description of the commissioning process, including documents to be used for facilitating:
 - a. Prefunctional checking and readiness verification.
 - b. Start-up plan and procedures.
 - c. Functional test plan and verification procedures.
 - d. Retesting procedures.
 - e. Management protocols for address deficiencies due to defective products or non-complying work.
 - f. Management protocols for addressing other project-specific issues.
10. Phased commissioning activities, planned and unplanned.
11. Warranty period seasonal and deferred testing.
12. Progress reporting and log for tracking issues.

PART 2 PRODUCTS

2.1 DOCUMENTATION IDENTIFICATION SYSTEM

- A. Give each submitted form or report a unique identification; use the following scheme.
- B. Type of Document: Use the following prefixes:
 1. Commissioning Plan: CP-.
 2. Prefunctional Checklist: PC-.
 3. Functional Test Procedure: FTP-.
 4. Functional Test Report: FTR-.
 5. Commissioning Report: CR-.
- C. System Type: Use the first 4 digits from CSI/CSC MF (Master Format), that are applicable to the system; for example:
 1. 2300: HVAC system as a whole.
 2. 2320: HVAC Piping and Pumps.
 3. 2330: HVAC Air Distribution.
- D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.
- E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.
- F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

PART 3 EXECUTION

3.1 COMMISSIONING PLAN

- A. Prepare and implement the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
 1. Call and chair meetings of the Commissioning team when appropriate.
 2. Give Contractor sufficient notice for scheduling commissioning activities.

3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
 4. ASHRAE Guideline 1.1 may be used as a guide for the Commissioning Plan.
 5. Avoid replication of information included in the construction Contract Documents to the greatest extent possible.
- B. Review the construction Contract Documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.
- C. Commissioning Schedule:
1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
 2. Contractor's scheduling responsibilities are specified in the construction Contract Documents.
 3. Revise and re-issue schedule monthly.
 4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.

3.2 CONSTRUCTION CONTRACT DOCUMENTS

- A. General Commissioning Specifications: Architect has prepared general commissioning specifications for inclusion in the construction Contract Documents; review and submit comments to Owner.
1. These specifications include:
 - a. Procedures applicable to all types of items to be commissioned.
 2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction Contract Documents by Architect:
 - a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
 - b. Additional Owner personnel training.
 - c. Additional operation or maintenance data that should be submitted.
- B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
 2. The Checklist forms are intended to be part of the Contractor's Contract Documents.
- C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
 2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.
- D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction Contract Documents.
- E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction Contract Documents

3.3 PREFUNCTIONAL CHECKLISTS

- A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
 2. Identify each Checklist by using Contract Documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
 3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
 4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
 5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
 6. Include line items for each physical inspection to be performed.
 7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
 8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
 9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.
- B. Prefunctional Checklists - Format:
1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
 2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
 3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
 - a. "This Checklist is submitted for approval with no exceptions."
 - b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
 4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
 5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

3.4 FUNCTIONAL TEST PROCEDURES

- A. Develop test procedures in sufficient detail to demonstrate that functional performance is in accordance with Contract Documents, including proper operation through specified modes of operation where there is a different system response, including seasonal, unoccupied,

warm-up, cool-down, part- and full-load regimes.

1. Obtain assistance and review by installing subcontractors.
2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.
3. Include test setup instructions, description of tools and apparatus, special cautions, and.
4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring, or manual functional testing.
6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.

B. Functional Test Forms: Prepare and distribute forms in advance of testing. Use a consistent format to the greatest degree practicable. For each form, include the following:

1. General and specific instructions for using form.
2. Document Identifiers:
 - a. Date and Test Party Identifier: Identification of the date(s) of the test, and the party conducting it.
3. Complete testing procedure information.
 - a. Instrumentation: A listing of instrumentation and tools necessary to complete the test.
 - b. Test Instructions: Step-by-step instructions of how to complete the test, including functionality to test, and conditions under which the tests should be performed. Include instructions for returning affected systems and equipment to their as-found state at the conclusion of the tests.
4. Test Data:
 - a. Results: Include side-by-side space for recording the expected system response and the actual response. Note observed readings, results, and adjustments.
 - b. Deficiencies: Include space for a list of any discovered deficiencies and for an explanation of how they were mitigated.
5. Signature Block: Signature of the designated commissioning lead and the system and equipment installer attesting that the recorded test results are accurate.

3.5 CONSTRUCTION PHASE

- A. Coordinate the commissioning work with Contractor and Construction Manager; ensure that commissioning activities are being incorporated into the master schedule.
- B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.
- C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review proposed commissioning schedule, activities, and responsibilities with parties involved. Require attendance by every member of the Commissioning Team.
- D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.
- E. Submit periodic progress reports to Owner and Contractor.
- F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly

defined in warranties.

- G. Review and approve submittals directly related to commissioning.
- H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.
- I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.
- J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.
- K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.
- L. Building Envelope Commissioning:
 - 1. Develop for Contractor's and Subcontractors' use project-specific checklists, each targeted for commissioning the installation of a set of related components and systems that comprise the building enclosure.
 - 2. Conduct construction observation of building enclosure systems, at initial installation of work, milestone observations throughout construction, performance testing and verification of components and systems, their interfaces, and whole building performance test (if required).
- M. HVAC Commissioning:
 - 1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
 - 2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
 - 3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
 - 4. Review TAB Plan prepared by Contractor.
 - 5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
 - 6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
 - 7. Analyze trend logs and monitoring data to verify performance.
 - 8. Prepare a standard trend logging package of primary parameters that will provide Owner's operations staff clear indications of system function in order to identify proper system operation and trouble shoot problems; provide any additional information needed to interpret the trend logs.
- N. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer's personnel; include documentation in O&M manuals.
- O. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.
- P. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.

- Q. Operation and Maintenance Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.
- R. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

3.6 TRAINING

- A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.
 - 1. Include a 1 hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
 - 2. Include a 1 hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test forms for re-commissioning purposes.
 - 3. Establish criteria for determining satisfactory completion of training.
- B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.

3.7 CLOSEOUT

- A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
 - 1. Include the Final Commissioning Plan and Final Report.
 - 2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
 - a. Design intent documentation, furnished by Architect or others.
 - b. Detailed operational sequences.
 - c. Startup plan and approved startup reports.
 - d. Filled out Prefunctional Checklists.
 - e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
 - f. Training plan and training records.
 - g. Recommissioning recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.
- B. Final Commissioning Report: Include:
 - 1. Executive summary.
 - 2. List of participants and roles.
 - 3. Brief facility description.
 - 4. Overview of commissioning scope and general description of testing and verification methods.
 - 5. For each item commissioned, an evaluation of adequacy of:
 - a. The product itself; i.e. compliance with Contract Documents.
 - b. Installation.
 - c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
 - d. O&M documentation, including design intent.
 - e. Operator training.
 - 6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
 - 7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
 - 8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).

9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.
- C. Recommissioning Manual: Revise the Commissioning Plan documents, checklists, and Functional Test forms as necessary based on accepted recommendations of the final Commissioning Report. Provide step-by-step instructions for recommissioning, blank forms, and cross-references to O&M data needed during recommissioning.

3.8 POST-OCCUPANCY PHASE

- A. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.
- B. On-Site Review: 10 months after Substantial Completion conduct on-site review with Owner's staff.
 1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
 2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
 3. Make suggestions for improvements and for recording these changes in the O&M manuals.
 4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.
 5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

END OF SECTION

SECTION 024100
DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.
- B. Abandonment and removal of existing utilities and utility structures.

1.2 RELATED REQUIREMENTS

- A. Section 003100 - Available Project Information: Existing building survey conducted by Owner; information about known hazardous materials.
- B. Section 011000 - Summary: Limitations on Contractor's use of site and premises.
- C. Section 011000 - Summary: Sequencing and staging requirements.
- D. Section 011000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- E. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- F. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- G. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- H. Section 017419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- I. Section 311000 - Site Clearing: Vegetation and existing debris removal.
- J. Section 312000 - Earth Moving: Topsoil removal.
- K. Section 312323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- L. Section _____ - _____: Other hazardous material remediation.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Site Plan: Showing:
 - 1. Vegetation to be protected.
 - 2. Areas for temporary construction and field offices.
 - 3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as specified by OSHA and local authorities.

1. Indicate extent of demolition, removal sequence, bracing and shoring, and location and construction of barricades and fences.
 2. Identify demolition firm and submit qualifications.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.4 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Fill Material: As specified in Section 312323 - Fill.

PART 3 EXECUTION

3.1 SCOPE

- A. Remove paving and curbs as required to accomplish new work.
- B. Remove other items indicated, for salvage, relocation, recycling, and disposal.
- C. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as required so that required rough grade elevations do not subside within one year after completion.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 017000.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
1. Obtain required permits.
 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 3. Provide, erect, and maintain temporary barriers and security devices.
 4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 6. Do not close or obstruct roadways or sidewalks without permit.
 7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.

- E. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- G. Perform demolition in a manner that maximizes salvage and recycling of materials.
 - 1. Comply with requirements of Section 017419 - Waste Management.
 - 2. Dismantle existing construction and separate materials.
 - 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.3 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.4 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 015000 .

- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.5 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; comply with requirements of Section 017419 - Waste Management.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 02 82 13 – ASBESTOS ABATEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for furnishing all tools, personnel, equipment, safety devices and cleanup materials as required for the Work to be performed and for the removal/disturbance and disposal of asbestos containing material (ACM) waste. This shall include, but is not limited to, industrial vacuum cleaning equipment, equipped with high efficiency particulate air (HEPA) filters, sprayers, wetting agents, negative air units, and providing personal protective equipment (PPE) to all personnel who will enter the Work Site or who will be in contact with ACM. Contractor is also required to provide protective equipment to persons outside of their employment who may be required to visit the Work Site.
- B. ACM to be impacted during this construction are summarized in Table 1 below. Contractor shall determine from the Contract Drawings and Contract Documents which of the items listed in Table 1 will be disposed in accordance with this Section. An ACM survey should be performed of all areas that were inaccessible or hidden during previous surveys and may be disturbed within the limits of the Work as specified herein, and manage all ACM identified.

Table 1: Confirmed ACM

Material	% ACM & Type	Approximate Quantity	Description / Locations / Friability
9x9 Dark Grey Speckled Tile	4.8% Chrysotile	Up to \pm 9,500 ft ²	The 9x9 Dark Grey Speckled Tile was observed in numerous locations throughout the building. Upper-Level locations include: throughout Assessor's Office, throughout Tax Collector's Office, throughout Justice Department and adjacent Corridor, throughout Human Resources, throughout Supervisor's Office, throughout Finance Department, Old Court Room, Janitor's Closet. Lower-Level locations include: throughout Lower Lobby and part of adjacent Corridor, IT Storage (North), throughout the three Storage Rooms in the northeast corner of the building, throughout Storage Room in the southeast corner, throughout the Old Police Entryway and throughout Large File Storage Room. Tile was found to be in mostly good condition but is damaged in some locations such as the

Material	% ACM & Type	Approximate Quantity	Description / Locations / Friability
			Old Police Entryway. This material is non-friable.
Black Mastic	1.5% Chrysotile	Up to \pm 11,300 ft ²	The Black Mastic was observed in all of the same areas as the 9x9 Dark Grey Speckled Tile that are detailed above, as well as beneath the 12x12 Pink Tile on the floor throughout the Town Attorney's Office. This material was observed to be in good condition and is non-friable.
9x9 Red Tile	3.3% Chrysotile	Up to \pm 15 ft ²	The 9x9 Red Tile was observed to be located only within a single closet in the Supervisor Office. This material was observed to be in good condition and is non-friable.
Black Tar on Foundation Wall	3.6% Chrysotile	Up to \pm 2,100 ft ²	The Black Tar was observed on the foundation wall in Storage A141. The tar existed from the basement slab surface up to a height of approximately five (5) feet above the slab level. The Black Tar is likely located on the foundation wall throughout the basement level of the building. This material was observed to be in good condition and is non-friable.
9x9 Tan Speckled Tile	1.8% Chrysotile	Up to \pm 24 ft ²	The 9x9 Tan Speckled Tile was observed to be located only within the mechanical room in the Town Attorney Office. This material was observed to be in good condition and is non-friable.
White Pipe Elbow Insulation	33% Chrysotile	Up to \pm 61 each	26 elbows were observed in the Evidence Storage Room and 10 elbows were observed in the Northwest Utility Room. The elbows are on a pipe run (up to six pipes) which traverses above the drop ceiling of the Lower Level. The quantity of elbows above the drop ceiling has been estimated to be up to 25, but they are included in the white paper wrap insulation quantity, detailed in this table below. Please note, that dust located on top of the drop ceiling on the Lower Level should be treated as ACM dust as there is a potential that ACM insulation could have deteriorated and released particles onto the drop ceiling. In the event of ceiling tile removal, it is recommended that the ceiling tiles be pre-cleaned of any visible dust/debris prior to

Material	% ACM & Type	Approximate Quantity	Description / Locations / Friability
			removal/disturbance to prevent a release of dust using HEPA vacuuming or wet wiping procedures. Clean up of the dust would be considered an operations and maintenance action and would not constitute an asbestos removal project. This material was observed to be in good condition and is friable.
White Paper Wrap Insulation	Up to \pm 335 linear feet, and up to \pm 2 ft ²	40% Chrysotile	The paper wrap insulation was observed within the Northwest Utility Room on the Lower Level and then is located along up to six pipes over the drop ceiling to the following locations: Boiler Room, Storage Room located in the southeast corner of Please note, that dust located on top of the drop ceiling on the Lower Level should be treated as ACM dust as there is a potential that ACM insulation could have deteriorated and released particles onto the drop ceiling. In the event of ceiling tile removal, it is recommended that the ceiling tiles be pre-cleaned of any visible dust/debris prior to removal/disturbance to prevent a release of dust using HEPA vacuuming or wet wiping procedures. Clean up of the dust would be considered an operations and maintenance action and would not constitute an asbestos removal project. This material was observed to be in good condition and is friable. This material was also found to be located along an edge of a tank in the Boiler Room (up to \pm 2 ft ²)
White Exterior Window Caulk	4.4% Chrysotile	Up to \pm 1,155 linear feet	The white exterior window caulk was observed to be underneath a grey caulking layer around the perimeter on the exterior of each existing window. Note that the grey caulk is not ACM. The white caulk is brittle and breaks easily. This material was observed to be in good condition and is non-friable.
Black Layer on Foundation Wall	9.6% Chrysotile	Up to \pm 1,680 ft ²	The Black Layer was observed on the exterior foundation wall on the western side of the building (exterior left elevation). The layer was measured to be approximately four (4) feet tall and is likely located on the foundation wall

Material	% ACM & Type	Approximate Quantity	Description / Locations / Friability
			throughout the exterior of the building. This material was observed to be in good condition and is non-friable.
White-Grey Transite	23.5% Chrysotile	Up to ± 315 ft ²	The transite panels were observed to be on the roof level and were located on the western and eastern walls, beneath the overhang of the upper roof. This material was observed to be in good condition and is non-friable.
Black Flashing Tar	1.5% Chrysotile	Up to ± 235 linear feet	The black flashing tar appears to be sporadically used on the Upper Roof and was observed on the fan, parts of the chimney and sporadically along the Upper Roof edge. This material was observed to be in good condition and is non-friable.
Black Backing Board	16% Chrysotile	Up to ± 3 ft ²	This style of black backing board was only observed in one electrical box, which is located on the southern wall of the Utility Room of the Town Attorney's Office (identified on the floor plans as Storage A141).

- C. Specifically, the scope of this Work is to include areas associated with the Old Town Hall Building. No ACM materials were discovered within the New Town Hall / Police Building.
- D. The Work specifies utilization of management methods and containment systems, as required, to eliminate or minimize the risk of worker and community exposure to asbestos dust/debris. ACM management work shall include the disturbance, removal, and off-site management of ACM associated with the construction Work described herein.
- E. All materials associated with ACM removal, including poly sheeting and wastewater should be considered contaminated and must be managed properly. The material associated with ACM removal shall be managed in accordance with United States Environmental Protection Agency (EPA), New York State Department of Environmental Conservation (NYSDEC), New York State Department of Labor (NYSDOL), and New York State Department of Health (NYSDOH) regulations.
- F. If Contractor uses Subcontractor(s) to perform any of the Work specified herein including laboratory work and waste disposal, this Section shall apply to all such Subcontractor(s) as if specifically referred to herein.
- G. Contractor or its Subcontractor(s) shall perform all Work necessary to carry out the proper identification, removal, collection, handling, storage, classification, testing, transportation, and disposal of ACM in accordance with all applicable Federal, State, and local laws, codes, rules, and regulations, and the requirements of this Specification.

- H. Contractor is required to field verify all job conditions, quantities, and locations of ACM which will be impacted as part of the Work. Testing and assessment of ACM shall be done as specified in this Section.
- I. Certified Industrial Hygienist (CIH) or other qualified safety professional should be employed to prepare a site-specific Construction Health and Safety Plan (CHASP) and Safe Work Plan (SWP), and to develop a personal air monitoring program in accordance with 29 CFR 1926.62, good industrial hygiene practices, and the requirements stated herein.

1.2 GENERAL INFORMATION AND REQUIREMENTS

- A. The Contractor is responsible for assuring compliance with all applicable Federal and State regulations and policies in place at the time of construction. This includes, but is not limited to, any Federal or State modifications to sampling or analytical methods, standards, or policies specified herein.
- B. This Section details the requirements for construction and demolition activities affecting materials identified as ACM as shown on the Drawings, specified herein, or required to complete the Work. All Work to be performed under this Section shall be performed using methods, tools, and equipment that have demonstrated effectiveness in preventing airborne emissions from migrating outside of work areas.

Additional information regarding ACM, including photographs of the confirmed ACM materials, is available in a Limited HAZMAT Survey Report prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C. and dated September 16, 2020.

- C. For construction and demolition activities affecting materials and structures that are coated with polychlorinated biphenyl (PCB)-containing paints or bitumastic coatings, and removal of fluorescent light ballasts, refer to Section 02 84 00 – PCB Material Removal.
- D. For construction and demolition activities affecting materials and structures that are coated with lead-based paint (LBP), refer to Section 02 83 33 – Lead Paint Management.
- E. All Work under this Section shall be performed to minimize the creation of airborne emissions; minimize the quantity of hazardous waste generated; protect the health and safety of all site personnel and the welfare of the public; and avoid adverse environmental impacts.
- F. In the absence of analytical testing results for a specific suspect building material, air monitoring and worker PPE requirements, including respiratory protection, shall address the potential presence of ACM, PCBs, LBP and heavy metals. Any unforeseen ACM discovered during the Work to be performed under this Section shall be remediated as necessary to complete the Work in accordance with this Section.
- G. The Contractor shall perform all Work under this Section without damaging or contaminating adjacent areas to where the work is being performed. Where such areas are damaged or contaminated, as determined by the Engineer, the Contractor shall restore the areas to their original condition at no additional cost to the Town.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- | | | |
|----|-----------------------|------------------|
| A. | PCB Material Removal | Section 02 84 00 |
| B. | Lead Paint Management | Section 02 83 33 |

1.4 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. Limited HAZMAT Survey Report prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C., dated September 16, 2020.

1.5 DEFINITIONS

- A. NYSDOH: New York State Department of Health
- B. ELAP: Environmental Laboratory Approval Program
- C. RCRA: Resource Conservation and Recovery Act
- D. NYSDEC: New York State Department of Environmental Conservation
- E. PPE: Personal Protective Equipment
- F. OSHA: Occupational Safety and Health Administration
- G. EPA: United States Environmental Protection Agency
- H. USDOT: United States Department of Transportation
- I. ACM: Asbestos Containing Materials
- J. APR: Air Purifying Respirator
- K. CFR: Code of Federal Regulations
- L. NYSDOL: New York State Department of Labor
- M. HAZWOPER: Hazardous Waste Operation
- N. HEPA: High Efficiency Particulate Air
- O. NESHAP: National Emission Standards for Hazardous Air Pollutants
- P. NIOSH: National Institute of Occupational Safety and Health

- Q. PCM: Phase Contrast Microscopy
- R. TEM: Transmission Electron Microscopy

1.6 SPECIAL REQUIREMENTS

- A. Commencement of Work: Five (5) business days prior to the proposed start of the work required under this Section at each separate location, the Contractor shall notify the Engineer and the onsite safety staff. No Work may proceed at any location until authorized by the Engineer.
- B. The Contractor shall coordinate any required equipment shutdowns with site operations personnel prior to starting the Work.
- C. Access Restrictions: The Contractor shall inform the Engineer and site operations personnel of proposed access restrictions (i.e., areas or items of equipment which will not be accessible during the proposed work) and give them estimated time frames (including specific dates) of such proposed access restrictions. The Contractor shall be aware that other contractors may be in any of the work areas associated with this Contract. As a result, the Contractor shall not have exclusive rights to any work area and shall fully cooperate and coordinate this Work with the work of other contractors who may be on site. Therefore, the Contractor shall notify other contractors in advance of the disturbance, Abatement, removal, construction/demolition, and disposal Work included herein, to provide them with sufficient time for coordination of interrelated items that are included in their contracts and that must be performed before, after, or in conjunction with the Work included under this Section.
- D. Unexpected Entry into a Regulated Area: In the event that Town personnel must enter a Regulated Area for reasons unrelated to the supervision or inspection of Work being performed under this Section (e.g., under emergency conditions), the Contractor shall immediately stop work and clean up any loose debris, so as to permit the safe entry by Town personnel. Any disturbance of dusts, materials, or wastes that may potentially generate airborne concentrations of contaminants equal to or above an OSHA Action Level shall not proceed until all Town personnel have exited from the Restricted Area.
- E. Meetings: The Contractor shall visit and investigate the site, review the Drawings, review this Section, and become familiar with any conditions, which may affect the Work, as part of the pre-construction meeting and site walk-through. The Contractor shall hold all meetings with appropriate parties as scheduled and as otherwise necessary to accomplish the Work to be performed under this Section. In addition to the pre-construction meeting and site walk-through, other meetings may be required or may be requested by the Engineer, including briefings with site operations personnel. Written documentation (i.e., "minutes") of all meetings shall be generated by the Contractor, and copies shall be provided to the Town within three (3) business days following each meeting.
- F. Payment for the disposal of ACM waste will not be made until a signed copy of the manifest from the Treatment, Storage, and Disposal Facility (TSDF), certifying the amount of ACM waste delivered is returned with complete chain-of-custody (COC) documentation to the Town.

1.7 QUALITY ASSURANCE / QUALITY CONTROL

A. Regulatory Requirements

1. ASTM International

- a. E-1368: Standard Practice for Visual Inspection of Asbestos Abatement Projects.

2. United States Department of Transportation (DOT)

- a. 49 CFR 171: General Information, Regulations, and Definitions.
- b. 49 CFR 172: Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response information, and Training Requirements.
- c. 49 CFR 173: Shippers – General Requirements for Shipments and Packaging.
- d. 49 CFR 178: Specifications and Packaging.

3. New York State Department of Environmental Conservation (NYSDEC)

- a. 6 NYCRR Part 360: Solid Waste Regulations.
- b. 6 NYCRR Part 364: Waste Transportation Regulations.
- c. 6 NYCRR Part 370-374 and 376: Hazardous Waste Regulations.

4. New York State Department of Health (NYSDOH)

- a. 10 NYCRR 55-2: Approval of Laboratories Performing Environmental Analysis.
- b. Environmental Laboratory Accreditation Program (ELAP).

5. United States Environmental Protection Agency (EPA)

- a. 40 CFR 61: National Emission Standards for Hazardous Air Pollutants (NESHAP).
- b. 40 CFR 260-263: Hazardous Waste Regulations.
- c. 40 CFR 302: Designation, Reportable Quantities, and Notification.
- d. 40 CFR 763: Asbestos Hazard Emergency Response Act (AHERA).

6. National Institute for Occupational Safety and Health (NIOSH):

- a. Method 7400: Asbestos and Other Fibers by PCM.
- b. Method 7401: Asbestos by TEM.

7. New York State Department of Labor (NYSDOL)

- a. 12 NYCRR 56: Asbestos Rules and Regulations.

8. Occupational Safety and Health Administration (OSHA)

- a. 29 CFR 1910: Occupational Safety and Health Standards.

- b. 29 CFR 1926.65: Hazardous Waste Operations and Emergency Response.
 - c. 29 CFR 1910.134: Respiratory Protection Standard.
 - d. 29 CFR 1910.1001: Asbestos Standard for General Industry.
 - e. 29 CFR 1910.1200: Hazard Communication Standard.
 - f. 29 CFR 1926: Safety and Health Regulations for Construction Industry.
 - g. 29 CFR 1926.1101: Asbestos Standard for the Construction Industry.
- 9. Underwriters Laboratories, Inc. (UL)
 - a. UL 586: Standard for Safety High-Efficiency Particulate Air Filter Units.
- B. The laboratory used for testing shall be ELAP certified for all required parameters.
- C. All treatment, storage and disposal facilities (TSDF) and recycling facilities and transporters which the Contractor intends to use to treat and/or transport and dispose ACM hereunder shall be approved for use by the Engineer prior to any removal from the Work Site. The Engineer reserves the right to inspect Contractor's transporters, equipment storage facility and the TSDF at any time prior to, or subsequent to, the award of this Contract.
- D. Should any problems arise regarding the Engineer-approved TSDF or recycling facility chosen to accept the ACM for treatment and disposal that would require the return of such ACM to Contractor or the Town or should such Engineer-approved TSDF or recycling facility have violated any environmental regulation which would result in any regulatory enforcement action, immediately notify the Engineer and Town in writing of such situation, and make provisions for the lawful storage of the ACM, until an alternate TSDF or recycling facility can be located by Contractor and approved by the Engineer.
- E. Employ a certified NYSDOL Asbestos Abatement Supervisor on-site at all times during the Work and ensure that all employees, including Subcontractors, are qualified and experienced in the work of preparing and removing and disposing of the ACM, which they shall perform under this Contract. All employees shall be NYSDOL certified Asbestos Handlers and be knowledgeable in the pertinent environmental regulations and in personal protection and other safety procedures.
- F. Before using any Subcontractor(s) to perform any of the other ACM work under this Specification, including laboratory work, submit an executed "Statement of Qualifications of Asbestos Abatement Subcontractor" for each such Subcontractor.
- G. Hazardous Waste: Contractor and/or its Subcontractors involved in any activity that relates to the handling, storage, or disposal of hazardous waste shall demonstrate a minimum two (2) years of experience in hazardous waste management.
- H. The Subcontractor(s) transporting hazardous waste shall be considered Hazardous Waste Subcontractor(s).
- I. Submit an executed "Statement of Qualifications of Hazardous Waste Subcontractor" for each such Subcontractor before using any Subcontractor(s) to conduct any hazardous waste management including laboratory work.
- J. Provide documentation that the minimum insurance criteria have been met.

- K. Identify all legal or administrative actions or proceedings in which Contractor (or any proposed Sub-consultants) or Subcontractor(s) and testing laboratory has been involved within the last five (5) years which were brought by the EPA, NYSDEC, OSHA or any other agency having safety, health or environmental responsibilities or functions.
- L. Scheduling: The Contractor shall coordinate and schedule all phases of the Work to be performed under this Section with the Town, subcontractors, material suppliers, and other parties as necessary to ensure the proper execution of the Work.
- M. Compliance: In addition to the detailed requirements of this Section, the Contractor shall comply with all applicable regulations of federal, state, and local authorities pertaining to the disturbance, Abatement, removal, construction/demolition, handling, storage, transportation, and disposal of ACM and asbestos wastes. All materials regarding the interpretation of any regulations, standards, or policies shall be submitted to the Engineer for resolution before starting the Work. Where the requirements of this Section, or federal, state, or local regulations conflict or vary, the most stringent requirements or regulations shall apply.
- N. The Town reserves the right to reject items incorporated into the Work, which fail to meet the specified minimum requirements. The Town also reserves the right to reject Contractor submittal items that are deemed inappropriate or unacceptable by the Engineer or Town. Submittal items that may be deemed inappropriate or unacceptable include proposed vendors or subcontractors with previous regulatory citations/violations. The Town further reserves the right, and without prejudice to other recourse, to accept non-complying items subject to an adjustment in the Contract amount, as approved by the Town.
- O. Qualifications
 - 1. Contractor (Asbestos Abatement Company): The Contractor shall possess a current NYSDOL asbestos license and shall have successfully completed at least two (2) Asbestos Projects of comparable scope and methodologies to the work being performed under this Section within the past three (3) years. This experience shall be documented by identifying the following: (a) the name, address, and phone number of each facility where the work was performed; (b) the name of the individual representing the owner at each facility; (c) the types of facilities where the work was performed; (d) the volume and type of each material that was abated; (e) the specific methods of Abatement used at each facility (including the tools, technologies, and engineering controls employed);
 - 2. Asbestos Supervisor: The Contractor shall have on staff and assigned to this Contract an Asbestos Supervisor. The Asbestos Supervisor shall be currently certified by the NYSDOL. In addition, the Asbestos Supervisor shall have a minimum of two (2) years' experience on Asbestos Projects and shall have served as the Asbestos Supervisor on at least three (3) Asbestos Projects of comparable scope and methodologies to the work being performed under this Section.
 - 3. Asbestos Handler: The Contractor shall have on staff and assigned to this Contract a sufficient number of experienced and properly trained Asbestos Handlers. Asbestos Handlers shall be currently certified by the NYSDOL and

shall have a minimum of one (1) year of experience on Asbestos Projects and shall have worked on at least three (3) Asbestos Projects of comparable scope and methodologies to the work being performed under this Section.

1.8 SUBMITTALS

A. Pre-Abatement Submittals:

1. Contractor's Asbestos Handling License issued by NYSDOL.
2. Asbestos Site-Specific Variances, as applicable. If a site-specific variance is sought, submit the following:
 - a. One copy of the completed DOSH-751 and DOSH-465 forms.
 - b. One copy of the NYSDOL site-specific variance decision.
3. Asbestos Project Notice to be posted at the building prior to the start of work as required by NYSDOL Code Rule 56.
4. EPA Notification of Demolition and Renovation, as applicable.
5. NYSDOL Project Notification.
6. SDS for all chemicals, solvents, products and materials to be utilized during the Work.
7. Manufacturer's specifications / certifications and installation instructions for all materials and equipment to be utilized during the Work.
8. Written notifications to local fire, rescue, and emergency services informing them of the nature and schedule of Work at the Site.
9. List of contact persons and emergency phone numbers for Contractor personnel to be posted at the Site.
10. Asbestos abatement personnel documentation, including:
 - a. NYSDOL worker training certifications.
 - b. NYSDOH 2832 asbestos training certificates.
 - c. Medical examinations / evaluations documentation.
 - d. Respirator fit test documentation.
 - e. OSHA 10-hour training certifications.
11. Waste Transporter Permit: One copy of the transporter's current, valid NYSDEC Part 364 waste transporter permit.
12. Landfill: Landfill to be used for ACM disposal must be licensed to receive asbestos wastes by NYSDEC (Part 360 Permit) and by EPA. Out of state landfills must provide licenses from relevant local agencies having jurisdiction.
13. Analytical Laboratory Qualifications for Analyzing Suspect Potential ACM and PCM Air Samples.
14. Asbestos Abatement Work Plan: Each Contractor that will disturb ACM during the course of Work to be performed under this Section shall submit a detailed, project-specific Asbestos Abatement Plan that addresses work procedures and equipment to be used during the disturbance, removal, handling, collection, and disposal of ACM and asbestos wastes. Work requiring an Asbestos Abatement Plan includes, but is not limited to, Abatement, spot removal, and construction/demolition activities. The Asbestos Abatement Plan shall be prepared in accordance with OSHA Construction Standards and all other pertinent federal, state, and local regulations. The Asbestos Abatement Plan shall also be signed and dated by a CIH or other qualified safety professional.

B. Asbestos Work Closeout Submittals:

1. Waste shipment records and disposal site receipts: Copy of waste shipment record and disposal site receipt, for each shipment, showing that the ACM has been properly disposed. Waste
2. Daily Log: Submit copy of Asbestos Abatement Contractor Supervisor's Daily project log, including entry/exit logs, organized by date.
3. On company letterhead, provide a detailed written description of location, type and start/completion dates for each asbestos abatement work area.
4. Air monitoring data: Submit copies of air sampling results and chain-of-custody forms.
5. Copies of any variances or amendments obtained during the course of the Work.

PART 2 - MATERIALS

2.1 EQUIPMENT AND MATERIALS

- A. Furnish all labor, materials, services, permits, and equipment necessary to carry out the ACM removal and disposal activities (which includes removal, handling, storing, transporting, and off-site disposal of ACM and asbestos wastes).
- B. The following equipment and material shall be used, at a minimum, for proper execution of the Asbestos Abatement work. Additional equipment and materials shall be used, as required, for activities to be conducted in accordance with applicable regulations. The use of additional or alternate materials and equipment shall be included in the Asbestos Abatement Plan and shall be subject to review. All equipment and materials shall be in new or "like new" condition and in good working order:
 1. Respiratory Protection: In accordance with the approved Respiratory Protection Program contained in the Asbestos Abatement Plan
 2. PPE: The Contractor shall provide personnel who have a potential to be exposed to materials or wastes containing contaminants, with appropriate PPE as prescribed by the Contractor's CIH or qualified safety personnel.
 3. HEPA Vacuum Filtration Systems: All vacuum equipment employed in the Work Site shall utilize HEPA filtration systems that are 99.97-percent efficient to capture 0.3-micron particulate size. Vacuums shall be equipped with appropriate size brushes, crevice tools and other angular tools necessary for proper cleaning of all surfaces.
 4. Decontaminated Wastewater Filtration System: As a minimum, the system shall contain a three-stage filtering system with a final filter no greater than 0.5-micron.
 5. As a minimum, two (2) layers of securely attached 6-mil PVC sheeting shall be used to cover the Work Site. The sheeting shall extend 20-feet from the edge of

the Work Site and 20-feet from the base of the container used for off-site disposal and must be secured to the ground.

6. Off-site waste transportation containers shall be EPA and USDOT approved solid enclosed containers, lined with two layers of 6-mil PVC sheeting and locked and secured at all times.
7. Temporary electrical cords and outlets shall be of an approved type, connected to a source of power outside of the Work Site, and protected by a ground fault circuit interrupter (GFCI).
8. Disposable Bags: Minimum 6 mil thick, black, and preprinted with a Caution Label that is in compliance with OSHA 29 CFR 1926.1101(k)(8).
9. Glove Bags: 6 mil thick, clear, fire retardant polyethylene. Select glove bag sizes as appropriate for the size and location of the Work.
10. Negative Air Pressure Units: Local exhaust system, capable of maintaining negative air pressure within the containment, and provides for HEPA filtration of efficiency not less than 99.97 percent with 0.3-micron particles. Equip the unit(s) with filter alarm lights and operation time meter.
11. Plastic Sheeting: Minimum 6 mil thick, clear, fire retardant polyethylene.
12. Piping Insulation: Commercially available lag cloth specifically designed to repair and/or cover asbestos insulation.
13. Other Equipment:
 - a. Temporary lighting, heating, hot water units and all other equipment shall be Underwriter's Laboratories (UL) listed.
 - b. All electrical equipment shall be in compliance with the National Electric Code (NEC), Article 590 – Temporary Wiring.

PART 3 - EXECUTION

3.1 PREPARATION

- A. For each Regulated Work Area, abatement workers will demarcate the area by placing asbestos-warning barrier tape at least 25 feet around the perimeter of each component to be abated. Then caution signs will be posted that meet the specifications of OSHA 29 CFR 1910.1001 at the locations and approaches to locations where airborne concentrations of asbestos may exceed ambient background levels. Signs will be posted at a distance sufficiently far away from the work area to permit an employee to read the sign and take the necessary protective measures to avoid exposure. Windows, vents, or doors associated with buildings within the regulated area and close to the asbestos will be treated as a

critical barrier and covered with two layers of 6-mil reinforced polyethylene sheeting. These critical barriers will be constructed to prevent gross asbestos debris from accidentally entering the building during removal activities. After establishing a taped barrier, decontamination unit will be constructed according to NYSDOL Code Rule 56. A single decontamination unit may be used for abatement of multiple components within one regulated area.

- B. **Worker Decontamination Unit:** A worker decontamination facility will be constructed and prepared in accordance with NYSDOL Code Rule 56 and will consist of an equipment room, shower room, and clean room. The constructed decontamination unit will be supported by 2-inch by 4-inch studs. If the decontamination unit is located outdoors, it will be enclosed in plywood. Each space will be clearly identified and separated from the others by plastic sheet doors arranged to minimize fiber and air transfer as people pass between areas. Each room will have an interior measurement of 4 feet by 4 feet, and the clean room will have floor area of at least 32 square feet (SF) for up to six abatement workers. Air locks will have three alternating layers of 6-mil polyethylene sheeting and the flaps will be weighted to fall back in place after the passage of workers.
1. **Clean Room:** This area will be for persons to remove and leave street clothes and put on clean disposable coveralls. Approved respiratory protection equipment will be stored in this area. The floor of the clean room will be kept dry. At the end of each shift, the room will be cleaned using wet rags. No ACM will be allowed in this room.
 2. **Shower Room:** This area will be used by workers when they leave the work area and after undressing in the equipment room. Cleanly dressed workers heading for the work area from the clean room will pass through the shower room. The shower room will include a completely watertight operational shower. The shower will be constructed so that water leakage is minimized. Any leaking water will be cleaned up immediately. Showers will be equipped with hot and cold running water and soap, and sufficient disposal towels for the number of workers at the job site. The water shut-off and drain pump operation controls will be arranged so that an individual can shower without assistance from either inside or outside the work area. Contaminated water will be pumped into a drain provided with an in-line 5-micron water filter.
 3. **Equipment Room:** An area where workers coming out of or from a work area can remove personal protective equipment (PPE) (with the exception of respirators) before proceeding into the shower. This room is not intended for storage of ACM and will be kept clean. This room is to be cleaned at least once per shift, using wet methods.
- C. **Utilities:** The temporary use of any on-site utilities shall be subject to the approval of the Town. The Contractor shall furnish all water and hoses needed for the Work, as well as any temporary hookups. Also, the Contractor shall supply all heating equipment and water filtration devices needed for the Work. In addition, all temporary lighting and temporary electrical service to a Regulated Work Area shall be provided by the Contractor and shall be in weather-proof enclosures and be ground fault protected.

- D. Signs: The Contractor shall post conspicuous warning signs at all approaches to work areas and waste storage areas. The signs shall be located at such a distance so that personnel may read the sign and take the necessary precautions before entering a work area or waste storage area. Signs shall comply with the requirements of federal, state, and local regulations. Once Clearance Air Monitoring results indicate that a Project Monitor is in compliance with the provisions for re-occupancy set forth in 12 NYCRR 56, the signs shall be removed. At a minimum, each sign shall bear the following information in English and the predominant language that is spoken by the Contractor's employees if English is not spoken:

**DANGER
ASBESTOS CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA
NO SMOKING**

- E. Fire Extinguishers: The Contractor shall maintain at least two functional fire extinguishers in each Restricted Area. The fire extinguishers shall have a minimum rating of 2-A:10-B:C, and each fire extinguisher shall be checked daily by the Asbestos Handler Supervisor to ensure that it remains functional throughout the duration of the Asbestos Project.

3.2 AIR MONITORING

- A. Air monitoring shall be conducted by the air monitor in accordance with OSHA and as defined in this Section.
1. Area Air Monitoring: Area air samples will be collected by a third party (not affiliated with abatement contractor) Project Monitor/Air Sampling Technician in accordance with NYSDOL Code Rule 56.
 2. Personnel Monitoring: Personnel samples shall be collected on no less than 25% of the abatement workers. Personnel samples will be collected and analyzed in accordance with NIOSH Method 7400 (PCM). Results will be posted on site prior to the next work shift.
 - a. The Contractor shall collect personal air samples from employees who are anticipated to have the greatest risk of exposure, as determined by the Contractor. Exposure Monitoring shall be conducted during each phase of the Asbestos Project (e.g., pre-abatement, Abatement, and cleanup) for one (1) work shift from at least one (1) employee that is representative of each type of work task that is being performed. Each personal air sample will "run" for the employee's entire work shift in order to ensure that enough volume (of air) is collected, and an accurate 8-hour TWA can be calculated. Documentation regarding the sample numbers, specific shift when the sampling was conducted, the work tasks that were sampled, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory chain-of-custody form.
 - b. If at any time, PCM analysis of any air sample (i.e., from Exposure Monitoring performed by the Contractor) in any phase of the Asbestos

Project (i.e., pre-abatement, Abatement, cleanup, or clearance) indicates that the filter was “overloaded” and a fiber count cannot be obtained, the sample shall immediately undergo TEM analysis. All costs of the additional TEM analysis will be at the Contractor’s expense.

3. Final Clearance: The Project Monitor and Abatement Supervisor will conduct the final clearance inspection following each phase of the abatement. The Project Monitor / Air Sampling Technician shall collect final clearance air samples in accordance with NYSDOL Code Rule 56 following each phase of the abatement work. All Clearance Air Monitoring results shall meet or be below background ambient air levels or 0.01 f/cc of air (whichever is greater), prior to the breakdown of the Containment. If Clearance Air Monitoring results indicate a fiber count greater than background ambient air levels or 0.01 f/cc of air in any area, the Contractor will be required to re-clean that area. Repeated cycles of cleaning and Clearance Air Monitoring will be performed until a fiber count is achieved that meets or is below background ambient air levels or 0.01 f/cc of air within the area. All costs of re-cleaning and additional Clearance Air Monitoring will be at the Contractor's expense.
4. Documentation: Complete documentation of all air monitoring activities shall be in accordance with this Section.
5. The Contractor shall submit all air monitoring results to the Town as soon as possible, but no later than five (5) calendar days from when the air samples were collected.

3.3 BULK REMOVAL

- A. Protection of Existing Work to Remain: All Work involving the disturbance ACM must be conducted without damage to, or contamination of equipment or surfaces within the work areas or other areas adjacent to the work areas. All such damage or contamination shall be immediately corrected and cleaned up by the Contractor at the Contractor's expense.
- B. Containments and Negative Air Pressure Equipment: Pressure differential readings for each workday shall be obtained and reviewed by the Asbestos Supervisor on a daily basis. All readings shall be documented and kept in the Contractor’s Project Record, as required in this Section. The Asbestos Supervisor shall notify the Engineer and the Town immediately, if any variations in the pressure differential readings may have led to the migration of asbestos fibers outside of a Regulated Work Area. Corrective actions shall be implemented immediately to ensure that negative pressure is restored.
- C. Personnel Decontamination Enclosure System: The Contractor shall ensure that employees do not leave a Regulated Work Area wearing any potentially contaminated protective work clothing or PPE. Employees are required to shower prior to leaving the Regulated Work Area.

- D. Workplace Entry and Exit Procedures: Workers and authorized personnel will enter the regulated area through the decontamination unit. Before entering the regulated area, personnel will read and be familiar with posted regulations, personal protection requirements (including workplace entry and exit procedures), and emergency procedures. Personnel will proceed first to the designated clean area, remove street clothes, and appropriately don respiratory protection, disposable coveralls, head covering, and foot covering. Hard hats, eye protection, and gloves will also be utilized. Clean respirators and protective clothing will be provided and utilized by each person for each separate entry into the work area. Before leaving the regulated area, personnel will remove gross contamination from the outside of respirators and protective clothing by brushing and wet wiping procedures. Small HEPA vacuums with brush attachments may be utilized for this purpose. Any reusable, contaminated footwear will be stored in the work area. Upon completion of abatement, it will be disposed of as asbestos-contaminated waste. Only rubber boots will be decontaminated at the completion of the abatement, for reuse. After removing disposable clothing and while still wearing respirators, personnel will proceed to the contractor's portable shower unit and clean the outside of the respirator and any exposed face area under running water prior to removal of respirator, then shower and shampoo to remove potential residual asbestos contamination. The asbestos waste from the shower will flow through a cartridge filter.
- E. Abatement Procedures: The following provides step-by-step procedures to complete asbestos abatement at the site. The procedures shall not be implemented until the pre-abatement preparation procedures as outlined under Article 3.1 are completed:
1. Wrap and Cut: This method refers to the procedure of wrapping the pipe, cutting it into manageable sections, and lowering the pipe to the ground. However, this method will be used at the discretion of the Abatement Supervisor. Larger diameter pipes will require removal by wet methods (see procedure 2 below). Pipes that are not isolated (e.g., pipes in runs containing multiple insulated lines or in close proximity to insulated process equipment) may also be abated by wet methods. In areas where pipe insulation is severely damaged, the insulation can either be removed by wet methods or repaired using wet lagging techniques. Once the integrity of the pipe jacket and insulation is secure, then the pipe will be wrapped with two layers of 6-mil nylon-reinforced polyethylene sheeting. Prior to cutting the pipe, a 2 linear foot section of insulation will be abated using the glovebag method. Glovebag removal will be performed on pipe lengths of at least 6 feet, but no more than 15 feet. The length will depend on the diameter of the pipe. The exposed ends of the insulation where the glovebag was performed will be sealed with expansion foam or equivalent. The exposed pipe where the glovebag was performed will be sprayed with a tinted lock-down encapsulant. The pipe will then be sheared at each of the exposed 2 linear foot sections. Cutting must be performed using non-sparking tools. The use of torches to cut pipes will not be allowed. The piping must be properly labeled prior to disposal. During all manipulations of the pipe section, the piping and associated structures shall be stabilized to prevent accidental dropping of pipe or ACM debris. In the event of a release, the Contractor will immediately spray material with amended solution. The gross debris will be physically removed, double-bagged, and disposed of as asbestos-containing waste.
 2. Gross Removal Techniques (Wet Methods): A floor layer of 6- mil nylon-reinforced polyethylene sheeting will be placed under (if possible) and around

the component to be abated. While wetting the material, the material will be removed and immediately placed into a 6-mil polyethylene disposal bag that is properly labeled. The bag will be wet wiped or vacuumed with a unit containing a HEPA filter. After exterior cleaning, the bag will then be placed into a second 6-mil bag, gooseneck tied, and transported to an on-site disposal container. Waste must be removed from the work area and deposited in a designated area or inside the waste container as work progresses. The floor polyethylene (sheeting) and floor gross debris must also be kept wet during the removal process. Gross floor debris must be removed as soon as possible. Material that has become loose during the abatement process will either be removed or covered with polyethylene sheeting prior to the end of the work shift. At least one worker will be dedicated to spray amended water on the insulation and adjacent surfaces. After removal, the substrate component and floor polyethylene will be fine cleaned and visually inspected for any gross debris. Should no gross debris be observed, then the substrate will be sprayed with a tinted lock-down encapsulant. Polyethylene sheeting associated with flooring do not require an application of a lock-down encapsulant. Floor sheeting will be disposed as asbestos-containing waste.

3. Non-Friable Asbestos Removal Methods: While the material is wet, fasteners (bolts, nails, etc.) supporting the material will be removed. The materials will be placed in a dumpster lined with two layers of 6-mil nylon-reinforced polyethylene sheeting. The materials will be properly labeled for disposal. If breakage occurs, the debris will be removed wet and placed into two 6-mil polyethylene bags for disposal. Removal will be performed in accordance with OSHA 1910.1001 and 1926.1101.

F. Safe Work Practices for Trace Asbestos Materials: During the disturbance, cleanup, and disposal of trace asbestos materials (i.e., Building Materials containing less than or equal to 1% of asbestos):

1. The Contractor shall adhere to the following standards: An exposure assessment shall be performed in accordance with 29 CFR 1926.1101(f) (2) (i) to determine if workers disturbing, handling, or performing cleanup activities involving trace asbestos materials, must wear PPE or respiratory protection.
2. Wetting agents or special work methods shall be utilized to control potential employee exposures to asbestos during the handling, mixing, removing, cutting, application, or cleanup, of trace asbestos materials, except if the use of these wetting agents/work methods is not feasible (e.g., using them may create electrical hazards or equipment malfunctions).
3. Asbestos-contaminated wastes and debris shall be cleaned-up promptly and disposed of in leak-tight containers. The handling, disposal, and transport of trace asbestos-containing material wastes is not regulated since the wastes are not ACM (i.e., they do not contain greater than 1% asbestos).
4. The use of high-speed abrasive saws that are not equipped with “point-of-cut” ventilators or enclosures with HEPA-filtered exhaust air shall be prohibited.

5. The use of compressed air to cleanup or remove trace asbestos materials is strictly prohibited.

3.4 CLEANUP AND DISPOSAL

- A. Cleanup: All cleaning work shall progress from the point most remote from the intakes of the Negative Air Pressure Equipment, towards the intakes of the equipment, as well as from the highest point of the surfaces to be cleaned towards the lowest point of the surfaces. The Contractor shall maintain all surfaces, including protective tarps, polyethylene sheeting, and coverings within each Regulated Work Area, free of accumulations of dusts, wastes, and debris. The Contractor shall perform housekeeping activities daily throughout each work shift and at the end of each work shift, in order to prevent any accumulation of dusts, wastes, and debris in these areas. Dry sweeping and using compressed air to cleanup a Regulated Work Area is strictly prohibited. HEPA-filtered vacuums and wet cleaning methods shall be used to ensure that these areas remain free of visible dust and debris. In addition, only cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the materials or as approved by the Town, shall be used.
- B. Collection, Containerization, and Filtration of Wastes: The Contractor shall collect and containerize asbestos waste (solid and liquid), debris, PPE, and containment materials on a daily basis in accordance with the Asbestos Abatement Plan. Using chutes to move construction debris or waste (bagged or not bagged) is strictly prohibited.
 1. Prior to containerizing ACM waste materials, the wastes shall be “adequately wetted,” and wrapped in 6-mil (0.006”) polyethylene sheeting, or double-bagged in 6-mil polyethylene bags. The bags shall be “goose necked” and sealed airtight with duct tape, and each bag (or wrapped item) shall be labeled with the appropriate OSHA warning label for asbestos and must also bear the generator label as required by the EPA NESHAP standard.
 2. Corrugated cartons or drums may be used in conjunction with polyethylene bags and sheeting for the disposal of ACM waste that have sharp-edged components (e.g., nails, screws, or tin sheeting) which may tear the bags or sheeting. The waste within these drums or cartons must be wrapped or double-bagged in accordance with this Section. In addition, the cartons/drums must be labeled in accordance with this Section.
 3. Wastewater derived from the Asbestos Project shall be collected and filtered through a system with at least a 5.0-micron particle size collection capability. A system containing a series of several filters with progressively smaller pore sizes shall be used to avoid the rapid clogging of the filtration system by large particles. Contaminated filters shall be disposed of as asbestos waste. Filtered wastewater shall be discharged in accordance with all applicable federal, state, and local regulations.
 4. The Contractor shall store all bagged Asbestos-Containing Waste Materials in DOT-approved container systems (e.g., a roll-off or trailer). No container shall be filled in excess of the capacity marked on the container, and all containers

shall be lined with 6-mil (0.006”) polyethylene sheeting, have a hard top, and shall be locking in addition to meeting any other federal, state, and local asbestos waste storage requirements. In addition, all containers shall have an intact and legible label affixed to it in accordance with this Section. No bagged asbestos waste shall be stored in a Regulated Work Area or decontamination enclosure system for longer than the current work shift that generated the waste.

5. Non-Asbestos Waste: The Contractor shall store non-asbestos waste materials separately from asbestos-containing wastes, shall provide all non-asbestos waste non-asbestos wastes in accordance with federal, state, and local regulations.
- C. Labeling: The Contractor shall affix warning labels to all asbestos waste disposal bags, wrapped items, and containers (i.e., drums, dumpsters, trailers, or roll-offs). Labels shall comply with the requirements of federal, state, and local regulations. At a minimum, each label on disposal containers/bags/items shall bear the following information in English:

**DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
[GENERATOR NAME, ADDRESS, TELEPHONE NUMBER]**

- D. Final Visual Inspection and Clearance Air Monitoring: The independent third-party monitor shall not conduct clearance air monitoring until the Regulated Work Area has been inspected by the Asbestos Supervisor and the Project Monitor has performed the final visual inspection. During this inspection, the Asbestos Supervisor and the Project Monitor shall determine if the following has been achieved: (a) all ACM and asbestos waste materials have been abated and removed from the area; (b) the area is clean and dry; (c) Critical Barriers and Isolation Barriers are intact; (d) Negative Air Pressure Equipment is turned on and functioning. If any of these items have not been achieved, the Contractor shall perform the necessary corrective actions to achieve compliance before conducting the Clearance Air Monitoring.
- E. Breakdown of Regulated Work Area: Critical Barriers shall not be removed, and Negative Air Pressure Equipment shall not be turned off until clearance air monitoring results meet the criteria specified in this Section and NYSDOL Code Rule 56.
- F. Disposal of Wastes: The Contractor shall notify the Town at least five business days prior to the removal of any waste containers, so that the Town can inspect the containers and the waste manifests. Asbestos-containing wastes shall be disposed of to ensure that containers do not remain on the job site for longer than necessary. Containers that have reached their storage capacity shall not remain on site and transportation arrangements shall be made for their removal.
- G. Disposal Records: The Contractor shall submit written evidence that the landfill receiving Asbestos-Containing Waste Materials is approved by federal, state, and local regulatory agencies to receive the wastes. If regulated PCBs (as defined in Section 02 84 00 – PCB Removal) were detected in the wastes, the contractor will also ensure that the landfill is approved by federal, state, and local regulatory agencies to receive PCB-regulated wastes. The Contractor shall submit one (1) copy of the completed manifest that has been signed

and dated by the initial transporter and landfill in accordance with 6 NYCRR 372 and 40 CFR 262, to the Town.

END OF SECTION 02 82 13

SECTION 02 83 33 – LEAD PAINT MANAGEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements for furnishing all tools, personnel, equipment, safety devices, spill prevention, and cleanup materials as required for the Work to be performed and for the removal/disturbance and disposal of lead-based paint (LBP) containing waste. This shall include, but is not limited to, industrial vacuum cleaning equipment, equipped with high efficiency particulate air (HEPA) filters capable of removing paint waste, and providing personal protective equipment (PPE) to all personnel who will enter the Work Site or who will be in contact with hazardous waste. Contractor is also required to provide protective equipment to persons outside of their employment who may be required to visit the Work Site.
- B. Materials containing LBP potentially impacted during this construction are summarized in Table 1 below. Contractor shall determine from the Contract Drawings and Contract Documents which of the items listed in Table 1 will be disposed in accordance with this Section. A LBP survey should be performed of all areas that were inaccessible or hidden during previous surveys and may be disturbed within the limits of the Work as specified herein, and manage all LBP identified.

Table 1: Confirmed LBP

Location	Room	Object	Color	Condition	Lead (mg/cm ²)
Old Town Hall Building	Upper Floor Lobby	Door Threshold	Black	Intact	1.12
Old Town Hall Building	Upper Floor Supervisor's Office	Wall Baseboard	Black	Intact	1.43
Old Town Hall Building	Upper Floor Supervisor's Office	Wall	White	Intact	2.64
Old Town Hall Building	Upper Floor Justice Department	Wall Baseboard	Black	Intact	1.65
Old Town Hall Building	Upper Floor Justice Department	Wall Baseboard	Black	Intact	3.76
Old Town Hall Building	Lower Floor Eastern Corridor	Wall	Yellow	Intact	2
Old Town Hall Building	Lower Floor Cell Blocks	Door Security Bars	Black	Intact	1.35

Location	Room	Object	Color	Condition	Lead (mg/cm ²)
Old Town Hall Building	Lower Floor Cell Blocks	Door Security Bars	Black	Intact	1.06
Old Town Hall Building	Lower Level Police Storage	Wall	Tan	Intact	1
Old Town Hall Building	Lower Level IT Communications Room	Wall	Green	Intact	1
Old Town Hall Building	Lower Level IT Communications Room	Wall	White	Intact	1
Old Town Hall Building	Lower Level Town Attorney Office	Beam	White	Intact	1.91
Old Town Hall Building	Lower Level Town Attorney Office	Electric Panel	Grey	Intact	1.76
Old Town Hall Building	Lower Level Town Attorney Office	Door	White	Intact	1
Old Town Hall Building	Lower Level Town Attorney Office	Door	White	Intact	1
Old Town Hall Building	Interior Stairway	Stair Stringer	Black	Intact	1.41
Old Town Hall Building	Interior Stairway	Stair Stringer	Black	Intact	2.43

- C. Specifically, the scope of this Work is to include areas associated with the Old Town Hall Building.
- D. The Work specifies utilization of management methods and containment systems, as required, to eliminate or minimize the risk of worker and community exposure to lead dust/debris generated during LBP disturbance. The Work also specifies disposal requirements that conform to all applicable Federal, State and local laws and regulations. LBP management work shall include the disturbance, removal, and off-site management of LBP associated with the construction Work described herein. The LBP shall be removed intact on the components, with a minimal disruption to the painted surface or shall be removed from the components expected to be disturbed during construction.
- E. LBP materials should be abated as specified prior to cutting, drilling, abrading, or altering any painted components of these structures.
- F. It is not necessary to remove all LBP from impacted components.
- G. All materials associated with LBP removal, including LBP chips and spent sand blast media containing lead should be considered contaminated and must be managed properly.

The material associated with LBP removal shall be managed in accordance with United States Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) regulations. Contractor shall be responsible for obtaining all required permits and/or approvals for their selected LBP management method(s).

- H. If Contractor uses Subcontractor(s) to perform any of the Work specified herein including laboratory work and waste disposal, this Section shall apply to all such Subcontractor(s) as if specifically referred to herein.
- I. Contractor or its Subcontractor(s) shall perform all Work necessary to carry out the proper identification, removal, collection, handling, storage, classification, testing, transportation, and disposal of LBP in accordance with all applicable Federal, State, and local laws, codes, rules, and regulations, and the requirements of this Specification.
- J. Contractor is required to field verify all job conditions, quantities, and locations of LBP which will be impacted as part of the Work. Testing and assessment of LBP shall be done as specified in this Section.
- K. Certified Industrial Hygienist (CIH) or other qualified safety professional should be employed to prepare a site-specific Construction Health and Safety Plan (CHASP) and Safe Work Plan (SWP), and to develop a personal air monitoring program in accordance with 29 CFR 1926.62, good industrial hygiene practices, and the requirements stated herein.
- L. The Contractor shall provide, upon review by the Engineer, an original signed Certificate for Removal of all LBP. No removal and disposal activities shall take place without this signed Certificate for Removal prominently posted at the Work Site. All activities involving the removal of LBP must end upon expiration of the Certificate for Removal; Work cannot resume until a request for a certificate renewal has been submitted.
- M. The surfaces on which paint removal activities are to take place may have a number of different existing coatings applied to various substrate materials. The Contractor shall determine which of the removal systems specified herein to use. Where the Contractor determines that a system, which is not listed, would be better suited to the Work, the Contractor shall submit that proposed system to the Engineer for approval. The Contractor shall also arrange for a field demonstration of the proposed system at no cost to the Town. If a substitute system is approved, there will be no additional cost to the Town. Manufacturer instructions and recommendations shall be strictly followed.

1.2 GENERAL INFORMATION AND REQUIREMENTS

- A. The Contractor is responsible for assuring compliance with all applicable Federal and State regulations and policies in place at the time of construction. This includes, but is not limited to, any Federal or State modifications to sampling or analytical methods, standards, or policies specified herein.
- B. This Section details the requirements for construction and demolition activities affecting materials and structures coated with or containing Lead or other heavy metals as shown on the Drawings, specified herein, or required to complete the Work, including all affected

coatings identified and impacted by the Work. All Work to be performed under this Section shall be performed using methods, tools, and equipment that have demonstrated effectiveness in preventing airborne emissions from migrating outside of work areas.

1. Coated material and structures may contain other heavy metals in addition to Lead. Where Lead is discussed in this Section, the Contractor shall consider other heavy metals (i.e. arsenic, cadmium, chromium, etc.)

Additional information regarding LBP is available in a Limited HAZMAT Survey Report prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C. and dated September 16, 2020.

- C. For construction and demolition activities affecting materials and structures that are coated with polychlorinated biphenyl (PCB)-containing paints or bitumastic coatings, and removal of fluorescent light ballasts, refer to Section 02 84 00 – PCB Material Removal.
- D. All Work under this Section shall be performed to minimize the creation of airborne emissions; minimize the quantity of hazardous waste generated; protect the health and safety of all site personnel and the welfare of the public; and avoid adverse environmental impacts.
- E. In the absence of analytical testing results for a specific painted/coated material, air monitoring and worker PPE requirements, including respiratory protection, shall address the potential presence of PCBs, Lead and heavy metals. Any unforeseen PCB or heavy metal-containing paints/coatings discovered during the Work to be performed under this Section shall be remediated as necessary to complete the Work in accordance with this Section.
- F. The Contractor shall perform all Work under this Section without damaging or contaminating adjacent areas to where the work is being performed. Where such areas are damaged or contaminated, as determined by the Engineer, the Contractor shall restore the areas to their original condition at no additional cost to the Town.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. PCB Material Removal Section 02 84 00

1.4 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. Limited HAZMAT Survey Report prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C., dated September 16, 2020.

1.5 DEFINITIONS

- A. NYSDOH: New York State Department of Health
- B. ELAP: Environmental Laboratory Approval Program
- C. RCRA: Resource Conservation and Recovery Act
- D. NYSDEC: New York State Department of Environmental Conservation
- E. PPE: Personal Protective Equipment
- F. OSHA: Occupational Safety and Health Administration
- G. EPA: United States Environmental Protection Agency
- H. USDOT: United States Department of Transportation

1.6 NOTED RESTRICTIONS

- A. Disturbance to the sheathing of the LBP components shall be kept to a minimum.
- B. The LBP components shall be placed together in 6-mil PVC lined, steel containers. LBP contaminated materials shall be kept separated from other contaminated materials removed from the Work Site.
- C. Crushing of the LBP components to facilitate transportation shall be conducted only after the component has been placed into the container.
- D. All systems components are assumed to be energized until confirmed to be deenergized.

1.7 SPECIAL REQUIREMENTS

- A. Commencement of Work: Five (5) business days prior to the proposed start of the work required under this Section at each separate location, the Contractor shall notify the Engineer and the onsite safety staff. No Work may proceed at any location until authorized by the Engineer.
- B. The Contractor shall coordinate any required equipment shutdowns with site operations personnel prior to starting the Work.
- C. Access Restrictions: The Contractor shall inform the Engineer and site operations personnel of proposed access restrictions (i.e., areas or items of equipment which will not be accessible during the proposed work), and give them estimated time frames (including specific dates) of such proposed access restrictions. The Contractor shall be aware that other contractors may be in any of the work areas associated with this Contract. As a result, the Contractor shall not have exclusive rights to any work area, and shall fully cooperate and coordinate this Work with the work of other contractors who may be on site. Therefore, the Contractor shall notify other contractors in advance of the disturbance, Abatement, removal, construction/demolition, and disposal Work included herein, to

provide them with sufficient time for coordination of interrelated items that are included in their contracts and that must be performed before, after, or in conjunction with the Work included under this Section.

- D. Unexpected Entry into a Lead Control Area: In the event that Town personnel must enter a Lead Control Area for reasons unrelated to the supervision or inspection of Work being performed under this Section (e.g., under emergency conditions), the Contractor shall immediately stop work and clean up any loose debris, so as to permit the safe entry by Town personnel. Any disturbance of paints/coatings, dusts, materials, or wastes that may potentially generate airborne concentrations of contaminants equal to or above an OSHA Action Level shall not proceed until all Town personnel have exited from the Lead Control Area.
- E. Meetings: The Contractor shall visit and investigate the site, review the Drawings, review this Section, and become familiar with any conditions, which may affect the Work, as part of the pre-construction meeting and site walk-through. The Contractor shall hold all meetings with appropriate parties as scheduled and as otherwise necessary to accomplish the Work to be performed under this Section. In addition to the pre-construction meeting and site walk-through, other meetings may be required or may be requested by the Engineer, including briefings with site operations personnel. Written documentation (i.e., "minutes") of all meetings shall be generated by the Contractor, and copies shall be provided to the Town within three (3) business days following each meeting.
- F. Payment for the disposal of Lead Wastes (with the exception of painted/coated scrap metal) will not be made until a signed copy of the manifest from the Treatment, Storage, and Disposal Facility (TSDF), certifying the amount of Lead Wastes delivered is returned with complete chain-of-custody (COC) documentation to the Town.

1.8 QUALITY ASSURANCE / QUALITY CONTROL

A. Regulatory Requirements

- 1. Code of Federal Regulations (CFR)
 - a. 29 CFR 1910 - Occupational Safety and Health Standards
 - b. 29 CFR 1926 - Safety and Health Regulations for Construction
 - c. 40 CFR 260-263 - Hazardous Waste Regulations
 - d. 49 CFR 171-180 - Hazardous Material Transportation Regulations
- 2. New York State Department of Environmental Conservation (NYSDEC)
 - a. 6 NYCRR Part 360 - Solid Waste Regulations
 - b. 6 NYCRR Part 364 - Waste Transportation Regulations
 - c. 6 NYCRR Part 370-374 and 376 - Hazardous Waste Regulations
- 3. New York State Department of Health (NYSDOH)
 - a. 173 .14 - Safety Standards for Lead-Based Paint Abatement
 - b. Environmental Laboratory Accreditation Program (ELAP)

4. United States Environmental Protection Agency (EPA)
 - a. 40 CFR 260-263 - Hazardous Waste Regulations
 - b. Method 1311 - Toxicity Characteristic Leaching Procedure (TCLP)
 - c. Resource Conservation and Recovery Act (RCRA)
- B. Comply with the OSHA Lead Construction Standard (29 CFR Part 1926.62) for Contractor personnel and Subcontractors.
- C. The laboratory used for testing shall be ELAP certified for all required parameters.
- D. All treatment, storage and disposal facilities (TSDF) and recycling facilities and transporters which the Contractor intends to use to treat and/or transport and dispose LBP hereunder shall be approved for use by the Engineer prior to any removal from the Work Site. The Engineer reserves the right to inspect Contractor's transporters, equipment storage facility and the TSDF at any time prior to, or subsequent to, the award of this Contract.
- E. Should any problems arise regarding the Engineer-approved TSDF or recycling facility chosen to accept the LBP for treatment and disposal that would require the return of such LBP to Contractor or the Town or should such Engineer-approved TSDF or recycling facility have violated any environmental regulation which would result in any regulatory enforcement action, immediately notify the Engineer and Town in writing of such situation, and make provisions for the lawful storage of the LBP, until an alternate TSDF or recycling facility can be located by Contractor and approved by the Engineer.
- F. Employ a certified EPA / New York State (NYS) Lead Supervisor on-site at all times during the Work and ensure that all employees, including Subcontractors, are qualified and experienced in the work of preparing and removing and disposing of the LBP, which they shall perform under this Contract. All employees shall be knowledgeable in the pertinent environmental regulations and in personal protection and other safety procedures. All lead abatement workers must have valid EPA/NYS Lead Worker certifications.
- G. Contractor and/or its Subcontractors involved in any activity which may impact LBP (i.e., LBP sampling, lead removal, and removal design) shall have demonstrated a minimum three (3) years of experience in lead hazard assessment and management, environmental and personal air monitoring, worker protection and training, and lead remediation specification writing.
- H. The Subcontractor(s) performing paint removal or other lead management work shall be considered Lead Abatement Subcontractor(s).
- I. Before using any Subcontractor(s) to perform any of the other lead management work under this Specification, including laboratory work, submit an executed "Statement of Qualifications of Lead Abatement Subcontractor" for each such Subcontractor.
- J. Hazardous Waste: Contractor and/or its Subcontractors involved in any activity that relates to the handling, storage, or disposal of hazardous waste shall demonstrate a minimum two (2) years of experience in hazardous waste management.

- K. The Subcontractor(s) transporting hazardous waste shall be considered Hazardous Waste Subcontractor(s).
- L. Submit an executed "Statement of Qualifications of Hazardous Waste Subcontractor" for each such Subcontractor before using any Subcontractor(s) to conduct any hazardous waste management including laboratory work.
- M. Provide documentation that the minimum insurance criteria have been met.
- N. Identify all legal or administrative actions or proceedings in which Contractor (or any proposed Sub-consultants) or Subcontractor(s) and testing laboratory has been involved within the last five (5) years which were brought by the EPA, NYSDEC, OSHA or any other agency having safety, health or environmental responsibilities or functions.
- O. Scheduling: The Contractor shall coordinate and schedule all phases of the Work to be performed under this Section with the Town, subcontractors, material suppliers, and other parties as necessary to ensure the proper execution of the Work.
- P. Compliance: In addition to the detailed requirements of this Section, the Contractor shall comply with all applicable regulations of federal, state, and local authorities pertaining to the disturbance, Abatement, removal, construction/demolition, handling, storage, transportation, and disposal of Lead-Containing Materials and Lead Wastes. All materials regarding the interpretation of any regulations, standards, or policies shall be submitted to the Engineer for resolution before starting the Work. Where the requirements of this Section, or federal, state, or local regulations conflict or vary, the most stringent requirements or regulations shall apply.
- Q. The Town reserves the right to reject items incorporated into the Work, which fail to meet the specified minimum requirements. The Town also reserves the right to reject Contractor submittal items that are deemed inappropriate or unacceptable by the Engineer or Town. Submittal items that may be deemed inappropriate or unacceptable include proposed vendors or subcontractors with previous regulatory citations/violations. The Town further reserves the right, and without prejudice to other recourse, to accept non-complying items subject to an adjustment in the Contract amount, as approved by the Town.
- R. In order to classify a paint or coating as non-PCB or non-heavy metal containing, a paint chip/coating sample or an XRF reading must be collected. The bulk samples shall be sent to an analytical laboratory meeting the requirements of this Section.
 - 1. Suspect PCB or Heavy Metal-Containing Paints: Although there are no certification requirements pertaining to an individual that collects paint chip/coating samples in an industrial or commercial setting, this Section requires paint chip/coating sampling to be performed by an individual who has successfully completed a PCB awareness course and HAZWOPER Training course (as defined in this Section) within the past year. In addition, the individual shall possess a current EPA Lead Inspector or EPA Risk Assessor certification, or shall have successfully completed a Lead Awareness Training course (within the past year) as defined in this Section and have documented experience in collecting paint chip samples.

2. The qualifications of individuals who will collect paint chip/coating samples or XRF readings must be approved by the Engineer prior to sample/reading collection. Analytical results for paint chip/coating samples or XRF readings that are collected by individuals not approved by the Engineer will not be recognized or accepted as valid by the Town.

S. Qualifications

1. Contractor (Paint Removal Company): The Contractor shall have successfully completed at least two (2) projects of comparable scope and methodologies to the Work being performed under this Section within the past three (3) years. This experience shall be documented by identifying the following: (a) the name, address, and phone number of each facility where the Work was performed; (b) the name of the individual representing the owner who supervised the work at each facility; (c) the types of facilities where the work was performed; (d) the volume and type of each material that was abated/removed; (e) the specific methods of Abatement/removal used at each facility (including the tools, technologies, and engineering controls employed).
2. Competent Person: The Contractor shall have on staff and assigned to this Contract a Competent Person who has successfully completed United States Department of Transportation (USDOT) Hazardous Materials Transportation Training and RCRA Training courses. In addition, the Competent Person shall have successfully completed both HAZWOPER Training and Lead Awareness Training courses as defined in this Section, or C-3/C-5 Supervisor Competent Person Training for Deleading of Industrial Structures as defined in this Section, or training as an EPA Lead Supervisor in accordance with 40 CFR 745.225 (b)(7)(vi). Each training course shall have been completed within the past year in the form of either an initial course or a refresher course. In addition, the Competent Person shall be able to fulfill the duties defined in this Section, and have a minimum of two (2) years' experience on projects involving Lead, and has served as the Competent Person on at least three (3) projects of comparable scope and methodologies to the work being conducted under this Section.
3. Waste Manager: The Contractor shall have on staff and assigned to this Contract a waste manager who has successfully completed USDOT Hazardous Materials Transportation Training, HAZWOPER Training, Lead Awareness Training, and RCRA Training courses as defined in this Section. Each training course shall have been completed within the past year in the form of either an initial course or a refresher course. In addition, the waste manager shall have a minimum of two (2) years' experience on projects involving hazardous wastes (including Lead). It is acceptable for an individual who meets the criteria of the Competent Person, to also serve as the waste manager for this Contract as long as the individual fulfills all of the requirements of this paragraph.
4. Lead Worker: The Contractor shall have on staff and assigned to this Contract a sufficient number of lead workers who have successfully completed USDOT Hazardous Materials Transportation Training and Lead Awareness Training courses as defined in this Section. Each training course shall have been completed within the past year in the form of either an initial course or a refresher

course. In addition, each lead worker shall have a minimum of one (1) year of experience on projects involving Lead, and have worked on at least three (3) projects of comparable scope and methodologies to the work being conducted under this Section.

5. **Air Monitor:** The Contractor shall have an air monitor assigned to this Contract who has successfully completed Lead Awareness Training course as defined in this Section. This training course shall have been completed within the past year in the form of either an initial course or a refresher course. In addition, the air monitor shall have a minimum of two (2) years' experience in conducting Area Monitoring and Exposure Monitoring on projects involving hazardous wastes (including Lead). It is acceptable for an individual who meets the criteria of the Competent Person (as defined in this Section) or waste manager (as defined in this Section), to also serve as the air monitor for this Contract as long as the individual satisfies all of the requirements of this paragraph.

1.9 SUBMITTALS

- A. ***Lead Management Plan(s):*** Each Contractor that will disturb Lead or other heavy metals during the course of Work to be performed under this Section shall submit a detailed, project-specific Lead Management Plan that addresses work procedures and equipment to be used during the disturbance, removal, handling, collection, and disposal of Lead-Containing Materials and Lead Wastes. Work requiring a Lead Management Plan includes, but is not limited to, Abatement, spot removal, and construction/demolition activities. The Lead Management Plan shall be prepared in accordance with OSHA Construction Standards and all other pertinent federal, state, and local regulations. The Lead Management Plan shall also be signed and dated by a CIH or other qualified safety professional.

1. Lead Control:

- a. Drawings showing the location and details of the following: (a) each Lead Control Area; (b) each Hygiene Facility; (c) proposed electrical hookups; (d) proposed water hookups; (e) each waste storage area; (f) restroom areas; (g) areas designated for eating, drinking, and smoking;
- b. A detailed discussion regarding project coordination (i.e., how the Contractor will organize the Work with other contractors or Town employees working at the site) and the sequencing of Lead related Work;
- c. A detailed discussion regarding the collection, handling procedures, and disposal of Lead-Containing Materials and Lead Wastes (including the collection, filtering, and disposal of wastewater);
- d. A detailed discussion regarding the procedures and methodologies that will be used to conduct Exposure Monitoring and Area Monitoring for particulates. Also, provide the name and qualifications (i.e., training and experience documentation) of the air monitor who will be responsible for conducting the air monitoring activities. The air monitor shall at a minimum, satisfy the qualification requirements set forth in this Section;
- e. A detailed discussion regarding housekeeping procedures to be used for maintaining clean work areas and clean Hygiene Facilities;

- f. A detailed discussion regarding the specific methods and procedures of emissions control that will be used to ensure that airborne contaminant levels do not meet or exceed an OSHA Action Level outside of each Lead Control Area. It should be noted that even after paint/coating removal, there is still the potential to generate elevated airborne levels of Lead. Therefore, the Contractor shall provide engineering controls to capture potential Lead dusts or fumes emitted during demolition work that involves the cutting or burning of steel structures that have already been abated;
 - g. A detailed analysis for each Work activity that has the potential to disturb Lead-Containing Materials or Lead Wastes. Each task analysis shall include, but is not limited to, the following information: (a) the type of work activity; (b) the tools/equipment that will be used; (c) operation and maintenance practices and procedures that will be used for the tools/equipment; (d) the types of Lead-Containing Materials that may be disturbed or Lead Wastes that may be generated when performing the activity; (e) the engineering controls that will be used to control the spread of contamination during the activity; (f) the proposed crew size for the activity and individual employee responsibilities during the activity; (g) housekeeping procedures that will be used during the activity; (h) PPE and proposed respiratory protection that will be used for the activity;
 - h. Equipment and Supplies: Identify the equipment and supplies that will be used to perform the Work;
 - i. Rental Equipment Notification: If rental equipment is to be used during the Work, the Contractor shall notify the rental agency in writing concerning the intended use of the equipment. Rental equipment data demonstrating compliance with the performance requirements of this Section must be presented to and approved by the Engineer prior to use;
 - j. Safety Data Sheets (SDSs): Provide SDSs for all chemical products (including chemical stripping products) to be used for the Work;
 - k. The name and qualifications (i.e., experience and training documentation) of the Competent Person who will be responsible for the oversight and execution of the Lead Management Plan during all activities affecting Lead-Containing Materials and Lead Wastes. At a minimum, the Competent Person shall satisfy the qualification requirements set forth in this Section and be present whenever work of this Section is being performed.
2. Waste Management:
- a. The identification of Lead-Containing Materials, Lead Wastes, and hazardous wastes (as defined in 40 CFR 261 and 6 NYCRR 371) associated with the Work;
 - b. The estimated quantity of each waste type (regulated and non-regulated) that will be generated and disposed of/recycled;
 - c. The name, address, phone number, and qualifications for each vendor and facility that has not been identified in the Construction Waste Management Plan (as described in Section 01 74 19 – Construction Waste Management and Disposal), but will be transporting, storing, testing, or disposing of the wastes. Include a 24-hour phone contact for each vendor and facility;

- d. Current permit documentation for each recycling facility or TSDF indicating that the facility is approved by federal, state, and local regulatory agencies to receive Lead-Containing Materials and Lead Wastes. The documentation shall include an "acceptance letter" from each TSDF indicating its ability to accept the specific waste streams that will be generated during Work performed under this Section;
 - e. Current 6 NYCRR 364 permit documentation for the waste transporter(s) that will transport Lead-Containing Materials and Lead Wastes from the work site to the TSDF. The documentation shall clearly indicate the transporter's ability to deliver the Lead-Containing Materials and Lead Wastes to the chosen TSDF;
 - f. Spill prevention, containment, and cleanup contingency methods to be implemented during the Work, as well as procedures to be followed during a suspected Lead emissions/bulk material release or emergency situation. All measures and procedures shall be in accordance with the standards referenced in this Section;
 - g. A detailed discussion of the on-site handling, storage, removal, and disposal of waste materials. This discussion shall include, but is not limited to, the following: (a) specifications for a secondary containment system for each drum storage area; (b) the methods of demarcation that will be used to identify the waste storage areas and each waste container; (c) the methods and procedures that will be used to collect and containerize wastes on a daily basis; (d) the types of containers that will be used to containerize the wastes; (e) the submittal of weekly regulated waste inspection and inventory records as required in this Section;
 - h. The name and qualifications (i.e., experience and training documentation) of the waste manager who will be responsible for the oversight and execution of the Lead management plan during waste management activities involving Lead-Containing Materials and Lead Wastes. At a minimum, the waste manager shall satisfy the qualification requirements set forth in this Section.
3. A detailed schedule for the implementation of the Lead Management Plan elements. The schedule shall clearly indicate the starting and completion dates for the work, and shall allow adequate time for cleanup, inspections, and air monitoring activities.
4. Medical Surveillance: For all activities that result in airborne Lead concentrations equal to, or in excess of the Action Level (as defined in 29 CFR 1926.62), or for those activities that take place within a Lead Control Area, the Contractor shall submit for this Contract a sufficient number of properly trained and experienced workers, each of whom shall: (a) have completed initial blood testing (including Zinc Protoporphyrin (ZPP) testing), and have a Blood Lead Level (BLL) below 35 micrograms per deciliter ($\mu\text{g}/\text{dl}$) (if the worker's BLL is in excess of 35 $\mu\text{g}/\text{dl}$, the worker shall show medical approval for this Work); (b) have received a medical exam that included a Pulmonary Function Test (PFT) within the past year; (c) have received written medical clearance within the past year, by a licensed health care professional, to wear a respirator; (d) have received a qualitative or quantitative respirator fit-test for the specific respirator the employee will be using for this Work within the past year.

5. **Employee Documentation:** For all activities that result in airborne contaminant concentrations (i.e., heavy metals or PCBs) equal to, or in excess of an Action Level, PEL, or REL, or for those activities that take place within a Lead Control Area, the Contractor shall provide a sufficient number of properly trained and experienced workers, each of whom shall: (a) have written proof of training (e.g., certificates) in accordance with the qualification requirements of this Section for lead workers, Competent Persons, waste managers, and air monitors that will be used for the Work; (b) copies of resumes for lead workers, Competent Persons, waste managers, and air monitors that will be used for the Work, indicating work experience as required in this Section; (c) dates and written proof of initial medical surveillance by the Contractor or other employer within the past year, and proof that the employee is currently participating in the employer's ongoing medical surveillance program in accordance with this Section; (d) dates and written proof of respiratory clearance and a medical exam in accordance with this Section; (e) dates and written proof of a respirator fit-test in accordance with this Section.
 6. A current (i.e., within the last month) signed and notarized statement disclosing all of the Contractor's OSHA, EPA, and USDOT citations/violations on projects involving Lead within the past three (3) years. If the Contractor will be using a subcontractor, a current signed and notarized statement disclosing all of the subcontractor's OSHA, EPA, and USDOT citations/violations on projects involving Lead within the past three (3) years will also be required.
- B. ***Analytical Laboratory Qualifications for Analyzing Suspect Lead-Containing Materials and Wastes:*** Submit the name, address, and telephone number of each analytical laboratory selected to perform the analyses of waste samples (solid and liquid), air samples collected for Area Monitoring and Exposure Monitoring purposes, and paint/coating samples collected to classify building components. The analytical laboratory shall be currently accredited by the American Industrial Hygiene Association (AIHA) and NYSDOH ELAP. Provide copies of current AIHA and ELAP certificates along with dates of accreditation/reaccreditation. ELAP certificates must show evidence of certification for the specific analytical methods that will be used to analyze each type of sample that will be collected.
- C. ***Waste Sampling Documentation:*** Provide a complete analytical package of Toxicity Characteristic Leaching Procedure (TCLP) test results of waste samples within four (4) weeks after sample collection. The Contractor shall direct the laboratory to test the waste in accordance with 40 CFR 26 I, Appendix II, Method 1311 Toxicity Characteristic Leaching Procedure TCLP, and shall analyze all samples from each waste stream by TCLP for all eight (8) RCRA metals, other hazardous substances and characteristics to properly characterize the waste stream (i.e., ignitability, corrosivity, reactivity and toxicity, pH, etc.). When chemical strippers are used, test all liquids and sludge.
1. If contaminated waste is generated during LBP removal, provide a complete analytical package of wastewater test results of waste sample collection within four (4) weeks after sample collection.

- D. ***Air Monitoring Documentation:*** All air monitoring results and daily air monitoring reports shall be provided to the Engineer within 24-hours from the date the samples are collected. The results shall be signed by the laboratory employee who analyzed or supervised the analysis of the samples, as well as the air monitor that physically performed the air monitoring activities at the work site. All laboratory analytical results shall be accompanied by complete COC documentation.
1. Each daily air monitoring report shall be signed by the Contractor's employee who generated the report. The content of these reports shall include, but is not limited to, the following information: (a) sample "start" and "stop" times; (b) flow rates (initial and final) for each sample; (c) the total volume of air collected for each sample; (d) sample location descriptions/sample location drawings/names of individuals being sampled; (e) types (i.e., makes and models) of sampling equipment used; (f) types of sample media (i.e., filters and cassettes) used; (g) the most recent calibration dates, along with the calibration results, for the sampling equipment used; (h) the name of the air monitor that conducted the air monitoring; (i) dates that the air monitoring was conducted; (j) work tasks being performed during the air monitoring; (k) unique sample numbers used to identify each sample.
- E. ***Waste Documentation:*** Completed and signed waste manifests from TSDFs shall be provided to the Town within ten (10) business days of disposal. In addition, on-site waste storage areas shall be inspected weekly by the waste manager, who at a minimum shall satisfy the qualification requirements of this Section.
1. Each waste storage area inspection shall be documented in the form of a written report, and each report shall be signed by the Contractor's employee who generated the report. All reports shall be provided to the Town within 24-hours of the date the inspection is completed. The content of these reports shall include, but is not limited to, the following information: (a) the name of the individual that conducted the inspection; (b) descriptions of waste streams being stored; (c) types and quantities of waste containers being used; (d) the current disposal status (i.e., when each waste container is scheduled to be removed from the work site) and physical condition of each waste container; (e) the presence/absence of proper labeling for each waste container in accordance with this Section and federal, state, and local regulations; (f) secondary containment systems being used; (g) the methods being used to secure/lock each waste storage area to prevent any unauthorized entry; (h) the presence of any waste containers on site generated during the Work performed under this Section that violate RCRA generator storage time limitations, as defined in 40 CFR 262.
 2. In addition to performing weekly waste storage area inspections, the waste manager shall also maintain an ongoing waste inventory. The waste inventory record shall include, but is not limited to, the following information: (a) specific dates that each waste container was added/removed from the waste storage area; (b) the full name (printed) and signature of the individual responsible for adding/removing each waste container from the waste storage area.
- F. ***Lead Control Area Inspection Documentation:*** Lead Control Areas shall be inspected daily by the Competent Person.

1. Each daily Lead Control Area inspection shall be documented in the form of a written report, and each report shall be signed by the Contractor's employee who generated the report. All reports shall be provided to the Town no later than 24-hours after the inspection is completed. The content of these reports shall include, but is not limited to, the following information: (a) the types of work being performed; (b) the names of the lead workers, Competent Person, waste manager, and air monitor on site, as well as the name of the company each individual is representing; (c) the types of air monitoring (i.e., Exposure Monitoring or Area Monitoring) being conducted, and the number of samples being collected for each type of air monitoring activity; (d) any non-compliance issues observed (i.e., observations that conflict with the requirements of the Contractor's Lead management plan, this Section, or federal, state, and local regulations) along with the corrective actions that were taken to achieve compliance.
- G. **Contractor Project Record:** The Contractor's Competent Person shall maintain a project record at the work site. The Contractor project record shall be made available to the Engineer or Town for review at any time during the Work, and shall be submitted to the Town within 24-hours after the completion of the Work.
1. At a minimum, the Contractor project record shall contain the following information: (a) copies of training certificates for all individuals involved with the work; (b) copies of all air monitoring results generated during the work; (c) copies of all available paint chip/coating sample analytical data and XRF analyzer data, as well as paint/coating survey reports related to the work; (d) copies of all daily sign-in sheets as required in this Section; (e) a list of emergency phone numbers, including the local fire department, local police department, nearest hospital, as well as phone numbers for the Engineer and Town personnel responsible for administering the work; (f) a copy of the OSHA Lead in Construction Standard (29 CFR 1926.62); (g) copies of all SDSs pertaining to all chemicals being used during the work; (h) a copy of this Section and the related Drawings; (i) a copy of the Contractor's Lead Management Plan; (j) copies of all daily Lead Control Area inspection records; (k) copies of all weekly waste storage area inspection records; (l) a copy of the waste inventory; (m) a copy of the Contractor's Hazard Communication (HAZCOM) program.
 2. If it is determined that arsenic, cadmium, or chromium is present in addition to Lead, the Contractor project record shall also include copies of each applicable OSHA Standard (i.e., Inorganic Arsenic in Construction Standard (29 CFR 1926.1118), Hexavalent Chromium in Construction Standard (29 CFR 1926.1126), or Cadmium in Construction Standard (29 CFR 1926.1127)).
- H. **Daily Sign-In Sheets:** The Contractor shall generate daily sign-in sheets for all individuals entering and exiting each Lead Control Area for the duration of the Work. The daily sign-in sheets shall be maintained by the Competent Person, and shall be made available to the Engineer or Town for review at any time during the Work. All daily sign-in sheets shall be submitted to the Town within 24-hours after the completion of the Work.
1. At a minimum, each daily sign-in sheet shall include: (a) the individual's full name (printed); (b) the individual's signature; (c) the name of the company the individual is representing; (d) the time of entry and exit from each Lead Control

Area; and (e) verification by the Competent Person that the individual meets the applicable training requirements, if the individual intends to enter a Lead Control Area.

- I. **HAZCOM Program:** The Contractor's HAZCOM program shall be made available to the Engineer for review at any time during the Work.

PART 2 - MATERIALS

2.1 EQUIPMENT AND MATERIALS

- A. Furnish all labor, materials, services, permits, and equipment necessary to carry out the LBP contaminated component removal and disposal activities (which includes removal, handling, storing, transporting, and off-site disposal of LBP contaminated components).
- B. The following equipment and material shall be used, at a minimum, for proper execution of the LBP management work. Additional equipment and materials shall be used, as required, for activities to be conducted in accordance with applicable regulations. The use of additional or alternate materials and equipment shall be included in the Lead Management Plan, and shall be subject to review. All equipment and materials shall be in new or "like new" condition and in good working order:
 1. Respiratory Protection: In accordance with the approved Respiratory Protection Program contained in the Lead Management Plan.
 2. PPE: The Contractor shall provide personnel who have a potential to be exposed to materials or wastes containing contaminants, with appropriate PPE as prescribed by the Contractor's CIH or qualified safety personnel.
 3. HEPA Vacuum Filtration Systems: All vacuum equipment employed in the Work Site shall utilize HEPA filtration systems that are 99.97-percent efficient to capture 0.3-micron particulate size. Vacuums shall be equipped with appropriate size brushes, crevice tools and other angular tools necessary for proper cleaning of all surfaces.
 4. Decontaminated Wastewater Filtration System: As a minimum, the system shall contain a three-stage filtering system with a final filter no greater than 0.5-micron.
 5. As a minimum, two (2) layers of securely attached 6-mil PVC sheeting shall be used to cover the Work Site. The sheeting shall extend 20-feet from the edge of the Work Site and 20-feet from the base of the container used for off-site disposal, and must be secured to the ground.
 6. Off-site waste transportation containers shall be EPA and USDOT approved solid enclosed containers, lined with two layers of 6-mil PVC sheeting and locked and secured at all times.

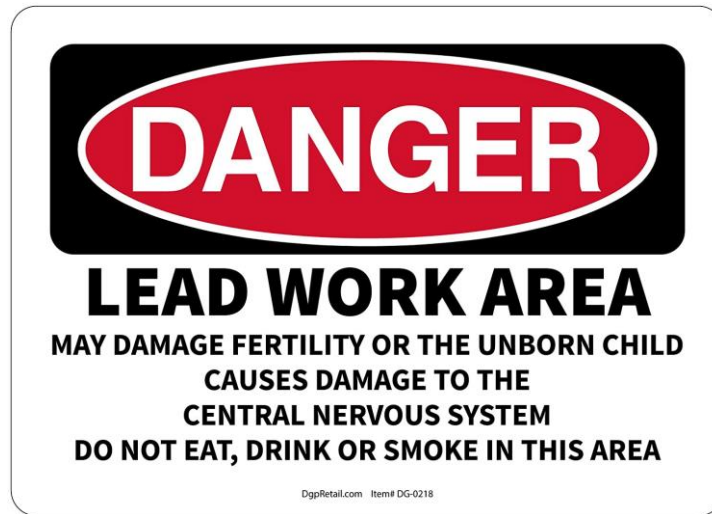
7. Temporary electrical cords and outlets shall be of an approved type, connected to a source of power outside of the Work Site, and protected by a ground fault circuit interrupter (GFCI).
8. Abrasives: Mechanical paint/coating removal equipment shall not use any products containing crystalline silica, and the equipment shall not utilize any non-recoverable materials or any cutting materials, which introduce toxic or hazardous materials into the environment.
9. Chemical Strippers: The Contractor shall utilize an environmentally safe chemical paint stripping system, with demonstrated suitability and efficiency in preparing cast-in-place concrete, cement, and plaster surfaces that are free of any visible residues of paints/coatings. The system shall include non-alkaline or alkaline strippers that provide the lowest possible level of toxicity consistent with the types of paints/coatings to be removed. Neutralization products and procedures shall be provided for all alkaline stripping systems, no stripping system shall contain methylene chloride, and the stripping system shall be low in volatile organic compounds (VOCs).

PART 3 - EXECUTION

3.1 PREPARATION

- A. Hygiene Facilities: The Contractor shall provide functional Hygiene Facilities as defined in this Section that are appropriate for the types of Work to be performed under this Section. The Contractor shall ensure that employees do not leave a Lead Control Area wearing any potentially contaminated PPE. Using compressed air to dislodge dust from clothing/PPE shall be strictly prohibited. The Contractor shall collect, test, and properly dispose of all wastewater generated from Hygiene Facilities.
 1. Hand Wash Stations: The Contractor shall provide functioning hand wash stations on all projects that disturb Lead-Containing Materials or Lead Wastes. Hand wash stations shall have running water at the tap, clean towels, and soap per 29 CFR 1926.51. Substituting "hand wipes" in place of soap and running water will not be acceptable.
 2. Showers: The Contractor shall provide shower facilities in accordance with 29 CFR 1926.62, for use by employees whose airborne exposure to Lead is above the PEL. When shower facilities are necessary, employees are required to shower at the end of the work shift each day prior to leaving the Lead Control Area that they are working in.
- B. Utilities: The temporary use of any on-site utilities shall be subject to the approval of the Town. The Contractor shall furnish all water and hoses needed for the Work, as well as any temporary hookups. Also, the Contractor shall supply all heating equipment and water filtration devices needed for the Work. In addition, all temporary lighting and temporary electrical service to a Lead Control Area shall be provided by the Contractor, and shall be in weather-proof enclosures and be ground fault protected.

- C. Signs: The Contractor shall post conspicuous warning signs at all approaches to work areas and waste storage areas. The signs shall be located at such a distance so that personnel may read the sign and take the necessary precautions before entering a work area or waste storage area. Signs shall comply with federal, state, and local regulations, including the requirements of OSHA. Signs shall not be removed until all Abatement, removal, and construction/demolition activities have been completed. At a minimum, each sign shall bear the following information in English and the predominant language that is spoken by the Contractor's employees if English is not spoken:



1. Each sign shall be appropriately modified to include additional warnings for other contaminants that are identified during Exposure Monitoring.
- D. Physical Boundary Delineation: The Contractor shall clearly delineate each work area and waste storage area with a Physical Boundary as defined in this Section.
- E. Work Area Preparation: The Contractor shall utilize HEPA-filtered vacuums, and wet methods during the initial cleaning of each work area. Prior to removal from each work area, all movable objects and mounted objects that can be removed shall be pre-cleaned using HEPA-vacuums and wet methods. Fixed objects that must remain within each work area shall be pre-cleaned using HEPA vacuums and wet methods, and subsequently covered with 6-mil polyethylene sheeting.

3.2 AIR MONITORING

- A. Air monitoring for airborne concentrations of Lead and other heavy metals shall be conducted by the air monitor in accordance with OSHA and as defined in this Section.
1. Exposure Monitoring: For Work, involving the disturbance of any detectable concentration of Lead or other heavy metals the Contractor shall collect personal air samples from employees who are anticipated to have the greatest risk of exposure, as determined by the Contractor's CIH or Competent Person. Personal air samples shall be collected during every work shift from at least one (1) employee that is representative of each type of work task that is being performed.

Each personal air sample shall “run” for the employee’s entire work shift in order to ensure that enough volume (of air) is collected and an accurate 8-hour TWA can be calculated. Documentation regarding the sample numbers, specific shift when the sampling was conducted, the work tasks that were sampled, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory COC form.

- a. Exposure Monitoring for other heavy metals may be discontinued following a complete negative exposure assessment and approval from the Engineer and the Contractor’s CIH / Competent Person. However, daily Exposure Monitoring for Lead shall remain, regardless of the negative exposure assessment results.
2. Area Monitoring: The Contractor shall collect a minimum of two (2) area air samples outside of each Lead Control Area on a daily basis for the duration of the Abatement, removal, or construction/demolition Work, as well as any other Work involving the disturbance of Lead-Containing Materials or Lead Wastes. During sampling activities, all air sample filter cassettes shall be positioned approximately five (5) to six (6) feet above the ground (in order to simulate an individual’s breathing zone), and shall not be placed immediately adjacent to obstructions (e.g., walls or columns) which may restrict the flow of air to the filter cassettes. Each air sample shall be analyzed for all contaminants identified during the exposure assessment. If area air monitoring indicates an emission level in excess of an OSHA Action Level outside of a Lead Control Area, all Work in that area shall be stopped immediately. The Contractor shall then take immediate corrective actions to reduce emission levels to below the Action Level(s), and the Contractor shall clean all adjacent areas that may have become contaminated due to the emissions. Documentation regarding the sample numbers, sample locations, the dates of sampling, the employee hours that were worked during the shift, and the total sampling times, shall accompany each laboratory COC form.
3. Documentation: Complete documentation of all air monitoring activities shall be in accordance with this Section.
4. The Contractor shall submit all air monitoring results to the Town as soon as possible, but no later than five (5) calendar days from when the air samples were collected.

3.3 BULK REMOVAL

- A. Protection of Existing Work to Remain: All Work involving the disturbance of Lead-Containing Materials or Lead Wastes must be conducted without damage to, or contamination of equipment or surfaces within the work areas or other areas adjacent to the work areas. All such damage or contamination shall be immediately corrected and cleaned up by the Contractor at the Contractor’s expense.
- B. Prohibited Activities: Contractors shall not conduct activities that are prohibited by OSHA and EPA regulations. The following activities are prohibited, regardless of whether they are conducted subject to an exposure assessment and written compliance program: (a)

burning-off paints/coatings; (b) using heat guns operating above 1,100°F; (c) dry machine sanding, grinding, or blasting paint without a HEPA vacuum exhaust tool; (d) uncontained hydroblasting or high-pressure washing; (e) welding painted/coated surfaces unless the paint/coating is removed at least 4-inches from area of heat application (per 29 CFR 1926.345(c)(1)), and local exhaust ventilation is used.

- C. Test Patches: Prior to choosing the paint removal method(s) for paints/coatings, the Contractor shall perform test patches on surfaces subject to Abatement, to determine if the method(s) meet the requirements of this Section.
- D. Mechanical Removal Equipment: When removing paints/coatings from metal surfaces, the paints/coatings must be removed to the extent that only the bare metal remains (i.e., no mill scale remains). In the case of substrates other than metal (e.g., concrete, brick, and block), paints/coatings shall be removed from the surface of the substrate. Acceptance of the Work shall be contingent upon inspection of the substrate surfaces by the Engineer, and must demonstrate the absence of residual paint/coating layers that can be physically measured, pried loose, or peeled away using a scraping device. The Contractor may only use products and tools meeting the performance specifications outlined below:
 - 1. Contractor shall utilize a vacuum-assisted power tool system with demonstrated suitability and efficiency in preparing metal surfaces to the SSPC SP-11 standard, and with demonstrated effectiveness in maintaining Lead emissions below OSHA exposure limits during the disturbance of paints/coatings. Such systems may include dustless needle guns, dustless rotopeens, and dustless right-angle grinders, all of which capture dust and debris at the cutting tool edge, and transport the material under vacuum conditions to an airtight disposal container. Dustless needle guns shall only be utilized on metal surfaces.
 - 2. The vacuum-assisted power tool system shall also be designed to permit the removal and replacement of collection containers under negative pressure in order to prevent the release of dusts. The system shall be equipped with an automatic "shut-off" in the event of vacuum failure.
 - 3. Abrasive/recovery tools shall be monitored at all times by a device capable of determining recovery at the face of each tool, and capable of automatically disabling the tool in the event that recovery levels are insufficient. The monitor, at a minimum, shall have the following features: (a) a remote warning light; (b) an adjustable recovery set point; (c) automatic equipment disabling capabilities; (d) a sensing range of 0-5 pounds per square inch (psi); (e) solid-state photohelic instrumentation; (f) remote sensing at the face of the tool.
 - 4. The safe recovery point shall be calibrated each day before start-up, or each time a new tool or vacuum source is used. All manufacturer recommendations shall be followed with respect to the set-up and use of the monitor, and the manufacturer's operations manual shall be kept on site at all times. A daily log shall be maintained by the Contractor, identifying all calibrations of recovery levels, as well as any "down time" as a result of insufficient recovery levels.
 - 5. The cutting head of the vacuum-assisted power tool system that is used on flat surfaces shall be capable of cutting to within 1-1/2" of any inside corner,

molding, or edge, and may include dustless rotopeens or dustless needle guns. Tools for corners and moldings shall be specifically designed for that purpose, and conform to all inside corners, outside corners, curved, flat, and angled surfaces that are to be abated under this Section. These tools shall also maintain vacuum control at the work surface/cutting head interface at all times. HEPA vacuum-shrouded needle guns may be used for non-flat surfaces in accordance with manufacturer recommendations. Vacuum-assisted finishing tools, such as right-angle grinders, may be used to achieve the SSPC SP-11 standard, but may not be used for primary removal.

6. Vacuum-assisted power tool systems meeting all of the specifications outlined herein, may be used pending the submittal of all required performance documentation, and their acceptance by the Engineer. Any tools, which do not meet all of the specifications, outlined herein, shall be removed from the project site immediately, and shall not be used for the Work to be performed under this Section.
- E. Chemical Strippers: Acceptance of the Work shall be contingent upon inspection of the abated substrate surfaces by the Engineer, and must demonstrate the absence of residual paint/coating layers that can be physically measured, pried loose, or peeled away using a scraping device. The Contractor may only use products and paint stripping systems meeting the performance specifications outlined below:
1. The Contractor shall utilize a chemical paint stripping system with a demonstrated effectiveness in maintaining Lead emissions below OSHA exposure limits during the disturbance of paints/coatings. The Contractor shall utilize a mechanical ventilation system during the work that exhausts away from occupied areas. The application of all paint-stripping systems shall be in accordance with manufacturer recommendations.
 2. The Contractor should note that more than one product may be required to strip LCP/coatings. The use of multiple products shall be in accordance with Work practices approved by the individual manufacturer of each chemical paint-stripping compound.
 3. All chemical paint-stripping products shall be presented to the Engineer for approval prior to the start of any Work to be performed under this Section. When presenting the products to the Engineer, they shall be in the manufacturer's unopened, original containers bearing accurate information regarding the products. Also, the manufacturer's labels on each container shall be intact and legible.
 4. Chemical paint stripping systems meeting all of the requirements outlined herein, may be used pending the submittal of all required performance documentation, and its acceptance by the Engineer. Any products, which do not meet all of the specifications, outlined herein, shall be removed from the project site immediately, and shall not be used for the Work to be performed under this Section.

3.4 CLEANUP AND DISPOSAL

- A. Cleanup: The Contractor shall maintain all surfaces, including protective coverings (polyethylene sheeting) within each work area, free of accumulations of paint chips/coating debris, dusts, and wastes. The Contractor shall perform housekeeping activities daily throughout each work shift and at the end of each work shift, in order to prevent any accumulation of paint chips/coating debris, dusts, and wastes in the work areas. Dry sweeping and using compressed air to cleanup a work area shall be strictly prohibited. HEPA-filtered vacuums and wet methods shall be used to ensure that each work area remains free of visible paint chips/coating debris, dusts, and wastes.
- B. Sampling and Laboratory Analysis of Paint Removal Wastes: For hazardous waste characterization, the waste manager shall sample all potential heavy metal and PCB-containing waste streams in accordance with 40 CFR 261 and 6 NYCRR Part 371. All waste samples shall be collected in the presence of the Engineer using the following procedure:
1. One (1) composite waste sample shall be collected for laboratory analysis from each waste drum that is generated. Each composite sample shall be a mixture of four (4) grab samples. The first grab sample shall be collected when the drum is approximately $\frac{1}{4}$ full of waste. The second grab sample shall be collected when the drum is approximately $\frac{1}{2}$ full of waste. The third grab sample shall be collected when the drum is approximately $\frac{3}{4}$ full of waste, and the fourth and final grab sample shall be collected when the manufacturers recommended capacity of the drum has been achieved, and the drum is ready to be sealed for transport to the TSDF. Each composite sample shall be labeled and submitted to a laboratory that satisfies the requirements of this Section. Each composite sample shall undergo Toxicity Characteristic Leaching Procedure (TCLP) analysis for the eight (8) RCRA metals.
 2. The Contractor shall also direct the laboratory to analyze each sample for any additional parameters that are required by the specific TSDF being used. In addition, if the waste stream is associated with the use of a chemical paint stripping system, the Contractor shall have the laboratory analyze each sample for pH and any other RCRA characteristic that may fail due to the chemical composition of the waste. Furthermore, if the waste stream may contain PCB-containing paint/coating chips, the Contractor shall collect samples in accordance with Section 02 84 00 – PCB Material Removal. The Contractor shall ensure that the laboratory being used to satisfy the requirements of this Section is also capable of performing these additional analytical tests.
 3. One (1) representative wastewater sample shall be collected for laboratory analysis from each drum that generated. Each sample shall be collected using appropriate field sampling equipment (e.g., a pipette or bailer), and shall be labeled and submitted to a laboratory that satisfies the requirements of this Section.
- C. Sampling and Laboratory Analysis of Painted Demolition Debris: The Contractor shall collect representative bulk samples of demolition wastes to determine proper disposal. All bulk samples shall undergo TCLP analysis for the eight (8) RCRA metals. If the waste

stream may contain PCB-containing paint/coating chips, the Contractor shall collect samples in accordance with Section 02 84 00 – PCB Material Removal.

1. Scrap Metal Exemption for Recycling: Under 6 NYCRR 371.1(c) (7), painted scrap metal can be sent to a recycling facility, rather than be discarded as hazardous waste. In order for the Town to submit a “c7 notification” to the NYSDEC and claim the “scrap metal exemption,” the Contractor must first submit notification to their recycling facility indicating that Lead is present on the scrap metal. If PCBs or other heavy metals are detected in the paints/coatings on the scrap metal, the Contractor shall also disclose this information to the recycling facility. The Contractor shall receive written permission from the recycling facility indicating that the facility will accept the Lead, heavy metal, and PCB paint/coated scrap metal generated during the Work to be performed under this Section. The Contractor shall submit this documentation to the Engineer for approval prior to disposal.
- D. Collection Separation, and Containerization of Wastes: The Contractor shall collect, separate (by waste stream/waste type), and containerize Lead Wastes (solid and liquid), debris, PPE, and containment materials on a daily basis in accordance with the lead management plan.
1. The Contractor shall store all wastes in DOT-approved container systems. No drum/container shall be filled in excess of the capacity marked on the drum/container. All drums/containers shall be sealed and covered immediately after filling, and each drum/container shall have a label affixed to it in accordance with the requirements of this Section. All labels shall remain intact and legible at all times.
 2. No water mixed with or contaminated by hazardous waste may be released onto the ground or into any drain or sewer. It should be noted that a discharge of more than 10 lb. of Lead (this includes 10 lb. of debris containing Lead) onto the ground or into the water within a 24-hour period, shall be considered a violation of the Clean Water Act and shall be treated as a “reportable quantity” in accordance with 40 CFR 117. Such a release shall be grounds for immediate termination of this Contract, and the Contractor shall be liable for any fines, penalties, or remediation costs.
 3. The Contractor shall store non-hazardous wastes separately from hazardous wastes, shall provide all non-hazardous waste containers, and shall make all transportation and disposal arrangements for nonhazardous wastes in accordance with federal, state, and local regulations.
- E. Storage of Wastes: The Contractor shall ensure that all drummed wastes are stored in a secondary containment system, and that each waste storage area is demarcated with a Physical Boundary. In addition, the Contractor shall post weekly waste inspections and waste inventories in the regulated waste storage area, as required in this Section, as well as the following emergency information: (a) the name and telephone number of the facility’s Emergency Coordinator; (b) the location of fire extinguishers and fire alarms; (c) the location of spill control materials; (d) the telephone number for the fire department (unless the facility has a direct alarm).

- F. Labeling: The Contractor shall attach warning labels to all hazardous waste drums/containers. Labels shall comply with the requirements of federal, state, and local regulations. At a minimum, all hazardous waste labels shall bear the following information in English:

HAZARDOUS WASTE

FEDERAL LAWS PROHIBIT IMPROPER DISPOSAL

**IF FOUND, CONTACT THE NEAREST POLICE OR
PUBLIC SAFETY AUTHORITY OR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY**

GENERATOR INFORMATION:

NAME: _____

ADDRESS: _____

CITY _____ STATE _____ ZIP _____

EPA ID NO. _____ EPA WASTE NO. _____

ACCUMULATION START DATE _____ MANIFEST TRACKING NO. _____

[_____]

[_____]

[_____]

D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX

HANDLE WITH CARE!

1. Labels shall indicate "Hazardous Waste - Pending Analysis" if waste classification is pending analysis.
- G. Disposal of Wastes: All waste profiles for containerized wastes must be reviewed by the Engineer and signed by the Town as the generator of the waste streams. The Contractor shall notify the Town at least fourteen (14) business days prior to the removal of any waste drums/containers, so that the Town can inspect the drums/containers and the waste manifests. Wastes shall be disposed of to ensure that drums/containers do not remain on the job site for more than ninety (90) calendar days from the initial "accumulation start date" on the label affixed to the drum/container. Containers that have reached their storage capacity shall not remain on site, and transportation arrangements shall be made for their immediate removal.

- H. Disposal Records: The Contractor shall submit written evidence that the TSDF receiving heavy metal-containing wastes is approved by federal, state, and local regulatory agencies to receive the wastes. If regulated PCBs (as defined in Section 02 84 00 – PCB Material Removal) were detected in the wastes, the Contractor shall also ensure that the TSDF is approved by federal, state, and local regulatory agencies to receive these wastes. Once all waste profiles have been completed, the Contractor shall provide the Town with a “Letter of Approval” issued from the TSDF indicating that the wastes will be accepted. The Contractor shall submit one (1) copy of the completed manifest that has been signed and dated by the initial transporter and TSDF in accordance with 6 NYCRR 372 and 40 CFR 262, to the Town. All waste profiles, manifests, and Land Disposal Restrictions (LDRs) must be signed by a Town employee.

END OF SECTION 02 83 33

SECTION 02 84 00 – PCB MATERIAL REMOVAL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Project will include the removal and disposal of PCB materials (herein referred to as PCB materials) at the Old Town Hall Building.
- B. Nine (9) light fixtures were found to contain ballasts that are known to contain PCBs (Limited Hazardous Materials Survey Report - Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C.). These nine (9) light fixtures were observed in the lower level of the Old Town Hall Building.
- C. PCBs were detected above laboratory reporting limits in some bulk caulk samples collected within the Old Town Hall Building; however, the PCB concentrations were below the 40 CFR Part 761 threshold of 50 ppm for classification as PCB-contaminated waste, and the 6 NYCRR Part 371.3 threshold of 50 ppm for classification as a hazardous waste. Therefore, this material is not subject to the disposal requirements for PCB materials described below and may be disposed of at an approved construction and demolition (C&D) debris disposal site.
- B. Materials containing PCB materials impacted during this construction are summarized in Table 1 below. Contractor shall determine from the Contract Drawings and Contract Documents which of the items listed in Table 1 will be disposed in accordance with this Section.

Old Town Hall Room ID	Material Description	Approximate Quantity (SF/LF/EA)
Storage A147	Light fixtures	2 EA
Storage A145	Light fixtures	2 EA
Storage A144	Light fixtures	2 EA
Storage A142	Light fixture	1 EA
Storage A141	Light fixtures	2 EA

- C. The Contractor shall be aware of all conditions of the Project and is responsible for verifying quantities and locations of all Work to be performed. Failure to do so shall not relieve the Contractor of its obligation to furnish all labor and materials necessary to perform the Work.
- D. All Work shall be performed in strict accordance with the Project Documents and all governing codes, rules, and regulations. Where conflicts occur between the Project Documents and applicable codes, rules, and regulations, the more stringent shall apply.
- E. Working hours shall be as required and approved by the Owner. PCB material removal activities including, but not limited to, work area preparation, gross removal activities, cleaning activities, waste removal, etc. may need to be performed during ‘off-hours’ (including nights and weekends). In addition, multiple mobilizations may be required to perform the work identified in this project. The Contractor shall coordinate and schedule all Work with the facility and Owner’s representative.
- F. If the Contractor, or remediation Subcontractor, encounters any previously unidentified and/or untested material that is suspected to be PCB-containing, the Contractor shall stop all work in the affected area and notify the Owner who will arrange for sampling and testing of the suspect material. If the material in question is in fact PCB-containing then the Contractor, or remediation Sub- contractor, shall remove and dispose of the material in accordance with this specification, with all referenced documents included as part of this specification, and with all Federal, state and local regulations. Removal and disposal of

any previously unidentified PCB-containing materials shall be performed by the Contractor at the unit prices bid for in this Contract.

1.2 PERMITS AND COMPLIANCE

- A. The Contractor shall assume full responsibility and liability for compliance with all applicable Federal, State, and local laws, rules, and regulations pertaining to Work practices, protection of Workers, authorized visitors to the site, persons, and property adjacent to the Work.
- B. Perform PCB related Work in accordance with New York State Department of Environmental Conservation (NYSDEC) Hazardous Waste Regulations (6 NYCRR 370-374, i.e. Hazardous Waste Rules), 40 CFR 761, and 29 CFR 1926, as specified herein. Where more stringent requirements are specified, adhere to the more stringent requirements.
- C. The Contractor must maintain current licenses or registrations pursuant to NYSDEC and United States Environmental Protection Agency (EPA) regulations for all Work related to this Project, including the removal, handling, transport, and disposal of hazardous and industrial waste.
- D. The Contractor shall be prepared to obtain an EPA ID number if so directed by the Owner.
- E. Failure to adhere to the Project Documents shall constitute a breach of the Contract and the Owner shall have the right to and may terminate the Contract provided, however, the failure of the Owner to so terminate shall not relieve the Contractor from future compliance.

1.3 SPECIAL REQUIREMENTS

- A. Commencement of Work: Five (5) business days prior to the proposed start of the work required under this Section at each separate location, the Contractor shall notify the Engineer and the onsite safety staff. No Work may proceed at any location until authorized by the Engineer.
- B. The Contractor shall coordinate any required equipment shutdowns with site operations personnel prior to starting the Work.
- C. Access Restrictions: The Contractor shall inform the Engineer and site operations personnel of proposed access restrictions (i.e., areas or items of equipment which will not be accessible during the proposed work), and give them estimated time frames (including specific dates) of such proposed access restrictions. The Contractor shall be aware that other contractors may be in any of the work areas associated with this Contract. As a result, the Contractor shall not have exclusive rights to any work area, and shall fully cooperate and coordinate this Work with the work of other contractors who may be on site. Therefore, the Contractor shall notify other contractors in advance of the disturbance, abatement, removal, construction/demolition, and/or disposal Work included herein, to provide them with sufficient time for coordination of interrelated items that are included in their contracts and that must be performed before, after, or in conjunction with the Work included under this Section.
- D. Unexpected Entry into a PCB Control Area: In the event that Town personnel must enter a PCB Control Area for reasons unrelated to the supervision or inspection of Work being performed under this Section (e.g., under emergency conditions), the Contractor shall immediately stop work and cleanup any loose debris, so as to permit the safe entry by Town personnel.
- E. Meetings: The Contractor shall visit and investigate the site, review the Drawings, review this Section, and become familiar with any conditions, which may affect the Work, as part of the pre-construction meeting and site walk-through. The Contractor shall hold all meetings with appropriate parties as scheduled and as otherwise necessary to accomplish the Work to be performed under this Section. In addition to the pre-construction meeting and site walk-through, other meetings may be required or may be requested by the Engineer, including briefings with site operations personnel. Written documentation

(i.e., “minutes”) of all meetings shall be generated by the Contractor, and copies shall be provided to the Town within three (3) business days following each meeting.

- F. Payment for the disposal of PCB materials will not be made until a signed copy of the manifest from the Treatment, Storage, and Disposal Facility (TSDF), certifying the amount of PCB Wastes delivered is returned with complete chain-of-custody (COC) documentation to the Town.

1.4 APPLICABLE STANDARDS AND REGULATIONS

- A. The Contractor shall comply with the following codes and standards, except where more stringent requirements are shown or specified:
- B. Federal Regulations:
1. 29 CFR 1910.1200, "Hazard Communication" (OSHA)
 2. 29 CFR 1910.134, "Respiratory Protection" (OSHA)
 3. 29 CFR 1910.145, "Specification for Accident Prevention Signs and Tags" (OSHA)
 4. 29 CFR 1926, "Construction Industry" (OSHA)
 5. 29 CFR 1926.500 "Guardrails, Handrails and Covers" (OSHA)
 6. 40 CFR 761, "PART 761—POLYCHLORINATED BIPHENYLS (PCBs)" (EPA)
 7. 49 CFR 171-173, Transportation Standards (DOT)
- C. New York State Regulations:
1. 6 NYCRR, Parts 360, 364, Disposal and Transportation (DEC)
 2. 6 NYCRR, Parts 370-373, "Hazardous Waste Management System"
- D. Standards and Guidance Documents:
1. American National Standard Institute (ANSI) Z88.2-80, Practices for Respiratory Protection

1.5 TRAINING

- A. The Contractor shall designate a Project Supervisor who shall meet the following qualifications:
1. The Project Supervisor shall be trained in PCB removal and hazardous waste management via an OSHA 40-hour HAZWOPER training and OSHA 8-hour Supervisor training.
 2. The Project Supervisor must be on-site at all times during the execution of the Work of this section. The Project Supervisor shall be responsible for the performance of the Work of this section and shall be the primary point of contact for the Owner.
- B. Employees managing Hazardous Waste as described in Section 3.3 must also meet the Personnel training requirements in section 6 NYCRR 373-3.2.
- C. The Contractor, or remediation Sub-contractor, is responsible for ensuring that all remediation worker personnel shall receive appropriate training and information regarding the potential hazards of PCBs, safety and health precautions, and the use and requirements of protective clothing and equipment prior to the start of any remediation work. Note that the safety requirements specified within this section are due to the presence of PCB containing materials within the Work Areas and may exceed the minimum safety requirements. The requirements of this section do not abrogate the Contractor's responsibility to adhere to this manual; wherever there is a conflict or overlap of requirements, the most stringent provisions shall apply.

1.6 SAFETY SUPPLIES AND PROTECTIVE CLOTHING

- A. All personnel must utilize proper PPE during all work activities. Proper PPE may vary depending on the job task, but may include disposable gloves, disposable rubber boots, steel-toe boots, Tyvek suits, protective vests, respirators, including replacement cartridges, hard hats, hearing protection, and eye protection.
- B. Respiratory Protection
 - 1. Establish a respirator program as required by ANSI Z88.2 and 29 CFR 1910.134. Provide respirator training.
 - 2. Select respirators from those approved by the Mine Safety and Health Administration (MSHA), and the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services. High Efficiency Particulate Air (HEPA) respirator filters shall be approved by NIOSH and shall conform to the OSHA requirements in 29 CFR 1910.134.
 - 3. Respirators shall be individually fit tested to personnel under the direction of an Industrial Hygienist or other qualified individual on a yearly basis. Fit-tested respirators shall be permanently marked to identify the individual fitted, and use shall be limited to that individual.
 - 4. The Contractor shall provide and make available a sufficient quantity of respirator filters so that filter changes can be made as necessary during the workday.
 - 5. Any authorized visitor, Worker, or supervisor found in the Work Area not wearing the required respiratory protection shall be removed from the Project site and not be permitted to return.

1.7 DELIVERY AND STORAGE

- A. Deliver all materials to the job site in original packages with containers bearing manufacturer's name and label.
- B. Store all materials at the job site in a suitable and designated area.
 - 1. Store materials subject to deterioration or damage away from wet or damp surfaces and under cover.
 - 2. Protect materials from unintended contamination and theft.
 - 3. Storage areas shall be kept clean and organized.
- C. Remove damaged or deteriorated materials from the job site. Materials contaminated with PCB shall be disposed of as PCB material as specified herein.

1.8 TEMPORARY UTILITIES

- A. Where available, obtain power from Owner's existing system. Otherwise provide power from other sources (i.e. generator).
 - 1. Provide temporary wiring and "weatherproof" receptacles in sufficient quantity and location to serve all HEPA equipment and tools.
 - 2. Provide wiring and receptacles as required by the Environmental Consultant for air sampling equipment.
- B. Provide temporary lighting for all Work Areas.
 - 1. The entire Work Area shall be kept illuminated at all times.

2. Provide lighting as required by the Environmental Consultant for the purposes of performing required inspections.

C. Utilize domestic water service, if available, from Owner's existing system.

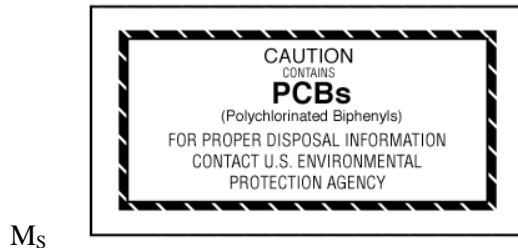
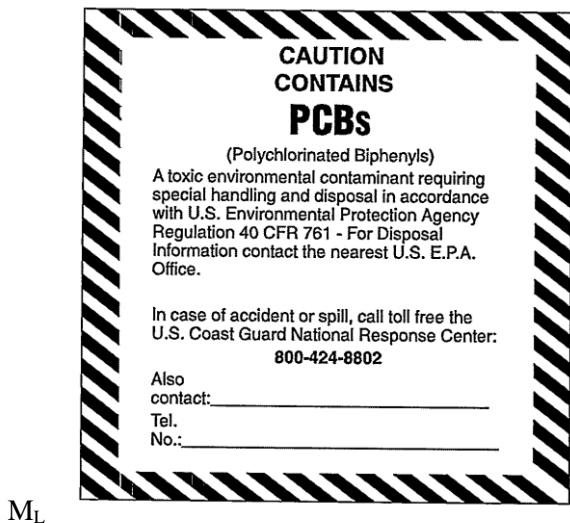
PART 2 PRODUCTS

2.1 PROTECTIVE CLOTHING

- A. Provide personnel utilized during the Project with disposable protective whole body clothing, head coverings, and foot coverings. Provide disposable plastic or rubber gloves, suitable to prevent PCB skin contact, to protect hands.
- B. Provide sufficient quantities of protective clothing to assure a minimum of four (4) complete disposable outfits per day for each individual performing abatement Work.
- C. Eye protection and hard hats shall be provided and made available for all personnel entering any Work Area.
- D. Authorized visitors shall be provided with suitable protective clothing, headgear, eye protection, and footwear whenever they enter the Work Area.

2.2 SIGNS AND LABELS, CONTAINERS

- A. Provide warning signs and barrier tapes at all approaches to PCB Work Areas. Locate signs at such distance that personnel may read the sign and take the necessary protective steps required before entering the area.
- B. Provide the appropriate "Large PCB Marking" or "Small PCB Marking" (M_L or M_S per 40 CFR 761) as shown below, of sufficient size to be clearly legible, for display on waste containers (bags, boxes, rollofs or drums) which will be used to contain or transport PCB contaminated material, in accordance with 40 CFR 761. In addition, U.S. Department of Transportation (DOT) 49 CFR Parts 171 and 172 requires the name and UN number of the material to be on the bags or drums, and, if shipped in bulk (rollofs, Gaylord boxes, etc) the bulk container must also be labeled: Polychlorinated biphenyl, solid mixture UN 3432.



- C. The PCB Materials are also NYS Hazardous Waste, and must have a label stating the following on each container :

HAZARDOUS WASTE--Federal Law Prohibits Improper Disposal. If found, contact the nearest police or public safety authority, or the U.S. Environmental Protection Agency.

Generator's Name and Address_____

Generator's EPA Identification Number_____

Manifest Tracking Number_____

- D. Provide 6 mil plastic disposal bags with PCB caution labels.
1. The "Small PCB Label" (Ms per 40 CFR 761) may be used as shown above. Bags shall also be labeled with U.S. DOT required markings per 49 CFR 172, Polychlorinated biphenyl, solid mixture UN 3432.
 2. Labeled PCB waste containers or bags shall not be used for non-PCB waste or trash. Any material placed in labeled containers or bags, whether turned inside out or not shall be handled and disposed of as PCB waste.

2.3 DAILY PROJECT LOG

- A. Provide a Daily Project Log. The log shall contain on title page the Project name, name, address and phone number of Owner; name, address and phone number of Environmental Consultant; name, address and phone number of Abatement Contractor; emergency numbers including, but not limited to local Fire/Rescue department.
- B. All entries into the log shall be made in non-washable, permanent ink and such pen shall be strung to or otherwise attached to the log to prevent removal from the log-in area. Under no circumstances shall pencil entries be permitted.
- C. The Project Supervisor shall document all Work performed daily and note all inspections.

2.4 SCAFFOLDING AND LADDERS

- A. Provide all scaffolding and/or staging as necessary to accomplish the Work of this Contract. Scaffolding may be of suspension type or standing type such as metal tube and coupler, tubular welded frame, pole or outrigger type or cantilever type. The type, erection and use of all scaffolding and ladders shall comply with all applicable OSHA construction industry standards.
- B. Provide scaffolding and ladders as required by the Environmental Consultant for the purposes of performing required inspections.

2.5 SHIPPING CONTAINERS AND PACKAGING

- A. Provide packaging in accordance with 49 CFR 173 Packaging Group 9, such as 30 or 55 gallon capacity fiber, plastic, or metal drums, Gaylord Boxes or other Intermediate Bulk Containers (IBCs), or non-siftable bulk containers, capable of being sealed air and water tight if PCB waste has the potential to damage or puncture disposal bags. Affix PCB caution labels on lids of drums, and opposite sides of drums or bulk containers, as well as the ends of bulk containers.

2.6 EQUIPMENT AND MATERIALS

- A. All dry vacuuming performed under this contract shall be performed with High Efficiency Particulate Air (HEPA) filter equipped industrial vacuums conforming to ANSI Z9.2.

- B. Any power tools used to drill, cut into, or otherwise disturb PCB material shall be manufacturer equipped with HEPA filtered local exhaust ventilation.
- C. All polyethylene (plastic) sheeting used on the Project (including but not limited to sheeting used for critical and isolation barriers, fixed objects, walls, floors, ceilings, waste container) shall be at least 6 mil fire retardant sheeting.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Should visible PCB debris be observed outside the Work Area, immediately stop Work notify the Owner; institute emergency procedures as directed. All costs incurred in decontaminating such non-Work Areas and the contents thereof shall be borne by the Contractor, at no additional cost to the Owner.
- B. The following submittals, documentation, and postings shall be maintained on-site by the Contractor during abatement activities at a location approved by the Abatement Project Monitor:
 - 1. NYS Department of Environmental Conservation Waste Transporter Permit.
 - 2. Project documents (specifications and drawings.)
 - 3. Applicable regulations.
 - 4. Material Safety Data Sheets of supplies/chemicals used on the Project.
 - 5. Approved Abatement Work Plan.
 - 6. List of emergency telephone numbers.
 - 7. Waste Disposal Log.
 - 8. Daily Project Log.
- C. The following documentation shall be maintained on-site by the Abatement Project Monitor during abatement activities:
 - 1. Project Monitor Daily Log.
 - 2. PCB Survey Report.

3.2 WORK AREA PREPARATION

- A. PCB caution signs shall be posted at all approaches to the PCB Work Area. Post all emergency exits as emergency exits only on the Work Area side, post with PCB caution signs on the non-Work Area side. Provide all non-Work Area stairs and corridors accessible to the PCB Work Area with warning tapes at the base of stairs and beginning of corridors. Warning tapes shall be in addition to caution signs.
- B. Access to areas of work shall be regulated to prevent unauthorized visitors.
- C. ***Personal/Equipment Decontamination Room or Area:*** An existing room or area that is adjacent to the work area shall be used for the decontamination of personnel and equipment. The room or area shall be covered by an impermeable dropcloth on the floor or horizontal working surface. The room or area must be of sufficient size to accommodate cleaning of equipment and removing personal protective equipment. Work clothing must be cleaned with a HEPA vacuum before it is removed. All equipment and surfaces of waste containers must be cleaned prior to removing them from the decontamination room or area. All personnel must enter and exit the PCB work area through the decontamination room or area.
- D. Work Area Preparation for Exterior Removal:
 - 1. All ground surfaces exterior to the work area shall have a layer of 6 mil fire retardant plastic sheeting, attached to the building face and laid down on the surface below the exterior abatement work area, at least 10 feet wide or to the furthest point of gravity fall for dislodged debris by methods used, whichever is further. For work at the second story and above, extend 6 mil fire

- retardant plastic sheeting as necessary. For work above third story, by sidewalk, street, or property boundary, scaffolding sides shall be covered in 6-mil fire retardant plastic sheeting.
2. All operable windows within the work area and 25 ft. from all sides of the work area shall be closed.
 3. In the work area, isolate all HVAC equipment intakes by temporarily shutting down units during removals and installing plastic sheeting over the opening.
- E. Work Area Preparation for Interior Removal:
1. Isolate all HVAC equipment, including installing plastic sheeting on all air returns and exhausts. Turn off all HVAC systems serving work area when feasible.
 2. All floor areas adjacent to the work area shall have a layer of 6 mil fire retardant plastic sheeting, attached to the interior wall and laid down on the surfaces below the abatement work area, at least 5 feet wide or to the furthest point of gravity fall for dislodged debris by methods used, whichever is further.
 3. All movable objects shall be removed from the immediate work area. All non-movable objects shall be covered with one layer of 6 mil fire retardant plastic sheeting and sealed at the edges.
 4. All operable windows within the work area shall be closed.
 5. Temporary dust barriers consisting of a minimum of 6-mil fire-retardant plastic sheeting shall be installed at hallways, corridors, doorways, and other openings to the work area not used for passage during removals) to establish work area containment enclosure.
 6. A 6-mil fire retardant plastic sheeting overlapping curtained doorway shall be installed at the entrance to the work area.
 7. For all work areas with use of electromechanical tools for PCB removals, HEPA filtered negative air ventilation units must be installed in work area and operate continuously during removal operations to establish negative pressure. A minimum of 4 air changes per hour must be maintained within work area during removals and cleanings until work area clearance is obtained from the APM.

3.3 REMOVAL OF PCB MATERIALS - GENERAL

- A. PCB-containing materials shall be removed in accordance with the Contract Documents.
- B. Non-PCB items remaining such as windows, doors, masonry, and all other building construction and components from which PCB materials are removed shall be decontaminated by physical or chemical means (such as stripper) such that no visible residue remains. The removal of the PCB materials may require the use of scrapers, solvents, mastic removal chemicals, or other methods/procedures to ensure complete removal.
- C. Use tools that generate the least amount of dust and will still complete the PCB caulk removal. See current EPA regulations and recommendations regarding tools and protective measures to be used for PCB caulk removals.
- D. Grinding electromechanical tools (e.g. angle grinders, masonry groove cutters, circular saws, and slot mills, etc.) are not allowed to be used for exterior open-air PCB caulk removals.
- E. For exterior removals, take appropriate precautions (e.g. install windscreens) to prevent dust and debris from migrating due to windy conditions.
- F. Remove accessible caulk that could be disturbed before cutting building components, such as window frames.
- G. All removed PCB material shall be placed into 6 mil plastic disposal bags or other suitable container upon detachment from the substrate. Large components with PCB material or PCB residue shall be

wrapped in one layer of 6 mil plastic sheeting. Sharp components likely to tear disposal bags shall be placed in fiber drums or boxes and then wrapped with sheeting.

- H. Power or pressure washers are not permitted for PCB removal or clean-up procedures.
- I. All construction and demolition debris determined by the Environmental Consultant to be contaminated with PCB shall be handled and disposed of as PCB waste. If non-porous (e.g. metal) removed components previously in contact with non-liquid PCBs are to be cleaned and decontaminated prior to disposal as non-PCB waste, the requirements of 40 CFR 761 Subpart D shall be met, including cleaning to Visual Standard No. 2, Near-White Blast Cleaned Surface Finish of the National Association of Corrosion Engineers (NACE). The project monitor shall verify compliance with Standard No. 2, by visually inspecting all cleaned removed components. The Contractor shall note that a near-white metal blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products, and other foreign matter.
- J. All PCB waste must be located at or near the point of generation, under the control of the Project Supervisor. Up to 55 gallons may be stored at the point of generation for an indefinite period, but any more than 55 gallons must be moved within 3 days to a Container storage area (CSA) as specified in 6 NYCRR Section 372.2 "Standards Applicable to Generators of Hazardous Waste", or off site. Waste may be stored at the CSA for 90 days, during which labeling, inspections, and other requirements must be met as described in 6 NYCRR Section 372.2, Section 373-3.1(d) and Subpart 373-3.
- K. The CSA and personnel managing it must also meet the following requirements of 6 NYCRR 373:
 - 1. Preparedness and Prevention provisions of Section 373-3.3
 - 2. Secondary containment requirements of 373-2.9(f)(1)
 - 3. Personnel training in section 373-3.2
 - 4. Contingency plans and emergency procedures in section 373-3.4 subparagraph 376.1(g)(1)(v)
 - 5. The containers must be dated when placed in storage, and accumulation times must be observed
 - 6. The total amount of hazardous waste stored in the storage area at one time is 13,200 lb.
 - 7. A label or sign stating "Hazardous Waste" must identify all areas and containers used to accumulate hazardous waste
- L. Closure of the CSA. If an EPA ID number and CSA were created specifically for the PCB removal work, once the removal work is complete the Contractor shall immediately close out the CSA, notify the DEC/EPA that the hazardous waste activity has concluded, and that the storage area is to be closed per 373-3.7(b) and (e).
- M. The Contractor is required to provide temporary protection of the building (i.e. roof, window openings, construction joints, etc.) at the end of each Work shift so as to maintain the building in a watertight condition.
- N. Personal protective equipment, including respirators, shall be utilized and worn during all removal operations until the Work Area is cleared by the APM.
- O. Following completion of gross abatement and after all accumulations of PCB waste materials have been containerized, the decontamination procedures in Section 3.6 shall be followed.
- P. Dry sweeping and any other methods that raise dust shall be prohibited.

3.4 REMOVAL OF PCB MATERIALS – LIGHT BALLASTS

- A. Federal and state regulations require PCB-containing light ballasts to be managed and disposed of as hazardous wastes, and the building owner/waste generator is required to notify the National Response Center (NRC) when disposing one pound or more of PCBs in a 24-hour period. Bis(2-ethylhexyl)

phthalate (BEHP) – containing light ballasts can be managed and disposed of as general construction and demolition (C&D) debris up to a reportable quantity of one hundred pounds. The NRC must be notified when the quantity of BEHP-containing light ballasts to be disposed of exceeds the referenced reportable quantity. Similar to PCB-containing light ballasts, BEHP-containing light ballasts that exceed the reportable quantity are to be managed and disposed of as hazardous waste.

- B. Ensure that all light fixtures are deenergized prior to removal.
- C. Inspect light ballasts for leaks and for labels indicating the presence or absence of PCB. Ballasts labeled as containing PCB or unlabeled shall be considered PCB-containing ballasts. Ballasts labeled as not containing PCBs shall be considered BEHP-containing ballasts.
- D. Segregate any identified leaking PCB-containing ballasts from non-leaking PCB-containing ballasts. Do not remove leaking PCB-containing ballasts from light fixtures until proper containment and spill cleanup methods are established, as described in Section 3.5. Remove non-leaking PCB-containing ballasts and package in NYSDOT-approved drums that are lined with 6 mil polyethylene bags. Place 1 to 3 inches of absorbent material at the bottom of the drums and place the ballasts in layers with 1 to 3 inches of absorbent material between each layer.
- E. BEHP-containing ballasts can be disposed of as general C&D debris, provided that the total quantity of light ballasts within the facility is less than one hundred pounds total. Alternatively, the BEHP-containing ballasts can be packaged with the PCB-containing ballasts and be disposed of as hazardous waste.
- F. Label containers as described in Section 2.2.
- G. Store waste containers on an impermeable barrier in a secured, demarcated location. Provide spill prevention controls, as necessary.
- H. Ensure that the time periods for on-site storage of generated wastes do not exceed the maximum timeframes permitted by federal, state, and local regulations.

3.5 SPILL CLEANUP

- A. PCB spills must be reported immediately. Subsequent to discovery, install barriers and caution signs around the perimeter of the affected area. Using appropriate PPE and handling methods, immediately transfer leaking items to a drip pan or other container. The following general procedures apply to cleanup of areas affected by PCB-containing items.
 - 1. Install requisite containment barriers.
 - 2. Utilize cleanup methods that eliminate the potential for cross-contamination and do not further spread the contamination.
 - 3. Contain and clean up liquid waste with rags or other conventional absorbent materials.
 - 4. Wipe all surfaces formerly in contact with PCB-contaminated material or otherwise exposed during removal procedures with reagent-grade solvent (applicable and approved per 40 CFR Part 761.79(c)) to remove any residual surface PCB contamination prior to collection of a confirmatory sample.
 - 5. Containerize wastes derived from the cleanup process with project-related PPE and containment wastes for subsequent off-site disposal as PCB waste.
 - 6. Waste receptacles must adhere to the regulatory requirements and be suitable to the type of waste being removed.
 - 7. Document the cleanup with records of decontamination in accordance with 40 CFR 761, Section 125. Provide test results of cleanup and certification of decontamination.

3.6 EQUIPMENT AND AREA DECONTAMINATION

- A. When removal of PCB materials is completed, the decontamination process shall consist of vacuuming (with a HEPA filter), wet wiping/mopping and a repeated vacuuming (with a HEPA filter) of the entire work area. All surfaces in and around the work area must be free of dust generated during the work.
- B. Decontaminate all tools and equipment before removal from the work area.
- C. If dust or debris has migrated to areas of the building other than the immediate work area, those areas shall be incorporated into the work area and thoroughly decontaminated to ensure all visible dust generated by the activity is eliminated.
- D. Uncontaminated dust barriers and other protective sheeting shall be placed in disposable construction bags and disposed of as normal trash.
- E. Visually inspect the area for any remaining dust or debris. Vacuum (with HEPA filter) and wet wipe until space is clean. Dispose of vacuum contents as PCB waste.
- F. Upon completion of decontamination and removing temporary dust barriers, a final inspection shall be performed by the Contractor and Abatement Project Monitor. As a result of any visual inspection by the Abatement Project Monitor, the Contractor will clean or reclean the affected areas at no additional expense to the Owner.

PART 4 DISPOSAL OF PCB WASTE

4.1 TRANSPORTATION AND DISPOSAL SITE

- A. The Contractor's Hauler and Disposal Site shall be approved by the Owner. For any permitted out-of-state landfill not specifically authorized for disposal of PCBs, written notice must be provided 15 days prior to the first shipment of the same waste stream that the waste may contain PCBs greater than 50ppm, in accordance with 40 CFR 761.62. The letter shall be acknowledged via a disposal facility representative's signature, printed name and title. If the facility is permitted to accept PCB waste, no letter is required. Note: For disposal within New York State, facilities must be specifically permitted to accept PCB waste.
- B. The Contractor shall give twenty-four (24) hour notification prior to removing any waste from the site. Waste shall be removed from the site only during normal working hours unless otherwise specified. No waste may be taken from the site unless the Contractor and Environmental Consultant are present and the Environmental Consultant authorizes the release of the waste as described herein.
- C. All waste generated as part of the PCB project shall be removed from the site within ten (10) calendar days after successful completion of all PCB abatement work.
- D. Upon arrival at the Project Site, the Hauler must possess and present to the Environmental Consultant a valid New York State Department of Environmental Conservation Part 364 Waste Hauler's Permit. The Environmental Consultant may verify the authenticity of the hauler's permit with the proper authority.
- E. The Hauler, with the Contractor and the Environmental Consultant, shall inspect all material in the transport container prior to taking possession and signing the Hazardous Waste Manifests.

4.2 WASTE STORAGE CONTAINERS

- A. All waste containers shall be fully enclosed and lockable (i.e. enclosed dumpster, trailer, etc.).

- B. The Environmental Consultant shall verify that the waste storage container and/or truck tags (license plates) match that listed on the New York State Department of Environmental Conservation Part 364 permit. Any container not listed on the permit shall be removed from the site immediately.
- C. The container shall be plasticized and sealed with one layer of 6 mil plastic. Once on site, it shall be kept locked at all times, except during load out. The waste container shall not be used for storage of equipment or contractor supplies.
- D. While on-site, the container shall be labeled with PCB Warning Labels and DEC Hazardous Waste Labels as specified in Section 2.2.
- E. The New York State Department of Environmental Conservation Waste Hauler's Permit number shall be stenciled on both sides and back of the container.
- F. The container is not permitted to be loaded unless it is properly plasticized, has the appropriate danger signage affixed, and has the permit number appropriately stenciled on the container.
- G. The Owner may initiate random checks at the Disposal Site to insure that the procedures outlined herein are complied with.

4.3 HAZARDOUS WASTE MANIFESTS

- A. A New York State Uniform Hazardous Waste Manifest shall be utilized solely as the waste Manifest for transportation. A hauler billing form or bill of lading may be used if the hauler needs an independent record, but shall not be used as a shipping document.
- B. The Manifest shall be completed by the Contractor and verified by the Environmental Consultant that all the information and amounts are accurate and the proper signatures are in place.
- C. The Manifest shall have the appropriate signatures of the Owner's Representative (the Generator) and the Hauler representative prior to any waste being removed from the site.
- D. Copies of the completed Manifest shall be retained by the Environmental Consultant and shall remain on site for inspection.
- E. Upon arrival at the Disposal Site, the Manifest shall be signed by the Disposal Facility operator to certify receipt of PCB materials covered by the manifest.
- F. The Disposal Facility operator shall return the original Manifest to the Owner's Representative (the Generator) as required by the DEC in 6 NYCRR 372 within 45 days. The Environmental Consultant must call the facility to investigate if not returned within 35 days, and call the DEC and file an Exception report if not returned within 45 days.
- G. The Contractor shall utilize the Waste Disposal Log provided by the Owner. This log shall be maintained by the Project Supervisor and shall be kept on site at all times. (See Appendix A.)
- H. Originals of all waste disposal manifests disposal logs shall be submitted by the Contractor to the Owner with the final close-out documentation.
- J. The Contractor must also submit reports and records per the requirements of 6 NYCRR 372.2

APPENDIX A

WASTE MANIFEST LOG

WASTE MANIFEST LOG

Facility: _____

Building: _____

Project: _____

Project Number: _____

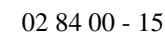
PCB Contractor: _____

Environmental Consultant: _____

Load No.	Hauler	NYSDEC #	License Plate No.	Size of Container	DATES (Chain of Events)			
					Departed from Site	Rec'd at Disposal Site	Manifest Returned	
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____	_____

COMMENTS:

PCB MATERIAL REMOVAL



APPENDIX B

CONTRACTOR'S ACKNOWLEDGEMENT STATEMENT

CONTRACTOR'S ACKNOWLEDGEMENT STATEMENT

Re: Abatement of PCB Materials

(Project Title)

(Project Location)

In consideration of the following individuals' employment in connection with the abatement, handling, and disposal of PCB Materials at the referenced project, I hereby certify that the employees: a) have received the medical examinations required by OSHA 29 CFR 1926.134; b) have been fit tested specifically for respirators used on the Project; and c) have received training in the proper handling of PCB materials, including the health implications and risks involved, as well as the use and limitations of the of personal protective equipment to be used.

Employee Name

**Social Security #
(last 4 digits)**

State	Driver	License
ID#		

[illegible]

Supervisor Signature

Printed Name

(Notary Block Here)

Title

SECTION 030100
MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cleaning of existing concrete surfaces.
- B. Patch exposed precast and cast-in-place concrete surfaces where existing fire protection and plumbing items have been removed or relocated.
- C. Resurfacing of concrete surfaces having spalled areas and other damage.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling: Coordinate and schedule cleaning with Owner to avoid disruption of Owner-occupied spaces and entry. Perform cleaning only during hours approved by Owner. Coordinate cleaning and repair work with the work of other trades.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.
- C. Application/Installation Instructions: Provide manufacturer's standard application or installation instructions for each product or material to be applied or installed.

1.4 CLEANING TEST

- A. Test Area: Test a minimum of 4 feet by 4 feet on each type of masonry, concrete, or precast concrete. Use manufacturer's application instructions. Let the test panel dry 3 to 7 days before inspection. Keep test panels available for comparison throughout the cleaning project.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

PART 2 PRODUCTS

2.1 CLEANING MATERIALS

- A. Acidic Cleaning Agent:
 - 1. Manufacturers:
 - a. Prosoco, Inc., 3741 Greenway Circle, Lawrence, KS 66046. Phone: (800) 255-4255; Fax: (785) 830-9797. E-mail: CustomerCare@prosoco.com.
 - b. An approved equal.
 - c. Substitutions: See Section 016000 - Product Requirements.

2. Product Description
 - a. Sure Klean Light Duty Concrete Cleaner is a general-purpose, non-etching acidic cleaner that removes rust, mud, atmospheric dirt, mortar smears, and other stains without altering the surface texture. Light Duty Concrete Cleaner is specifically formulated to remove common construction and atmospheric staining from a variety of substrates, including smooth architectural and engineered concrete, custom masonry, concrete brick, manufactured stone, and decorative pavers.
3. Typical Technical Data
 - a. Form: Clear, colorless liquid with slight odor
 - b. Specific Gravity: 1.129
 - c. pH: 0.976 (at 1 to 2 dilution)
 - d. Weight/Gal: 9.39 pounds
 - e. Total Solids: Not Applicable
 - f. VOC Content: Not Applicable
 - g. Flash Point: Not Applicable
 - h. Freeze Point: 12 degrees F
 - i. Shelf Life: 3 years in tightly sealed, unopened container
4. Limitations
 - a. Acidic contents may damage polished masonry, some non-masonry, and acid-sensitive surfaces.
 - b. May remove some surface-applied accent colors. Always test to confirm suitability and results prior to overall application.
 - c. Not for use on low-E glass; acrylic or polycarbonate sheet glazing; and glazing with surface-applied reflective, metallic, or other synthetic coatings and films.

2.2 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

- A. Manufacturers:
 1. Euclid Chemical Company: www.euclidchemical.com.
 2. SpecChem, LLC: www.specchemllc.com.
 3. W. R. Meadows, Inc: www.wrmeadows.com.
 4. Substitutions: See Section 016000 - Product Requirements.
- B. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.
 1. In-place material resistant to freeze/thaw conditions.
 2. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
 3. Manufacturers:
 - a. Euclid Chemical Company; EucoRepair V100: www.euclidchemical.com/#sle.
 - b. SpecChem, LLC; RepCon V/O: www.specchemllc.com.
 - c. W. R. Meadows, Inc; Meadow-Crete GPS: www.wrmeadows.com.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.3 ACCESSORIES

- A. Water: Clean and potable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means acceptance of substrate.

3.2 CLEANING EXISTING CONCRETE

- A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage. Protect in accordance with Manufacturer's recommendations.
- B. Before applying, read "Preparation" and "Safety Information" section in the Manufacturer's Product Data Sheet for Light Duty Concrete Cleaner. Dilute Light Duty Concrete Cleaner concentrate with 2 to 6 parts clean, potable water depending upon the substrate. Refer to Product Data Sheet for recommended dilution for intended use.
 - 1. Working from the bottom to the top, always prewet surface with fresh water. When cleaning vertical surfaces, keep lower areas wet to avoid streaking.
 - 2. Apply diluted cleaning solution directly to surface with recommended masonry brush or low-pressure spray.
 - 3. Let cleaner stay on the surface for 3-5 minutes or until stains are gone. Do not allow cleaner to dry on the surface; staining may result. If drying occurs, lightly wet treated surfaces with fresh water and reapply in a gentle scrubbing manner. If treated surfaces are left unattended, keep people away from the cleaner.
 - 4. Working from the bottom to the top, reapply cleaner and rinse thoroughly with fresh water to get all residues off the surface. If pressure-rinsing equipment is not available, brush the surface while rinsing with clean water. The best combination of rinsing pressure and water volume is provided by masonry washing equipment generating 400-1,000 psi with a water flow rate of 6-8 gallons per minute delivered through a 15-45 degree fan spray tip. Equipment should be adjustable to reduce water flow rate and rinsing pressure as required for controlled cleaning of more sensitive surfaces. See also "Equipment" section of the Product Data Sheet.
 - 5. Note: Multiple applications may etch acid-sensitive surfaces.
- C. Cleanup: Clean tools and equipment using fresh water.

3.3 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS

- A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.
- B. Follow bonding agent and repair mortar manufacturer's written installation instructions.
- C. Apply coating of bonding agent to entire concrete surface to be repaired.
- D. Fill voids with cementitious mortar flush with surface.
- E. Trowel finish to match adjacent concrete surfaces.
- F. Damp cure for four days.

END OF SECTION

SECTION 031513
PVC WATERSTOPS FOR CONCRETE JOINTS

PART 1 - GENERAL

1.1 Provision Includes

- A. Embedded waterstop in concrete including contraction, expansion and construction joints creating a continuous diaphragm to prevent the passage of fluid.
- B. The use of nonmetallic waterstops for use in concrete joints subjected to chlorinated water, sea water, and many waterborne chemicals.

1.2 References

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

- A. American Society for Testing and Materials (ASTM)
- B. Federal Specifications
 - 1. COE CEGS-03250 July 1995 Guide Specification for Military Construction.
 - 2. Corps of Engineers — CRD C572-74
 - 3. Bureau of Reclamation — C-902
- C. Canadian General Standards Board
 - 1. 41-GP-35M Types 1 and 3
- D. NSF International
 - 1. NSF/ANSI Standard 61 Certification for Drinking Water System Components — Health Effects.

1.3 Submittal Procedures

- A. Flexible PVC Waterstop
 - 1. PVC Waterstop submittal shall contain the following:
 - a. Samples of each size and shape to be used.
 - b. Plate drawings of the waterstop profile indicating all dimensions.
 - c. Shop drawings of shop made fittings to be provided by the manufacturer or prepared by the contractor.
 - d. Manufacturer's Literature, MSDS sheets, installation, safety, and splicing instructions.
 - e. Certificate of compliance to physical properties outlined in this specification with third-party independent test reports (all testing reports within three years of date of submittal).
 - 2. Flexible PVC Waterstop and Splices — Specimens identified to indicate manufacturer, type of material, size, quantity of material, and shipment or lot represented. Each sample shall be not less than 6 inches long of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the shop and every 10 splices made at the job site. The splice samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 12 inches long.

1.4 Delivery and Storage

- A. Material delivered and placed in storage shall be stored off the ground and protected from sunlight, moisture, dirt, and other contaminants.

PART 2 - PRODUCTS

2.1 Flexible PVC Waterstop

Intersection and change of direction waterstops shall be factory fabricated.

- A. Manufacturer:
1. J P Specialties, Inc. — Murrieta, CA, USA 92562 — Phone 800-821-3859; 951-763-7077; Fax 951-763-7074; Web www.earthshield.com; E-mail davidp@earthshield.com
 2. An approved equal.
- B. Flexible Polyvinyl Chloride (PVC) Waterstop shall be manufactured from a prime virgin, flexible polyvinyl chloride (PVC) compound, containing no pigments, scrap or reclaimed material.
- C. Flexible Polyvinyl Chloride (PVC) Waterstop shall be certified for use in potable water per NSF/ANSI Standard 61. Third-party certified documentation to be provided by manufacturer.
- D. Flexible Polyvinyl Chloride (PVC) Waterstop shall be California Prop 65 compliant and contain no hazardous phthalates.

2.2 Flexible Polyvinyl Chloride (PVC) Waterstop shall conform to the following typical physical properties:

Property	Test Method	Required Results
Specific Gravity	ASTM D 792	1.38 to 1.40
Shore A Hardness (15 sec.)	ASTM D 2240	77±3 at 25°C (77°F)
Tensile Strength	ASTM D638	2,100 psi
Ultimate Elongation	ASTM D638	400%
Stiffness in Flexure	ASTM D747	700 psi
Tear Resistance	ASTM D624	320 lbs./inch
Brittle Point	ASTM D746	-37°C (-35°F) No Failure
Accelerated Extraction Tensile Strength	Corps of Engineers	2,005 psi
Accelerated Extraction Elongation	Corps of Engineers	390%
Effect of Alkali Weight Change	CRD C572-74	+0.11%
Effect of Alkali Hardness Change	CRD C572-74	-0.6 points
Drinking Water Safe	NSF/ANSI 61	Waterstop certified by NSF for use in potable water
California Prop 65	CA Prop 65	Compliant — No hazardous phthalates

PART 3 - EXECUTION

3.1 General

- A. Waterstop, Installations and Splices — Waterstops shall be installed at the locations shown to form a continuous fluid-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified, trained personnel using approved equipment and procedures.
- B. Flexible PVC Shop Made Fittings — Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper template (profile dependent), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined and using an ST-10® waterstop splicing tool. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.
- C. Flexible PVC Waterstop — The splicing of straight lengths shall be done by squaring the ends to be joined and using an ST-10® waterstop splicing tool utilizing a thermoplastic splicing iron with a non-stick surface specifically designed for waterstop welding. The correct temperature (350°F to 380°F) shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2 Preparation

- A. Uncoil waterstop 24 hours prior to installation for ease of handling and fabrication.
- B. Position waterstop to ensure proper distance from steel reinforcing bars to prevent rock pockets and honeycomb (see installation section 3.04).
- C. Protect waterstop from damage during progress of work.
- D. Clean concrete joint after first pour to remove debris and dirt.

3.3 Examination/Inspection

- A. Prior to placement of concrete notify engineer for field inspection approval.
- B. Inspect waterstop and field splices for defects and conformance to Quality Assurance Standard section 3.05.
- C. Upon inspection of waterstop installation, replace any damaged or unacceptable waterstop and dispose of defective material.

3.4 Installation

- A. Position waterstop in joint as indicated on drawings.
- B. Center waterstop on joint, with approximately one-half of waterstop width to be embedded in concrete on each side of the joint.

- C. Allow clearance between waterstop and reinforcing steel of a minimum two times the largest aggregate size. Prevent rock pockets and air voids caused by aggregate bridging.
 - D. Ensure centerbulb is not embedded at expansion joints.
 - E. Secure waterstop in correct position using optional factory-installed brass eyelets (or JPS hog rings crimped between last two ribs on 12 inch maximum centers), and wire tie to adjacent reinforcing steel. Center-to-center spacing may be increased upon written request and approval from ENGINEER.
 - F. Carefully place concrete without displacing waterstop from proper position.
 - G. Thoroughly and systematically vibrate concrete in the vicinity of the joint, and to maximized intimate contact between concrete and waterstop.
 - H. After first pour, clean unembedded waterstop leg to ensure full contact of second concrete pour. Remove laitance, spillage, form oil and dirt.
- 3.5 Quality Assurance — Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following:
- A. Tensile strength not less than 60 percent of parent sections.
 - B. Free lap joints.
 - C. Misalignment of centerbulb, ribs, and end bulbs greater than 1/16 inch.
 - D. Misalignment which reduces waterstop cross section ore than 15 percent.
 - E. Bond failure at joint deeper than 1/16 inch or 15 percent of material thickness.
 - F. Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 inch in 10 feet.
 - G. Visible porosity in the weld.
 - H. Charred or burnt material.
 - I. Bubbles or inadequate bonding.
 - J. Visible signs of splice separation when cooled splice (24 hours or greater) is bent by hand at sharp angle.

END OF SECTION

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Footings.
 - 2. Foundation walls.
 - 3. Slabs-on-grade.
 - 4. Slabs on Steel Deck
 - 5. Concrete toppings.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.
 - 2. Division 7 Section "Sheet Waterproofing" for underslab waterproofing membrane.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture submit appropriate concrete design mix, signed and sealed by a New York State licensed Professional Engineer. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar

diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal.

- E. Current welding certificates.

- F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates (Report to include record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity).

- G. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semi-rigid joint filler.
13. Joint-filler strips.
14. Repair materials.

- H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances: 1/8" per 10'.

- I. Field quality-control test and inspection reports.

- J. Minutes of pre-installation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to the Owner/Owner Representative/Engineer of Record qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code-Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 1. ACI 301, "Specification for Structural Concrete,"
 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Waterproofing installer.
 - f. Waterproofing manufacturer field representative.
 2. Review special inspection, testing, and inspecting agency procedures for field quality control, concrete finishes and finishing, cold and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi-rigid joint fillers, forms and form removal limitations, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
- B. Water-stops: Store water-stops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.
 - 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

- D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive damp-proofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A1064, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I/II
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 1/2-inch nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
 - 1. Products:
 - a. Boral Material Technologies, Inc.; Boral BCN.
 - b. Euclid Chemical Company (The); Eucon CIA.
 - c. Grace Construction Products, W. R. Grace & Co.; DCI.
 - d. Master Builders, Inc.; Rheocrete CNI.
 - e. Sika Corporation; Sika CNI.

- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products:

- a. Axim Concrete Technologies; Catexol 1000CI.
- b. Boral Material Technologies, Inc.; Boral BCN2.
- c. Cortec Corporation; MCI 2000, 2005NS.
- d. Grace Construction Products, W. R. Grace & Co.; DCI-S.
- e. Master Builders, Inc.; Rheocrete 222+.
- f. Sika Corporation; FerroGard-901.

2.7 SHEET WATERPROOFING

- A. See Section 071326 and 071326.01

2.8 GRANULAR FILL MATERIALS

- A. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- B. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D 448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.9 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products:

- a. Axim Concrete Technologies; Cimfilm.
- b. Burke by Edoco; BurkeFilm.
- c. ChemMasters; Spray-Film.
- d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
- e. Euclid Chemical Company (The); Eucobar.
- f. L&M Construction Chemicals, Inc.; E-Con.
- g. Meadows, W. R., Inc.; Sealtight Evapre.
- h. Sika Corporation, Inc.; SikaFilm.
- i. Approved equal

- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

2.10 RELATED MATERIALS

- A. Expansion-and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings and Foundation Walls: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.50.
 - 3. Slump Limit: 3 to 6 inches.
 - 4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi (NWC 145 pcf) at 28 days.
2. Minimum Cementitious Materials Content: 520 lb/cu. yd.
3. Slump Limit: 3 to 6 inches.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

C. Slabs on Steel Deck: Proportion structural lightweight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C 567.
3. Slump Limit: 3 to 5 inches.
4. Air Content: 6 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size greater than 3/8 inch.
5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

2.13 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.

- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Do not chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50

deg F 48 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 VAPOR RETARDERS

- A. Provide Sheet Waterproofing in accordance with Sections 071326 and 071326.01.
- B. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 1. Lap joints 6 inches and seal with manufacturer's recommended tape.
- C. Granular Course: Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.
 1. Place and compact a 1/2-inch thick layer of fine-graded granular material over granular fill.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset

laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 2 inches into concrete.
 - 3. Locate horizontal joints in walls and columns at underside of floors, and at the top of footings or floor slabs.
 - 4. Space vertical joints in walls at 60 ft on center maximum, and 10 ft from wall corners. Locate joints beside piers integral with walls, and in concealed locations where possible.
 - 5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 - 2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.
 1. Apply scratch finish to surfaces as indicated in construction documents, and where to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces as indicated in construction documents.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface.
 - a. Specified overall values of flatness F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for slabs on steel deck.
 3. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8".
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system. See construction documents for locations.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F 35; and of levelness, L 25; with minimum local values of flatness, F 24; and of levelness, L 17; for slabs-on-grade.
 - b. Specified overall values of flatness, F 30; and of levelness, L 20; with minimum local values of flatness, F 24; and of levelness, L 15; for suspended slabs.
 3. Finish and measure surface so gap at any point between concrete surface and an unveled, freestanding, 10-foot long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound

manufacturer[unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project].

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least two months. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.

4. Curing procedures and maintenance of curing temperature.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

END OF SECTION 03300

SECTION 034100
PRECAST STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grout packing.
- B. Connection and supporting devices.
 - 1. Lintels.

1.2 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete 2019, with Errata (2021).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- D. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- E. IAS AC157 - Accreditation Criteria for Fabricator Inspection Programs for Reinforced and Precast/Prestressed Concrete 2017.
- F. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products 1999.
- G. PCI MNL-123 - Design and Typical Details of Connections for Precast and Prestressed Concrete 1988.
- H. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction 2000.
- I. UL (FRD) - Fire Resistance Directory Current Edition.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a pre-installation conference one week prior to commencing work of this section.
 - 1. Discuss limitations, if any, on field cutting of openings.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate standard component configurations, design loads, deflections, cambers, and bearing requirements.
- C. Shop Drawings: Indicate layout, unit locations, fabrication details, unit identification marks, reinforcement, connection details, support items, dimensions, openings, and relationship to adjacent materials. Indicate design loads, deflections, cambers, bearing requirements, and special conditions.
 - 1. Submit reviewed shop drawings and design data to authorities having jurisdiction for approval.

- D. Design Data: Submit design data reports indicating calculations for loadings and stresses of fabricated, designed framing.
- E. Designer's Qualification Statement.
- F. Fabricator's Qualification Statement: Provide documentation showing precast concrete fabricator is accredited under IAS AC157.
- G. Sustainable Design Reporting: If any fly ash, ground granulated blast furnace slag, silica fume, rice hull ash, or other waste material is used in mix designs to replace Portland cement, submit the total volume of concrete, mix design(s) used showing the quantity of Portland cement replaced, reports showing successful cylinder testing, and temperature on day of pour if cold weather mix is used.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Design precast concrete members under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: Precast concrete fabricator accredited by IAS according to IAS AC157.
- C. Erector Qualifications: Company specializing in erecting products of this section with not less than three years documented experience and approved by precast manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Handle precast members in position consistent with their shape and design. Lift and support only from support points.
- B. Lifting or Handling Devices: Capable of supporting member in positions anticipated during manufacture, storage, transportation, and erection.
- C. Protect members to prevent staining, chipping, or spalling of concrete.
- D. Mark each member with date of production and final position in structure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Structural Precast Concrete:
 - 1. Any manufacturer holding a PCI Group C Plant Certification for the types of products specified; see www.pci.org/find/manufacturer.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 PRECAST UNITS

- A. Precast Structural Concrete Units: Comply with PCI MNL-116, PCI MNL-120, PCI MNL-123, PCI MNL-135, ACI 318 and applicable codes.
 - 1. Design components to withstand dead loads and design loads in the configuration indicated on drawings and in accordance with applicable live loads indicated on structural drawings.
 - 2. Calculate structural properties of framing members in accordance with ACI 318.
 - 3. Fire Resistance: Provide designs tested to provide ratings as follows:

- a. Wall Assembly: Comply with UL (FRD) Assembly No. , hour rating.
4. Design system to accommodate construction tolerances, deflection of other building structural members and clearances of intended openings.

2.3 MATERIALS

- A. Cement: White Portland type, complying with ASTM C150/C150M, Type I.
- B. Aggregate, Sand, Water, Admixtures: Determined by precast fabricator as appropriate to design requirements and PCI MNL-116.

2.4 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi).
 1. Plain billet-steel bars.
 2. Unfinished.

2.5 FABRICATION

- A. Comply with fabrication procedures specified in PCI MNL-116.
- B. Ensure reinforcing steel, anchors, inserts, plates, angles, and other cast-in items are embedded and located as indicated on shop drawings.

2.6 FABRICATION TOLERANCES

- A. Comply with fabrication tolerances specified in PCI MNL-135.

2.7 FINISHES

- A. Ensure exposed-to-view finish surfaces of precast concrete members are uniform in color and appearance.
- B. Cure members under identical conditions to develop required concrete quality, and minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
- C. Finish members to PCI MNL-116 Commercial grade.
- D. Plant Finish: Normal plant finish; surface may contain small surface holes caused by air bubbles, minor chips or spalling at edges or ends, without major discoloration.

2.8 ACCESSORIES

- A. Connecting and Supporting Devices; Anchors and Inserts: Plates, angles, items cast into concrete, items connected to steel framing members, and inserts complying with PCI MNL-123 and as follows:
 1. Material: Carbon steel complying with ASTM A36/A36M.
 2. Finish: Prime painted, except where device surfaces will be in contact with concrete or will require field welding.
- B. Grout: Non-shrink, non-metallic, minimum yield strength of 10,000 psi at 28 days.
 1. Type: Epoxy.
- C. Bearing Pads: High density plastic, Vulcanized elastomeric compound molded to size, Neoprene (Chloroprene), or Tetrafluoroethylene(TFE); Shore A Durometer 90 minimum; 1/8 inch thick, smooth both sides.

- D. Bolts, Nuts and Washers: High strength steel type recommended for structural steel joints.

2.9 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Provide mix design for concrete.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive work and field measurements are as indicated on shop drawings.

3.2 PREPARATION

- A. Prepare support equipment for the erection procedure, temporary bracing, and induced loads during erection.

3.3 ERECTION

- A. Erect members without damage to structural capacity, shape, or finish. Replace or repair damaged members.
- B. Maintain temporary bracing in place until final support is provided. Protect members from staining.
- C. Install bearing pads.
- D. Grout underside of column bearing plates.
- E. Secure units in place. Perform welding in accordance with AWS D1.1/D1.1M.

3.4 TOLERANCES

- A. Erect members level and plumb within allowable tolerances.
- B. Comply with PCI MNL-135 for erection tolerances.

3.5 PROTECTION

- A. Protect members from damage caused by field welding or erection operations.

END OF SECTION

SECTION 034123
PRECAST CONCRETE STAIRS

PART 1 GENERAL

1.1 Description

- A. Work Included: These specifications cover manufacture, transportation and erection of precast concrete stairs and landings.
- B. Related Sections:
 - 1. 03300 – Cast-in-Place Concrete: Site Cast Precast
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

1.2 Quality Assurance

- A. Manufacturer Qualifications: Precast Prestressed Concrete Institute (PCI) Plant Certification Program and shall be certified in category C1.
- B. Erector Qualifications: Precast Prestressed Concrete Institute Qualified Erector and regularly engaged for at least 5 years in the erection of precast structural concrete similar to the requirements of this project. Retain a registered structural engineer to certify that erection is in accordance with design requirements.
- C. Welder Qualifications: In accordance with AWS D1.1.
- D. Codes and Standards: Comply with provision of following codes, specifications and standards, except as otherwise indicated.
 - 1. ACI 301 “Specifications for Structural Concrete”.
 - 2. ACI 318 “Building Code Requirements for Structural Concrete”.
 - 3. Concrete Reinforcing Steel Institute, “Manual of Standard Practice”.
 - 4. Precast Prestressed Concrete Institute MNL 116, Manual for Quality Control for Plants and Production of Precast Concrete Products”.
 - 5. Precast Prestressed Concrete Institute MNL 135, “Tolerance Manual for Precast and Pre-stressed Concrete Construction”.
 - 6. Precast Prestressed Concrete Institute MNL 120, “PCI Design Handbook”.
 - 7. American Welding Society, AWS D1.1 “Structural Welding Code-Steel”, D1.4 “Structural Welding Code – Reinforcing Steel”, D1.6 “Structural Welding Code - Stainless Steel”, C5.4, “Recommended Practices for Stud Welding”.
- E. Fabricator Qualifications: Fabricator must be certified producer member of the Precast/Prestressed Concrete Institute (PCI) and participate in its Plant Certification Program with a C1 classification.
- F. Performance Requirements:
 - 1. Delegated Design: Design precast concrete stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 2. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - a. Stairs shall be designed to support the full dead load plus 100 psf live load.

- b. Short term and long term deflection shall be no greater than Table 9.5 (b) of ACI-318.

1.3 Submittals and Design

- A. Shop Drawings:
 - 1. Erection drawings shall show dimensions for proper fabrication; reinforcing steel sizes, grades and locations; inserts accessories and handling methods; calculations for reinforcing; details, sections, jointing, anchoring, and all other necessary information.
- B. Tests and Reports:
 - 1. Perform all concrete testing in accordance with PCI MNL-116 requirements.

PART 2 PRODUCTS

2.1 Materials

- A. Portland cement:
 - 1. ASTM C 150, Type I or III
- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185 or A497 fabricated from plain steel wire into flat sheets having a minimum yield strength of 70,000psi.
- D. Plates and Angles: Cast-in loose plates and angles shall conform to ASTM 36.
- E. Water: Potable, clean and free from oils, acids, salts or other injurious substances.
- F. Admixtures:
 - 1. Air entrainment agents shall conform to ASTM C 260.
 - 2. Precast elements exposed to weather or vulnerable to deicers shall have 6% + 1.5% of air entrainment.
 - 3. Water reducing agent shall conform to ASTM C 494, Type A.
 - 4. High range water reducing agent shall conform to ASTM C494 Type A.
- G. Normal-Weight Aggregates:
 - 1. Fine Aggregates: ASTM C 33, washed natural sand
 - 2. Course Aggregates: Crushed stone conforming to ASTM C 33. Aggregate shall be graded crushed stone with a resulting weight of concrete up to 155 lbs./cu. ft.
- H. Grout:
 - 1. Cement shall be gray Portland cement, free from soluble salts and complying with ASTM C 150, Type I or Type III High Early Strength, one brand throughout work. Strength shall be 4,000 psi in 28 days.

2.2 Concrete Mixes

- A. 28-day compressive strength: Minimum of 5,000 psi
- B. Use of calcium chloride or admixtures containing chlorides is not permitted.

2.3 Fabrication

- A. Casting shall be done in rigidly constructed forms designed to produce dimensionally correct members with uniform surfaces per shop drawings.

- B. At time of casting, manufacturer shall incorporate all accessories, reinforcing steel and handling devices required for proper installation and handling of units.
- C. Provide finished units, which are straight, true to size and shape, and within specified casting tolerances.
- D. Make exposed edges sharp, straight, and square. Make flat surfaces into a true plane.
- E. Place and secure in the forms all anchors, clips, stud bolts, inserts, lifting devices, shear ties, and other devices required for handling and installing the precast units and for attachment of subsequent items indicated and specified.
- F. Curing:
 - 1. Form curing by moisture retention without supplemental heat until concrete reaches adequate strength for removal of product from forms, a minimum of 2,500 psi.
 - 2. Precast units shall be cured to the required 28 day strength prior to shipment.
- G. Casting tolerances: Maintain casting, bowing, warping and dimension tolerances within PCI MNL-116 and PCI MNL-135.

2.4 Product Delivery, Storage, & Handling

- A. Delivery and Handling:
 - 1. Carefully transport and handle precast concrete stairs so as to prevent soiling or damage. Store clear of ground in manner to prevent cracking, distortion, warping and to protect from damage and dirt. Soiling or staining of precast units may be cause for rejection of units. Lift and support units only at designated lifting or supporting points as shown on approved shop drawings.
- B. Delegated-Design Submittal:
 - 1. For precast concrete stairs indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Examination:
 - 1. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance of the Work.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 3. Do not install precast concrete units until supporting, building structural framing has attained minimum allowable design compressive strength or until supporting steel or other structure is complete.

PART 3. EXECUTION

3.1 Erection

- A. Work to be performed by a PCI Qualified Erector. Install in accordance with shop drawings and manufacturer's recommended installation procedures.
- B. Handling and Erection:
 - 1. Temporarily stabilize all precast work until permanent connections and/or adjoining cast-in-place concrete work or masonry has been completed and the framework is stable.

3.2 Grouting

A. Grouting:

1. After precast units have been placed and secured, grout open spaces at connections and joints between platforms and stairs, and between platforms and floor plank.
2. Place grout in a manner to finish smooth, plumb, and level with adjacent concrete surfaces.

3.3 Welding

- A. Welding shall be continuous with Low-Hydrogen rods per AWS A5.1 or A5.5

3.4 Patching

- A. Patch precast units if strength and appearance has not been impaired. Manufacturer of precast units shall point up all chopped areas. Pointed up areas shall have minimum variation in texture and color. Amount of variation shall be acceptable to the Architect.

3.5 Cleaning

- A. Remove rubbish and debris resulting from precast concrete stair work from premises upon completion.

END OF SECTION

SECTION 035400
CAST UNDERLAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Liquid-applied self-leveling floor underlayment.
 - 1. Use cementitious type at all locations.

1.2 RELATED REQUIREMENTS

- A. Section 017000 - Execution and Closeout Requirements: Alteration project procedures; selective demolition for remodeling.

1.3 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens) 2021.
- B. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete 2012.
- C. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars 2021.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Instructions.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.7 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cementitious Underlayment:
 - 1. ARDEX Engineered Cements; ARDEX V 1200 with ARDEX P51 Primer: www.ardexamericas.com.
 - 2. An approved equal.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

- A. Cast Underlayments, General:
- B. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 - 1. Compressive Strength: Minimum 4000 pounds per square inch after 28 days, tested per ASTM C109/C109M.
 - 2. Flexural Strength: Minimum 1000 psi after 28 days, tested per ASTM C348.
 - 3. Density: 125 pounds per cubic foot, nominal.
 - 4. Final Set Time: 1-1/2 to 2 hours, maximum.
 - 5. Thickness: Capable of thicknesses from feather edge to maximum 2 inch.
 - 6. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0 in accordance with ASTM E84.
- C. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/8 inch in size and acceptable to underlayment manufacturer.
- D. Reinforcement: Galvanized metal lath complying with recommendations of underlayment manufacturer for specific project circumstances.
- E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
- F. Primer: Manufacturer's recommended type.
- G. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

2.3 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Add aggregate for areas where thickness will exceed 1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.

- C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.2 PREPARATION

- A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- B. Wood: Install metal lath for reinforcement of underlayment.
- C. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- D. Vacuum clean surfaces.
- E. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- F. Close floor openings.

3.3 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Place to required thickness, with top surface level to 1/8 inch in 10 ft.
- C. For final thickness over 1-1/2 inches, place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
- D. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
- E. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.4 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

3.5 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION

SECTION 04810 - UNIT MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units (CMUs).
 - 2. Decorative concrete masonry units.
 - 3. Mortar and grout.
 - 4. Reinforcing steel.
 - 5. Masonry joint reinforcement.
 - 6. Ties and anchors.
 - 7. Miscellaneous masonry accessories.
- B. Related Sections include the following:
 - 1. Division 7 Section "Water Repellents" for water repellents applied to unit masonry assemblies.
 - 2. Division 7 Section "Fire-Resistive Joint Systems" for fire-resistive joint systems at heads of masonry walls.
 - 3. Division 7 Section "Joint Sealants" for sealing control and expansion joints in unit masonry.
- C. Products furnished, but not installed, under this Section include the following:
 - 1. Dovetail slots for masonry anchors, installed under Division 3 Section "Cast-in-Place Concrete."
 - 2. Anchor sections of adjustable masonry anchors for connecting to structural frame, installed under Division 5 Section "Structural Steel."
- D. Products installed, but not furnished, under this Section include the following:
 - 1. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."

1.3 DEFINITIONS

- A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops net-area compressive strengths $f'_m = 2000$ psi at 28 days.
- B. Determine net-area compressive strength (f'_m) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- C. Determine net-area compressive strength (f'_m) of masonry by testing masonry prisms according to ASTM C 1314.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 - 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- C. Samples for Initial Selection: For the following:
 - 1. Decorative concrete masonry units, in the form of small-scale units.
- D. Samples for Verification: For each type and color of the following:
 - 1. Decorative concrete masonry units.
 - 2. Accessories embedded in masonry.
- E. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
 - 1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- F. Qualification Data: For testing agency.
- G. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:
 - 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Grout mixes. Include description of type and proportions of ingredients.
 5. Reinforcing bars.
 6. Joint reinforcement.
 7. Anchors, ties, and metal accessories.
- H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
 2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- I. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
- J. Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below.

Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
 2. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
 3. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.
 4. Prism Test: For each type of construction required, per ASTM C 1314.
- E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and

inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
 - 2. Where 1 wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Products: Subject to compliance with requirements, provide one of the products specified.
 3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.3 CONCRETE MASONRY UNITS (CMUs)

- A. Shapes: Provide shapes indicated and as follows:
 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

- B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.
1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
 - a. Products:
 - 1) Addiment Incorporated; Block Plus W-10.
 - 2) Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block.
 - 3) Master Builders, Inc.; Rheopel.
- C. Concrete Masonry Units: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi
 2. Weight Classification: Normal Weight.
 3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
 5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.
- D. Decorative Concrete Masonry Units: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
 - a. Products:
 - 1) Grand Blanc Cement Products – Splitface Block
 2. Weight Classification: Normal Weight
 3. Size (Width): Manufactured to dimensions specified in "Concrete Masonry Units" Paragraph above.
 4. Pattern and Texture: As selected by Architect from manufacturer's full range.
 5. Colors: As selected by Architect from manufacturer's full range.
 6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.4 MASONRY LINTELS

- A. General: Provide masonry lintels complying with requirements below.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout.

Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

1. Provide solid, multicored, or hollow units, with shape and direction of cores optional, unless otherwise indicated.
2. Provide multicored units designed for use in reinforced, grouted masonry; either with vertical cores and with webs notched to receive horizontal reinforcement, or with horizontal cores and with holes in bed shells for placement of grout and to receive vertical reinforcement.
3. Where indicated for exterior applications, provide units recommended by manufacturer for exterior use in Project's location.
4. Provide special shapes where required for corners, jambs, coved bases, sills, and other special conditions indicated, including applications that cannot be produced by sawing standard units.
 - a. Provide square edged units for outside corners, unless otherwise indicated.
 - b. Provide coved internal corners.
 - c. Provide recessed, coved base units.
5. Where direct application of plaster is indicated or where bonded to backup masonry, provide units with rough, combed, or scored faces.

2.5 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
- D. Masonry Cement: ASTM C 91.
 1. Products:
 - a. Capital Materials Corporation; Flamingo Color Masonry Cement.
 - b. Essroc, Italcementi Group; Brixment or Velvet.
 - c. Holcim (US) Inc.; Mortamix Masonry Cement, Rainbow Mortamix Custom Buff Masonry Cement, White Mortamix Masonry Cement.
 - d. Lafarge North America Inc.; Magnolia Masonry Cement, Lafarge Masonry Cement, Florida Super Masonry, Trinity Super White Masonry Type S, Trinity White Masonry Type N.
 - e. Lehigh Cement Company; Lehigh Masonry Cement.
 - f. National Cement Company, Inc.; Coosa Masonry Cement.
- E. Mortar Cement: ASTM C 1329.
 1. Products:

- a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.
- F. Colored Cement Product: Packaged blend made from portland cement and lime, masonry cement, or mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
 2. Pigments shall not exceed 10 percent of portland cement by weight.
 3. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
 4. Products
 - a. Colored Portland Cement-Lime Mix:
 - 1) Capital Materials Corporation; Riverton Portland Cement Lime Custom Color.
 - 2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 3) Lafarge North America Inc.; Eaglebond.
 - 4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.
 - b. Colored Masonry Cement:
 - 1) Capital Materials Corporation; Flamingo Color Masonry Cement.
 - 2) Essroc, Italcementi Group; Brixment-in-Color.
 - 3) Holcim (US) Inc.; Rainbow Mortamix Custom Color Masonry Cement.
 - 4) Lafarge North America Inc.; Florida Custom Color Masonry or Magnolia Masonry Cement.
 - 5) Lehigh Cement Company; Lehigh Custom Color Masonry Cement.
 - 6) National Cement Company, Inc.; Coosa Masonry Cement.
 - c. Colored Mortar Cement:
 - 1) Lafarge North America Inc.; Magnolia Superbond Mortar Cement.
- G. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 3. White-Mortar Aggregates: Natural white sand or crushed white stone.
 4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- H. Aggregate for Grout: ASTM C 404.
- I. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for structural-clay tile facing units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

- J. Refractory Mortar Mix: Ground fireclay or non-water-soluble, calcium aluminate, medium-duty refractory mortar that passes ASTM C 199 test; or an equivalent product acceptable to authorities having jurisdiction.
- K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Products:
 - a. Addiment Incorporated; Mortar Kick.
 - b. Euclid Chemical Company (The); Accelguard 80.
 - c. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Morset.
 - d. Sonneborn, Div. of ChemRex; Trimix-NCA.
- L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
 - 1. Products:
 - a. Addiment Incorporated; Mortar Tite.
 - b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.
 - c. Master Builders, Inc.; Color Cure Mortar Admix or Rheomix Rheopel.
- M. Water: Potable.

2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.
- B. Masonry Joint Reinforcement, General: ASTM A 951.
 - 1. Interior Walls: Hot-dip galvanized, carbon steel.
 - 2. Exterior Walls: Hot-dip galvanized, carbon steel.
 - 3. Wire Size for Side Rods: 0.148-inch diameter (#9 gauge).
 - 4. Wire Size for Cross Rods: 0.148-inch diameter (#9 gauge).
 - 5. Spacing of Cross Rods, Tabs, and Cross Ties: 8" o.c. for exterior walls and 16" o.c. for interior walls, unless otherwise noted on plan.
 - 6. Provide in lengths of not less than 10 feet.
- C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.7 MISCELLANEOUS ANCHORS

- A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.
- B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.

- C. Anchor Bolts: Headed steel bolts complying with ASTM A 307, Grade A with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.

1. Products:

- a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
- b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
- c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
- d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.9 MASONRY-CELL INSULATION

- A. Loose-Granular Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).
- B. Molded-Polystyrene Insulation Units: Rigid, cellular thermal insulation formed by the expansion of polystyrene-resin beads or granules in a closed mold to comply with ASTM C 578, Type I. Provide specially shaped units designed for installing in cores of masonry units.

1. Products:

- a. Concrete Block Insulating Systems; Korfil.
- b. Shelter Enterprises Inc.; Omni Core.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride in mortar or grout.
 - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - 3. Limit cementitious materials in mortar for exterior and reinforced masonry to portland cement, mortar cement, and lime.
 - 4. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270 Proportion Specification. Provide Type S mortar.
- D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
 - 1. Pigments shall not exceed 10 percent of portland cement by weight.
 - 2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
 - 3. Mix to match Architect's sample.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
 - 1. Mix to match Architect's sample.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.11 SOURCE QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to perform source quality-control testing indicated below:
 - 1. Payment for these services will be made by Owner.
 - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- B. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
 - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 - 2. Verify that foundations are within tolerances specified.
 - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.
- B. Build chases and recesses to accommodate items specified in this and other Sections.
- C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
 - 2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
 - 3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.3 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.
- G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

- A. Lay hollow concrete masonry units as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.5 ANCHORING MASONRY TO STRUCTURAL MEMBERS

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
1. Provide an open space not less than 1/2 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.

3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
1. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
 2. Install preformed control-joint gaskets designed to fit standard sash block.
 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
 4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.7 LINTELS

- A. Install steel lintels where indicated.
- B. Provide masonry lintels where shown and where openings of more than 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.8 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Limit height of vertical grout pours to not more than 60 inches.

3.9 FIELD QUALITY CONTROL

- A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
 - 1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.
- B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
 - 1. Payment for these services will be made by Owner.
 - 2. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.
- C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780.
- G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- H. Prism Test: For each type of construction provided, per ASTM C 1314 at 7 days and at 28 days.

3.10 PARGING

- A. Parge masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.
- B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
- C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and non-masonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
 - 6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
 - 8. Clean stone trim to comply with stone supplier's written instructions.
 - 9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

END OF SECTION 04810

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Structural steel.
 - 2. Grout.
- B. Related Sections include the following:
 - 1. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
 - 2. Division 5 Section "Steel Deck" for field installation of shear connectors.
 - 3. Division 5 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other metal items not defined as structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand ASD-service loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction, Load and Resistance Factor Design," Volume 2, Part 9.
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified, New York State licensed professional engineer to prepare structural analysis data for structural-steel connections.
- B. Construction: Type FR, Fully Restrained Moment Connections.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
 - 1. Structural steel including chemical and physical properties.
 - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 - 3. Direct-tension indicators.
 - 4. Tension-control, high-strength bolt-nut-washer assemblies.
 - 5. Shop primers.
 - 6. Nonshrink grout.
- E. Source quality-control test reports.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- B. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
 - 3. AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings."
 - 4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 - 5. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."
 - 6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 - 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.

2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M, Grade 50 (345).
- B. HSS-Shapes: ASTM A1085, Grade 50, OR A500 (46 KSI SQUARE AND RECTANGULAR, 42 KSI ROUND)
- C. Channels, Angles-Shapes: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325(ASTM A 325M), Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563(ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436(ASTM F 436M) hardened carbon-steel washers.
 1. Finish: Plain.
 2. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8) compressible-washer type.
 - a. Finish: Plain.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head steel structural bolts with splined ends; ASTM A 563(ASTM A 563M) heavy hex carbon-steel nuts; and ASTM F 436(ASTM F 436M) hardened carbon-steel washers.
 1. Finish: Plain.
- C. Threaded Anchor Rods: ASTM F 1554, Grade 55.
 1. Configuration: Threaded Rod with Nut
 2. Nuts: ASTM A 563(ASTM A 563M) heavy hex carbon steel.
 3. Plate Washers: ASTM A 36/A 36M carbon steel.
 4. Washers: ASTM F 436(ASTM F 436M) hardened carbon steel.
 5. Finish: Plain.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant, High-Strength Grout (8000 PSI): ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings."
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.8 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Load and Resistance Factor Design Specification for Structural Steel Buildings."
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.

- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Load and Resistance Factor Design Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 051200

SECTION 05210 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Open-web K-series steel joists.
 - 2. KCS-type, open-web K-series steel joists.
 - 3. Long-span LH steel joists.

1.3 DEFINITIONS

- A. Special Joists: Joists requiring modification by the manufacturer to support non-uniform, unequal, or special loading conditions that invalidate SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders."

1.4 SUBMITTALS

- A. Product Data: For each type of joist, accessory, and product indicated.
- B. Shop Drawings: Show layout, mark, number, type, location, and spacing of joists. Include joining and anchorage details, bracing, bridging, accessories; splice and connection locations and details; and attachments to other construction.
 - 1. Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.
 - 2. Comprehensive engineering analysis signed and sealed by the qualified professional engineer responsible for its preparation.
- C. Welding Certificates: Copies of certificates for welding procedures and personnel.
- D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

- F. Research/Evaluation Reports: Evidence of steel joists' compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance.
 - 1. Manufacturer must be certified by SJI to manufacture joists complying with SJI standard specifications and load tables.
 - 2. Assumes responsibility for engineering special joists to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 3. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of joists that are similar to those indicated for this Project in material, design, and extent.
- B. SJI Specifications: Comply with SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders" (hereafter, "Specifications"), applicable to types of joists indicated.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel"; and AWS D1.3 "Structural Welding Code--Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle joists as recommended in SJI's "Specifications."
- B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.7 SEQUENCING

- A. Deliver steel bearing plates and other devices to be built into concrete and masonry construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Steel: Comply with SJI's "Specifications" for chord and web members.
- B. Steel Bearing Plates: ASTM A 36/A 36M.

- C. Carbon-Steel Bolts and Threaded Fasteners: ASTM F 568M, Property Class 4.6, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated
- D. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain, uncoated
- E. Welding Electrodes: Comply with AWS standards.
- F. Galvanizing Repair Paint: SSPC-Paint 20 ASTM A 780

2.2 PRIMERS

- A. Primer: SSPC-Paint 15, Type I, red oxide; FS TT-P-636, red oxide; or manufacturer's standard shop primer complying with performance requirements of either of these red-oxide primers.
- B. Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer with good resistance to normal atmospheric corrosion, complying with performance requirements in FS TT-P-664.

2.3 OPEN-WEB STEEL JOISTS

- A. Manufacture steel joists according to "Standard Specifications for Open Web Steel Joists in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord; of joist type indicated.
 - 1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
 - 2. Joist Type: LH-series (Long Span) steel joists.
- B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Camber joists according to SJI's Specifications
- G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications."
- C. Bridging: Fabricate as indicated and according to SJI's "Specifications."
 - 1. Furnish additional erection bridging if required.
- D. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated (Shop Prime Paint).
- E. Steel bearing plates with integral anchorages are specified in Division 5 Section "Metal Fabrications."
- F. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.
- G. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.5 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories to be primed by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one shop coat of primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- D. Painting of joists and joist accessories is specified in Division 9 Section "Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads have been applied.
- C. Field weld joists to supporting steel bearing plates. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts, unless otherwise indicated.
- E. Bolt joists to supporting steel framework using high-strength structural bolts, unless otherwise indicated. Comply with RCSC's "Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" or "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and [high-strength bolted connections.
- B. Field welds will be visually inspected according to AWS D1.1.
- C. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following procedures, as applicable:
 - 1. Radiographic Testing: ASTM E 94 and ASTM E 142.
 - 2. Magnetic Particle Inspection: ASTM E 709.
 - 3. Ultrasonic Testing: ASTM E 164.
 - 4. Liquid Penetrant Inspection: ASTM E 165.
- D. Bolted connections will be visually inspected.
 - 1. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Allowable Stress Design Specification for Structural Joints Using

ASTM A 325 or ASTM A 490 Bolts." or "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

- E. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.
- F. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates and abutting structural steel.
 - 1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
 - 2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 Section "Painting."
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 05210

SECTION 053100 - STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Composite floor deck.
 - 2. Metal roof deck.
- B. Related Sections include the following:
 - 1. Division 3 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.
 - 2. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.
- E. Product Test Reports: From a qualified testing agency indicating that each of the following complies with requirements, based on comprehensive testing of current products:
 - 1. Mechanical fasteners.
- F. Research/Evaluation Reports: Evidence of steel deck's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations for Cellular Deck Floor Systems with Electrical Distribution: Obtain cellular floor deck units and compatible electrical components, such as preset inserts, activation kits, afterset inserts, service fittings, header ducts, and trench header ducts, from the same manufacturer. Electrical components are specified in Division 16 Section "Underfloor Raceway."
- D. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- E. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those steel deck units tested for fire resistance per ASTM E 119 by a testing and inspection agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - 2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
- F. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."
- G. FM Listing: Provide steel roof deck evaluated by FM and listed in FM's "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Steel Deck:
 - a. Vulcraft
 - b. United Steel Deck, Inc..

2.2 COMPOSITE FLOOR DECK

- A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 29, the minimum section properties indicated, and the following:
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel, Grade 50, G30 zinc coating.
 - 2. Deck Profile: 1.5VL18
 - 3. Profile Depth: 1.5"
 - 4. Design Uncoated-Steel Thickness: 18 ga.
 - 5. Weight: 2.82 psf
 - 6. Span Condition: Triple span or more.
 - 7. Side Laps: Interlocking seam.

2.3 METAL ROOF DECK

- A. Metal Roof Deck: Provide sheet steel for deck and accessories conforming to ASTM A653 Structural Quality, with a minimum yield strength of 33 ksi. Galvanizing shall conform to ASTM A924 with a minimum coating class of G90 as defined in A653.
 - 1. Galvanized Steel Sheet: ASTM A653, Structural Steel, Grade 33, G90 zinc coating.
 - 2. Deck Profile: 1.5 F
 - 3. Profile Depth: 1.5"
 - 4. Design Uncoated-Steel Thickness: 20 ga.
 - 5. Weight: 2.09 psf
 - 6. Span Condition: Triple span or more.
 - 7. Side Laps: Interlocking seam.

2.4 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- G. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 29 for overhang and slab depth.
- H. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- I. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- J. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch wide flanges and level recessed pans of 1-1/2- inch minimum depth. For drains, cut holes in the field
- L. Galvanizing Repair Paint: ASTM A 780, SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.
- M. Repair Paint: Lead- and chromate-free rust-inhibitive primer complying with performance requirements of FS TT-P-664.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate decking bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels for entire length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR DECK INSTALLATION

- A. Fasten floor deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 1. Weld Diameter: 3/4 inch, nominal.
 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
 3. Weld Spacing: Space and locate welds as indicated.
 4. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches (910 mm), and as follows:
 1. Mechanically fasten with self-drilling No. 10 diameter or larger carbon-steel screws.
 2. Mechanically clinch or button punch.
 3. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 1. End Joints: Lapped.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.
- E. Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.
- F. Install piercing hanger tabs not more than 14 inches apart in both directions, within 9 inches of walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing: Owner will engage a qualified independent testing agency to perform field quality-control testing.
- B. Field welds will be subject to inspection.
- C. Shear connector stud welds will be inspected and tested according to AWS D1.1 for stud welding and as follows:
 - 1. Shear connector stud welds will be visually inspected.
 - 2. Bend tests will be performed if visual inspections reveal less than a full 360-degree flash or welding repairs to any shear connector stud.
 - 3. Tests will be conducted on additional shear connector studs if weld fracture occurs on shear connector studs already tested according to AWS D1.1.
- D. Testing agency will report test results promptly and in writing to Contractor and Architect.
- E. Remove and replace work that does not comply with specified requirements.
- F. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Division 9 Section.
- C. Repair Painting: Wire brushing, cleaning and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Division 9 Section.
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

SECTION 054000
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Formed steel stud exterior wall framing, including insulated headers.
- B. Exterior wall sheathing.
- C. Water-resistive barrier over sheathing.

1.2 RELATED REQUIREMENTS

- A. Section 051200: Structural building framing.
- B. Section 061053 - Miscellaneous Rough Carpentry: Wood blocking and miscellaneous framing.
- C. Section 072100 - Thermal Insulation: Insulation within framing members.
- D. Section 076200 - Sheet Metal Flashing and Trim: Head and sill flashings.
- E. Section 079200 - Joint Sealants.
- F. Section 092116 - Gypsum Board Assemblies: Lightweight, non-load bearing metal stud framing and sheathing.

1.3 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members 2016, with Supplement (2018).
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.
- E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories 2020.
- F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2017.
- G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities,

insulation, and firestopping.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Product Data: Provide data on insulated header framing members; describe material and finish, product criteria, limitations.
- D. Delegated-Design Submittal: Include analysis data, signed and sealed by the qualified professional engineer responsible for preparation of shop drawings. Cold-formed metal framing system shall be designed to include structural support for all accessory items attached to the perimeter wall framing. Such items may include, but are not limited to: exterior building signage (individual letters and plaque signs), canopy and canopy support structures, exterior building lighting and building-mounted maintenance access ladders.
- E. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, and type and location of fasteners, and accessories or items required of related work.
 - 1. Indicate stud and ceiling joist layout.
 - 2. Describe method for securing studs to tracks and for bolted framing connections.
 - 3. Design data:
 - a. Shop drawings signed and sealed by a professional structural engineer.
- F. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention .
- G. Designer's Qualification Statement.
- H. Manufacturer's Qualification Statement.

1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal Framing:
 - 1. ClarkDietrich: www.clarkdietrich.com.
 - 2. Marino: www.marinoware.com.
 - 3. An approved equal.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Framing Connectors and Accessories:
 - 1. Same manufacturer as metal framing.

2.2 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B. Design Requirements: Provide completed framing system having the following characteristics:
 - 1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100.
 - 2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
 - 3. Design Loads: In accordance with applicable codes.
 - 4. Live load deflection meeting the following, unless otherwise indicated:
 - a. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.
 - b. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
 - 5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 - 6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.3 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
 - 1. Gauge: As required to meet specified performance levels.
 - 2. Depth: As indicated on drawings.
 - 3. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.
- B. Jamb Studs: Engineered, C-shaped with wide flanges, designed to replace conventional double-stud framing at openings.
- C. Header: Engineered one-member assembly, with wide flanges and insulating inserts, designed to replace conventional box or nested header framing at openings.
 - 1. Jamb Mounting Clips: Manufacturer's standard.
 - 2. Products:
 - a. Rhino Insulated Headers by Mitek.
 - b. Substitutions: See Section 016000 - Product Requirements.
- D. Framing Connectors: Factory-made, formed steel sheet.
 - 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gauge, 0.1345 inch, and factory punched holes and slots.
 - 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100.
 - 3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 - a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.

4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.

2.4 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.

2.5 WALL SHEATHING

- A. Glass mat faced gypsum board; ASTM C1177/C1177M, square long edges, 5/8 inch thick, Type X - Fire Resistant.

2.6 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- C. Water-Resistive Barrier: As specified in Section 072500.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

3.2 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- C. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- D. Install intermediate studs above and below openings to align with wall stud spacing.
- E. Attach cross studs to studs for attachment of fixtures anchored to walls.
- F. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

3.3 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
 1. Provide steel diagonal bracing at corners with foam insulation or gypsum board wall sheathing.

2. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges, and ends.

3.4 FIELD QUALITY CONTROL

- A. Independent Inspection/Testing Agency: Inspection agency employed and paid by Owner, will examine Cold-Formed Metal Framing for wind resistance in accordance with Code-Required Special Inspections.

END OF SECTION

SECTION 055000
METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated steel items.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 042000 - Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 051200 - Structural Steel Framing: Structural steel column anchor bolts.
- D. Section 052100 - Steel Joist Framing: Structural joist bearing plates, including anchorage.
- E. Section 053100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- F. Section 055100 - Metal Stairs.
- G. Section 055133 - Metal Ladders.
- H. Section 055213 - Pipe and Tube Railings.
- I. Section 055305 - Metal Gratings and Floor Plates: Installation of Gratings on fabricated steel framing
- J. Section 099000 - Painting and Coating: Paint finish.
- K. Section 323300 - Site Furnishings: Steel pipe bollards to match other site furnishings.

1.3 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
- F. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.
- H. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing 2021.

- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- K. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- L. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
- M. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2014 (Amended 2015).
- N. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- O. AWS D1.2/D1.2M - Structural Welding Code - Aluminum 2014, with Errata.
- P. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel 2018.
- Q. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).
- R. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).
- S. SSPC-SP 2 - Hand Tool Cleaning 2018.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
 - a. Include the following, as applicable:
 - 1) Design criteria.
 - 2) Engineering analysis depicting stresses and deflections.
 - 3) Member sizes and gauges.
 - 4) Details of connections.
 - 5) Support reactions.
 - 6) Bracing requirements.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- D. Designer's Qualification Statement.
- E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.5 QUALITY ASSURANCE

- A. Design miscellaneous structural members under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Stainless Steel, General: ASTM A666, Type 304.
- F. Stainless Steel Tubing: ASTM A554, Type 304, 16 gauge, 0.0625 inch minimum metal thickness, 1-1/2 inch diameter.
- G. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- H. Slotted Channel Fittings: ASTM A1011/A1011M.
- I. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- J. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- K. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- L. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- M. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

- A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal gratings; galvanized finish.
- B. Equipment Screen support members: galvanized steel, prime painted for field finishing.
- C. Sill Angles for Stainless Steel Railing Assemblies: ASTM A36/A36M steel angles with anchoring devices and sizes as indicated in shop drawings for railing assembly, drilled and tapped for fastener types, sizes, and spacing indicated, stainless steel finish.
- D. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.

2.4 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.
- E. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- F. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.
- G. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- H. Stainless Steel Finish: No. 4 Bright Polished finish.

2.5 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. Obtain approval prior to site cutting or making adjustments not scheduled.
- E. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 055100
METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Structural steel stair framing and supports.
- C. Handrails and guards, including gates with hardware where indicated. Gate shall be equipped with self-closing hinges and latch.

1.2 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Placement of metal fabrications in masonry.

1.3 REFERENCE STANDARDS

- A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures 2006.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2021.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).
- J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
- K. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2014 (Amended 2015).

- L. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).
- N. SSPC-SP 2 - Hand Tool Cleaning 2018.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Design Data: As required by authorities having jurisdiction.
- D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- E. Designer's Qualification Statement.
- F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

1.5 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.1 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 - 1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 - 2. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
 - 3. At exit stairwells, provide unit stair towers designed for stacking to height of building as a self-supporting structure.

4. Dimensions: As indicated on drawings.
5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
7. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:

1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Architectural, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.

1. Concrete Depth: 1-1/2 inches, minimum.
2. Tread Pan Material: Steel sheet.
3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch minimum.
4. Pan Anchorage to Stringers: Welded or bolted to carrier angles welded or bolted to stringers.
5. Concrete Reinforcement: Welded wire mesh.
6. Concrete Finish: For resilient floor covering.

D. Risers: Same material and thickness as tread pans.

1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
2. Nosing Depth: Not more than 1-1/2 inch overhang.
3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.

E. Stringers: Rolled steel channels.

1. Stringer Depth: 10 inches.
2. End Closure: Sheet steel of same thickness as risers welded across ends.

F. Landings: Similar construction, using corrugated steel decking, supported and reinforced as required to achieve design load capacity.

G. Railings: Steel pipe guardrails with metal mesh panel insert. Handrail as specified.

H. Finish: Shop- or factory-prime painted.

I. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.3 HANDRAILS AND GUARDS

A. Wall-Mounted Hand Rails: Molded handrail unless otherwise indicated.

1. Size and shape: 1.5 inch overall width x 1.15 inch high, elliptical

2. Material and finish: Stainless Steel, Type 304, #4 Satin Brushed Finish.
3. Equal to Inpro #900SSO Stainless Steel Handrail System, Oval with stainless steel brackets.

B. Guards:

1. Top Rails: Round pipe or tube rails unless otherwise indicated.
 - a. Outside Diameter: 1-1/4 inch, minimum, to 1-1/2 inches, maximum.
2. Infill at Mesh Railings: Woven wire mesh panels.
 - a. Material and Finish: Stainless steel.
 - b. Equal to Wagner Architectural Mesh Infill Panel; BWSJD-02 with the following characteristics:
 - 1) Open area: 80.3%
 - 2) Weight: 2.18 lbs/sq. ft
 - 3) Opening limitation: 2.690 inches
 - 4) Overall thickness: 0.620 inches
 - 5) Aspect ratio: 1.00:1
 - c. Mounting: Mesh welded to steel bar frame, frame welded to posts.
3. End and Intermediate Posts: Same material and size as top rails.
 - a. Horizontal Spacing: Maximum six feet on center.
 - b. Mounting: Welded to top surface of stringer.

2.4 MATERIALS

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
- D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- E. Concrete Fill: Portland cement Type I, 3000 psi 28 day strength, 2 to 3 inch slump.
- F. Concrete Reinforcement: Mesh type, galvanized.

2.5 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

2.6 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.

1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
2. Number of Coats: One.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be embedded in masonry with setting templates.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

END OF SECTION

SECTION 055133
METAL LADDERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fixed aluminum access ladders.

1.2 RELATED SECTIONS

- A. Section 055000 - Metal Fabrications: Fasteners and installation requirements used to attach ladders to structure.
- B. Section 150500 - Basic electrical Material and methods: For grounding of ladders.
- C. Section 077200 – Roof Accessories: Roof Hatch for roof access.

1.3 REFERENCES

- A. Aluminum Association.
- B. ASTM B 209-Standard Specifications for Aluminum and Aluminum-Alloy sheet and Plate.
- C. ASTM B 221- Standard Specifications for Aluminum and Aluminum-Alloy Extruded bars-rods-wire-profiles-tubes.
- D. OSHA 1910.27- Fixed Ladders.
- E. OSHA 3124-12R- Stairways and ladders.
- F. CAL- OSHA-Title 8-Section 3277.Fixed Ladders.
- G. ANSI A14.3 Ladders –Fixed –Safety Requirements.

1.4 SUBMITTALS

- A. Submit under provision of Section 01300.
- B. Product Data: Manufacturer's data sheet on each product.
 - 1. Mill certification available on all extruded profiles and aluminum sheet.
 - 2. Mechanical &Performance Data available on all fasteners used.
 - 3. Assembly instruction.
- C. Shop Drawings:
 - 1. Detail fabrication and erection of each ladder indicated. Include plans, elevations, and sections, with details of material layouts and product components and finishes.
 - 2. Provide reaction load for rungs- floor mounts –wall mounts.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualification :
 - 1. Ladder manufacturer with minimum 10 years' documented experience in design and fabrication of ladders for commercial buildings.
 - 2. Certified to meet OSHA 3124-1910.27and ANSI A14.3

3. Professional engineering competent in design and structural analysis to fabricate ladders in compliance with industry standards and local codes.
4. Installer Qualification: Competent and experience firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.
5. Product Qualification: Product designed shall comply with OSHA 1910.27 minimum standards for ladders.

1.6 DELIVERY, STORAGE , AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

1.7 PROJECT CONDITIONS

- A. Field Measurements: verify dimensions by field measurement before fabrication.
 1. Established Dimensions: Where field measurements cannot be made without delaying the work, indicate
 2. Established dimensions on shop drawing submittal and proceed with fabrication.

1.8 WARRANTY

- A. Manufacturer has responsibility for an extended corrective period for work of this section for a period of 5 years from date of substantial completion against all the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly and without inconvenience and cost to Owner correct said deficiencies.
 1. Defects in materials and workmanship.
 2. Deterioration of material and surface performance below minimum OSHA standards as certified by independent third-party testing laboratory. Ordinary wear and tear, unusual abuse or neglect accepted.
 3. With the warranty period, the manufacturer shall, at its option, repair, replace, or refund the purchase price of defective ladder.
- B. Manufacturer shall be notified immediately of defective products and be given a reasonable opportunity to inspect the goods prior to return. Manufacturer will not assume responsibility, or compensation, for unauthorized repairs or labor. Manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose , design ,sale, installation, or use of the ladder, and shall not be liable for incidental or consequential damage , losses of or expense, resulting from the use of ladder products.

1.9 EXTRA MATERIALS

- A. Furnish Touch up kit for each type and color of paint finish provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturer
 1. O'Keeffe's, Inc: 325 Newhall St. San Francisco, CA 94124.ASD
TOLL FREE TEL: (888) 653-3333. Tel: (415) 824-4900. Fax (415) 824-5900 Email:
info@okeeffes.com.
Web: http://www.okeeffes.com.
- B. Substitutions: An approved equal.

- C. Request for substitutions will be considered in accordance with provisions of section 01600.

2.2 APPLICATIONS /SCOPE

- A. Safety cages or fall arrest required on ladders over 24 feet (7315mm) OSHA-3124-1910.27-CA OSHA-327
- B. Safety cages are required on high or hazardous areas.
- C. Landing Platforms are required at 30' feet (9m) above the bottom of ladder. OSHA-1910.27
- D. When no cage or well is provided landing platforms shall be provided for each 20 feet CA OSHA-3277.
- E. Landing Platforms: shall be equipped with standard railing and toe boards so to give safe access to the ladder.
- F. Platforms shall not be less than 24 inches in width 30 inches in length OSHA -1910.27.
- G. For MODEL 502
 - 1. Through-fixed –ladder extensions: the steps or rung shall be omitted from the extension and the extension of the side rails shall be to provide not less than 24 inches (61cm) or more than 30 inches (76cm) clearance between side rails. When ladder safety devices are provided, the maximum clearance between side rails of the extension shall not exceed 36 inches (91cm). OSHA- 1926.1053
 - 2. Each fixed access ladder: At least two loads of 250 pounds (114kg) each, concentrated between any two consecutive attachments the number and position of additional concentrated loads of 250 pounds (114kg) each, determined from anticipated usage of the ladder, shall also be included plus anticipated loads caused by ice, wind, rigging, and impact loads resulting from ladder safety device. Each step or rung shall be capable of supporting a single concentrated load of at least 250 pounds (114kg) applied in the middle of the step or rung. Ladders built in conformance with the applicable provisions of appendix A will be deemed to meet this requirement. OSHA-1926.1053(A)(1)

2.3 ALUMIMUM ACCESS LADDERS

- A. Ladders shall be detailed and submitted for approval prior to fabrication.
- B. Full dimension, wall mounted or floor attachments, material construction, and finish must be shown and comply with all safety orders pertinent to the installation.
- C. Fixed access ladders to conform to OSHA and ANSI A14.3 Standards.

2.4 CONTRACTORS TO VERIFY:

- A. Overall ladder height
- B. Floor to top of deck
- C. Roof hatch base height
- D. Wall to centerline of ladder
- E. Ladder width
- F. Parapet height and depth

G. Ladder finish

2.5 FIXED ACCESS LADDERS

A. Ladder Model 501: Heavy Duty Channel Rail Access Ladder

1. Ladder Rails:
 - a. Heavy duty channel rails are 3 inches x 1-3/4 inches x 1/8 inch aluminum alloy 6063-T5 with extruded aluminum cover plate.
 - b. Construction shall be with stainless steel fasteners, full penetration TIG welds and clean, smooth, and burr-free surfaces.
2. Ladder Rungs:
 - a. Extruded rung, alloy 6061-T6 Patent rated for 1500 LBS.
 - b. Not less than 1-1/4 inches in section and 18-3/8 inches or 24'' in length.
 - c. Rungs are 1-1/4 inch, square, deeply serrated for maximum grip and foot traction.
 - d. Rungs shall be able to withstand a 1500 lb. load without failure.
3. Wall Brackets:
 - a. Constructed from 3/16 aluminum sheet alloy 5052. Pre punched for mounting and securing to wall
 - b. Reaction Load: 350 lbs vertical and 250 lbs horizontal loads for each bracket spaced not more than 10 feet on center.
4. Floor Mounts:
 - a. Constructed from 3/16 inch by 2 inches aluminum flat bar alloy 6063-T5.
5. Hardware:
 - a. 18-8 stainless steel hex head cap screw: 1/4 inch by 3/4 inch, made from one of the following alloys: 303, 303se, 304, XM7, all of which are characterized as having a chromium content of 17-19% and a nickel content of 8-10%.
 - b. Hardness: 1/4 inch through 5/8 inch diameter: Rockwell B95-C32.
 - c. Yield Strength: 1/4 inch through 5/8 inch diameter, 2.25d and longer: 65,000 psi.
 - d. Tensile Strength: 1/4 inch through 5/8 inch diameter, 2.25d and longer: 100,000 - 150,000 psi
 - e. Stainless steel sheet metal screws: Austenitic 18-8 stainless steel

B. Ladder Model 502 - Tubular Rail, Low Parapet Access Ladder

1. Ladder Rails
 - a. Heavy duty channel rails are a 3 inches x 1-3/4 inches x 1/8 inch aluminum alloy -6063-T5 with extruded aluminum cover plate
 - b. Construction shall be with stainless steel fasteners, full penetration TIG welds, and clean, smooth, and burr-free surfaces.
2. Ladder rungs
 - a. Extruded rung, alloy 6061-T6 Patent rated for 1500 lbs.
 - b. Not less than 1-1/4 inches in section and 24'' in length.
 - c. Rungs are 1-1/4 inches square, deeply serrated for maximum grip and foot traction.
 - d. Rungs shall be able to withstand a 1500 lb. load without failure.
3. Wall brackets
 - a. Constructed from 3/16 inch aluminum sheet alloy 5052. Pre punched for mounting and securing to wall
 - b. Reaction Load: 350 lbs vertical and 250 lbs horizontal loads for each bracket spaced not more than 10 feet on center.
4. Floor Mounts
 - a. Constructed from 3/16 inch by 2 inches aluminum flat bar alloy 6063-t5.
5. Haredware

- a. 18-8 stainless steel hex head cap screw: 1/4 inch by 3/4 inch, made from one of the following alloys: 303, 303se, 304, XM7, all of which are characterized as having a chromium content of 17-19% and a nickel content of 8-10%.
 - b. Hardness: 1/4 inch through 5/8 inch diameter: Rockwell B95-C32
 - c. Yield Strength: 1/4 inch through 5/8 inch diameter, 2.25d and longer: 65,000 psi minimum
 - d. Tensile Strength: 1/4 inch through 5/8 inch diameter, 2.25d and longer: 100,000-150,000 psi minimum
 - e. Stainless steel sheet metal screws, rung connection to stringer: Austenitic 18-8 stainless steel.
6. Walk-through rail and roof over rail
- a. Rail extension, where specified, shall extend no less than 3 feet 6 inches above landing and shall be fitted with deeply serrated, tubular grab rails.
 - b. For ladder model 502, Through, Fixed-ladder Extensions
 - 1) The steps or rung shall be omitted from the extension and the extension of the side rails shall be to provide not less than 24 inches or not more than 30 inches clearance between side rails. When ladder safety devices are provided, the maximum clearance between side rails of the extension shall not exceed 36 inches per OSHA-1926.1053.

2.6 FINISHES

- A. Clear Anodic Finish: AA-M10C22A41 Mechanical finish as fabricated. Architectural class 1, clear coating 0.018 mm or thicker.

MATERIALS

- A. Aluminum sheet : Alloy 5052-H34 to comply with ASTM B209.
- B. Aluminum extrusions : Alloy 6063-T5 to comply with ASTM B221.

3.2 FABRICATION

- A. Rungs not less than 1-1/4 inches in section and 18-3/8 inches long, formed from tubular aluminum extrusions, square and deeply serrated on all sides.
- B. Rungs shall withstand 1,500 lb load without deformation or failure.
- C. Channel side rails : Not less than 1/8 inch wall thickness by 3 inches wide.
- D. Heavy duty tubular rails: Assembled from two interlocking aluminum extrusion no less than 1/8 inch wall thickness by 3 inches wide. Construction shall be self-locking, stainless steel fasteners, full penetration TIG welds, and clean, smooth, and burr-free surfaces.
- E. Walk –Through rail and roof rail extension, where specified, shall extend no less than 3 feet 6 inches above landing and shall be fitted with deeply serrated, tubular grab rails.

PART 3 - EXECUTION

4.1 EXAMINATION

- A. Coordinate anchorages required.
- B. Verify setting drawings, templates, and anchorages for structural loads as required for fastener resistance.

- C. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.
- D. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.

4.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction

4.3 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up and repair or replace damaged products before substantial completion.

END OF SECTION

SECTION 055133.23
ALTERNATING TREAD STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum Alternating Tread Stairs.

1.2 RELATED SECTIONS

- A. Section 055000 - Metal Fabrications: Miscellaneous metal supports.
- B. Section 061053 - Miscellaneous Rough Carpentry: Miscellaneous wood blocking.
- C. Section 072419 - Exterior Insulation Finish System: Wall finish impacted by structural support of stair.
- D. Section 075423 - TPO Roofing Membrane: Roof structure and perimeter metal.

1.3 REFERENCES

- A. OSHA 1910.25: Stairways.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013000.
- B. Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
- C. Shop Drawings for Stairs:
 - 1. Plan and section of stair installation, including all installation details for proposed attachments to exterior walls, roofs, and parapets.
 - 2. Indicate field-verified height conditions for overall stair height, parapet height(s) and any other dimensions required for the proper installation of the stair.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store stair until installation inside under cover. If stored outside, under a tarp or suitable cover.

1.6 WARRANTY

- A. Limited Warranty: Five years against defective material and workmanship, covering parts only, no labor or freight. Defective parts, if deemed so by the manufacturer, will be replaced at no charge, freight excluded, upon inspection at manufacturer's plant which warrants same.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Precision Ladders, LLC, which is located at: P. O. Box 2279; Morristown, TN 37816-2279; Toll Free Tel: 800-225-7814; Tel: 423-586-2265; Fax: 423-586-2091; Web: www.PrecisionLadders.com or an approved equal.
- B. Requests for substitutions will be considered in accordance with provisions of Section 016000.

2.2 ALUMINUM ALTERNATING TREAD STAIR

- A. Aluminum Alternating Tread Stair and Components: Stair, mounting brackets and handrails on both sides.
 - 1. Model: Model AT -*** (***= vertical height in inches) Aluminum Alternating Tread Stair as manufactured by Precision Ladders, LLC. Select model numbers based on field verified height conditions at locations shown on Roof Plan.
 - 2. Type: Walk-thru type.
 - 3. Capacity: Unit shall support a 1,000 lb total load without failure.
 - 4. Degree of Incline: 56 or 68 degrees.
 - 5. Performance Standard: Units designed and manufactured to meet or exceed OSHA 1910.25.
- B. Components:
 - 1. Stair Side Stringers: 3 inch by 2 inch by 1/8 inch extruded 6005-T5 aluminum tubing. Pitch: 56 or 68 degrees.
 - 2. Stair Center Stringer: 10 inch by 1/4 inch extruded 6005-T5 aluminum flat bar. Note: Neoprene trim adhered to front edge of center stringer to protect climber.
 - 3. Stair Treads: 1 inch aluminum Bar Grating, 9 13/16" deep by 11 7/8" wide.
 - 4. Stair Mounting Brackets: 6 inch by 1/4 inch aluminum flat bar
 - 5. Handrails: 1-1/4 inches Schedule 40, 6005-T5 aluminum pipe provided with internal aluminum fittings.
 - 6. Finishes:
 - a. Finishes
 - 1) Powder Coated, color as selected by Owner from manufacturer's full color range.

2.3 FABRICATION

- A. Completely fabricate stair ready for installation before shipment to the site.

PART 3 EXECUTION

3.1 EXAMINATION

- A. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- B. Examine materials upon arrival at site. Notify the carrier and manufacturer of any damage.

3.2 INSTALLATION

- A. Install in accordance with approved submittals and manufacturer's written instructions.

3.3 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 055213
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Free-standing railing at steps and ramps.
- D. Balcony railings and guardrails.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 055100 - Metal Stairs: Handrails other than those specified in this section.
- C. Section 092116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.
- D. Section 099000 - Painting and Coating - Paint finish.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures 2006.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- D. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes 2017.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2009 (Reapproved 2015).
- G. ASTM A790/A790M - Standard Specification For Seamless And Welded Ferritic/Austenitic Stainless Steel Pipe -20.
- H. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2021.
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
- J. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification 2014 (Amended 2015).

- K. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- L. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel 2017.
- M. AWS C3.4M/C3.4 - Specification for Torch Brazing 2016.
- N. AWS C3.5M/C3.5 - Specification for Induction Brazing 2016 (Amended 2017).
- O. AWS C3.9M/C3.9 - Specification for Resistance Brazing 2009.
- P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Samples: Submit two, 12 inch long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.
- D. Samples: Submit two, 36 inch x 36 inch mesh panel samples for verification.
- E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- F. Designer's Qualification Statement.
- G. Fabricator's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Handrails:
 - 1. Inpro #900SSO Stainless Steel Handrail system with stainless steel brackets, or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.

- B. Handrails with Integral LED Lighting:
 - 1. LEDscape Lighting; LEDscape Handrail; www.ledscape.com or approved equal.
- C. Metal Rail Mesh Panel Infill:
 - 1. Wagner Architectural Mesh Infill Panel; BWSJD-02 Stainless Steel or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 - 1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
 - 2. For anchorage to stud walls, provide backing plates, for bolting anchors.
 - 3. Posts: Provide adjustable flanged brackets.
- G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.
- H. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
 - 1. Ease exposed edges to a small uniform radius.
 - 2. Welded Joints:
 - a. Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
 - b. Stainless Steel: Perform welding in accordance with AWS D1.6/D1.6M.
 - 3. Brass/Bronze Brazed Joints:
 - a. Perform torch brazing in accordance with AWS C3.4M/C3.4.
 - b. Perform induction brazing in accordance with AWS C3.5M/C 3.5.
 - c. Perform resistance brazing in accordance with AWS C3.9M/C3.9.

2.3 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish for interior application, to be painted.

- C. Stainless Steel Bars and Shapes : ASTM A276/A276M for exterior application.
- D. Stainless Steel Pipe: ASTM A790/A790M for exterior application.
- E. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.4 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 - 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Weld connections that cannot be shop welded due to size limitations.
 - 1. Weld in accordance with AWS D1.1/D1.1M.
 - 2. Match shop welding and bolting.
 - 3. Clean welds, bolted connections, and abraded areas.
 - 4. Touch up shop primer and factory-applied finishes.
 - 5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

- C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Field weld anchors as indicated on shop drawings. Touch-up welds with primer. Grind welds smooth.
- F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

3.5 SCHEDULE

- A. Exterior Stairs and Ramps: Guard rails shall be stainless steel pipe railing system. Handrail shall be stainless steel with integral LED lighting as specified herein and as located on drawings. Non-lighted handrails shall be stainless steel pipe railing to match the LED lighted railing. Refer to Light Fixture Schedule. Mesh infill panels shall be stainless steel as specified herein.
- B. Interior Exit and Convenience Stairs (ST-1, ST-2, and ST-4): Guard rails shall be stainless steel pipe railing system. Handrail shall be stainless steel as specified herein. Mesh infill panels shall be stainless steel as specified herein.
- C. All Other Interior Stairs and Ramps: Guard rails and hand rails shall be steel pipe rails, painted.
- D. Interior Balcony Railing: Guard rail shall be square, stainless steel tubing with flat, rectangular stainless steel bars. Top rail shall be stainless steel handrail as specified herein.

END OF SECTION

SECTION 055305
METAL GRATINGS AND FLOOR PLATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Formed metal floor gratings.
- B. Perimeter closure.

1.2 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Ledge angles for support of gratings.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- E. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire 2019.
- F. NAAMM MBG 531 - Metal Bar Grating Manual 2017.
- G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide span and deflection tables.
- C. Shop Drawings: Indicate details of component supports, perimeter construction details, and tolerances.
- D. Samples: Submit two samples, 12 by 12 inch in size illustrating surface finish, color, and texture.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. McMaster-Carr; #6849T362, or approved equal.
- B. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

- A. Steel Sheet for Lock Forming: Hot-dipped galvanized, ASTM A653/A653M, FS Type B, with G90/Z275 coating.
- B. Steel Framing: ASTM A36/A36M shapes, galvanized per ASTM A123/A123M.
- C. Cross Bars: ASTM B211/B211M solid bars.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.3 ACCESSORIES

- A. Fasteners and Saddle Clips: Galvanized steel:
- B. Perimeter Closure: Of same material as grating.

2.4 FABRICATION

- A. Grating Type: NAAMM MBG 531, Pressure Locked Type.
- B. Top Surface: Smooth.
- C. Bearing Bar: 1 inch high by 1/8 inch wide, spaced at 1-3/16 inch on center.
- D. Cross Bar: Spaced 4 inches on center.

2.5 FINISHES

- A. Galvanizing for Steel Shapes: ASTM A123/A123M.
- B. Galvanizing for Steel Hardware: ASTM A153/A153M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify that opening sizes and dimensional tolerances are acceptable.
- C. Verify that supports are correctly positioned.

3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions.
- B. Mechanically cut galvanized finish surfaces. Do not flame cut.
- C. Anchor by bolting through saddle clips.
- D. Secure to prevent movement.

SECTION 057500
ARCHITECTURAL METAL COLUMN COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work of this section includes materials, accessories and related items for the complete installation of column covers.
- B. Related work specified elsewhere includes internal post structure for solid support of column covers.

1.2 SUBMITTALS

- A. Submit complete shop drawings indicating quantities, finishes, dimensions, and attachment relationships.
- B. Submit manufacturers product data, specifications and installation instructions.
- C. Submit color and finish samples to determine range of texture and consistency of color and finish to be expected in the finished work. Standard sample size shall be 3" x 3".

1.3 QUALITY ASSURANCE

- A. Manufacturer shall have a minimum of 5 years experience in manufacturing architectural metals.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver components in clearly marked containers and packages suitable for shipment of specified products so as to prevent finish damage in transit. Provide protective wrapping or film to provide protection.
- B. Store components in locations that will avoid damage from job-site traffic, moisture, stacking or other job-site contamination
- C. Handle components to avoid racking, twisting, denting or scratching of finished surfaces.

1.5 WARRANTY:

- A. Provide manufacturer's warranty against defects in material and workmanship for a period of one year beginning on Date of Substantial Comple
- B. Finish warranty: (Note: Warranty must be requested at time of quotation) Warrant fluoropolymer coating to remain free, under normal atmospheric conditions, from peeling, checking, cracking, chalking in excess of numerical rating of 8 when measured in accordance with ASTM D4214, of fading in excess of 5 N.B.S. Units during warranty period. Warranty period shall be 10 years, beginning at Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Acceptable products include column covers manufactured by: Fry Reglet Corporation,
Series E – Economical Butt Joint
FRY REGLET CORPORATION
1377 Stonefield Court
Alpharetta, GA 30004
Phone 800-955-2343 FAX 800-200-4379

2.2 PRODUCTS

- A. SERIES E - ECONOMICAL BUTT JOINT
1. Aluminum sheet and plate: Type 3003-H14, 5005-H34 (anodized) or 5052-H32 alloy complying with ASTM B209.
 - a. Thickness: 0.125”.
 - b. Finish: Kynar 500 Paint - Fluoropolymer.
 - c. Color: As selected by Architect from manufacturer’s full range of color selections.
 2. Formed steel posts: Supplied by factory.
 3. Manufactured Units:
 - a. Configuration: Oval, as indicated on drawings.
 - b. Joint Type: Vertical – Soft V Butt Joint
 - c. Horizontal: Through Ceiling
 - d. Floor: Fixed Inset Base Reveal.
- B. FABRICATION
1. Form column covers to specified dimension and diameters as indicated on shop drawings.
 2. Column covers shall be self-aligning with attachment clips at 18 inches on center to assure solid attachment to post structures.
 3. Form radii to achieve true and smooth curves as indicated.
 4. Provide column covers in sections a maximum 12’-0” tall per section. Provide additional sections to achieve finished heights above 12’-0”.
 5. Columns shall have no exposed fasteners unless specified.
 6. Provide additional bracing components as necessary to stiffen substructure and to ensure solid mid-span bracings and connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine job-site conditions for conditions that may adversely affect installation of column covers.
- B. Verify dimensions of column covers prior to installation to assure compatibility with job-site conditions.
- C. Verify post structure is plumb, level, and parallel prior to installation of column covers.
- D. Visually examine finished surfaces to assure that blemished or dented surfaces are not present prior to installation.

3.2 PREPARATION

- A. Verify/coordinate with other trades prior to installation insofar as they are affected by column cover installation.

3.3 INSTALLATION

- A. Install components in accord with manufacturer's installation instructions and approved shop drawings.
- B. Anchor components to related structures such as floors, walls and beams as indicated on approved shop drawings. Use anchors with holding strength to provide a solid installation. Use only plated, galvanized or stainless steel anchors.

3.4 CLEANING

- A. Remove protective coverings and clean column covers to remove adhesives and tape residue. Test all solvents on non-exposed surfaces prior to use.
 - 1. For painted surfaces, use a mild detergent solution on a soft cloth.
 - 2. For stainless steel, use a glass cleaner and a soft cloth.
 - 3. For other surfaces, contact manufacturer for proper cleaning procedures.
- B. Visually inspect all exposed surfaces for scratches or blemishes.
- C. Protect column covers from damage during remainder of construction period.

END OF SECTION

SECTION 061053
MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roofing nailers.
- B. Preservative treated wood materials.
- C. Fire retardant treated wood materials.
- D. Communications and electrical room mounting boards.
- E. Concealed wood blocking, nailers, and supports.
- F. Miscellaneous wood nailers, furring, and grounds.

1.2 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- D. AWWA U1 - Use Category System: User Specification for Treated Wood 2018.
- E. PS 1 - Structural Plywood 2009 (Revised 2019).
- F. PS 20 - American Softwood Lumber Standard 2020.
- G. WWP A G-5 - Western Lumber Grading Rules 2017.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.

2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Western Wood Products Association; WWP A G-5.
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 1. Lumber: S4S, No.2 or Standard Grade.
 2. Boards: Standard or No.3.

2.3 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1, A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- B. Other Applications:
 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
 2. Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.
 3. Other Locations: PS 1, C-D Plugged or better.

2.4 ACCESSORIES

- A. Fasteners and Anchors:
 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
 2. Anchors: Toggle bolt type for anchorage to hollow masonry.

2.5 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWP A U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP A standards.
- B. Fire Retardant Treatment:
 1. Exterior Type: AWP A U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

- b. Treat exterior rough carpentry items.
 - c. Do not use treated wood in direct contact with ground.
 - 2. Interior Type: AWP A U1, Use Category UCFA, Commodity Specification H, low temperature, low hygroscopic type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. Interior rough carpentry items are to be fire retardant treated.
 - c. Treat rough carpentry items as indicated.
 - d. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
 - 1. Preservative Pressure Treatment of Lumber Above Grade: AWP A U1, Use Category UC3B, Commodity Specification A using waterborne preservative to [] lb/cu ft retention.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber in contact with roofing, flashing, or waterproofing.
 - c. Treat lumber in contact with masonry or concrete.
 - d. Treat lumber less than 18 inches above grade.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.
- D. Where blocking is required in exterior walls, install fire-retardant treated wood blocking.

3.3 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

- E. Provide the following specific nonstructural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall paneling and trim.
 - 7. Toilet partitions.

3.4 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.5 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

3.6 CLEANING

- A. Waste Disposal: See Section 017419 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 062000
FINISH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Finish carpentry items.
- B. Wood casings and moldings.
- C. Non-wood casings, trim and moldings

1.2 RELATED REQUIREMENTS

- A. Section 099000: Painting and Coating - Interior and exterior painting: Painting of finish carpentry items.

1.3 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- B. ASTM F925 - Standard Test Method for Resistance to Chemicals of Resilient Flooring 2013 (Reapproved 2020).
- C. ASTM F1515 - Standard Test Method for Measuring Light Stability of Resilient Flooring by Color Change 15.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.
- E. AWI (QCP) - Quality Certification Program Current Edition.
- F. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- G. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0 2021.
- H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 2. Include certification program label.
- C. Samples: Submit two samples of wood and non-wood trim 24 inch long.
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org.
 - 2. Provide labels or certificates indicating that the work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- B. Protect from moisture damage.
- C. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.
- C. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Yellow poplar, prepared for paint finish and Maple, prepared for stain finish.

2.2 WOOD-BASED COMPONENTS

- A. Provide sustainably harvested wood, certified or labeled as specified in Section 016000 - Product Requirements.

2.3 LUMBER MATERIALS

- A. Hardwood Lumber: Yellow Poplar species, quarter sawn, maximum moisture content of 6 percent ; with vertical grain , paint grade.
- B. Hardwood Lumber: Maple species, quarter sawn, maximum moisture content of 6 percent; with vertical grain, stain grade.

2.4 FASTENINGS

- A. Adhesive for non-wood products: Suitable for the purpose and approved by the non-wood product manufacturer; not containing formaldehyde or other volatile organic compounds.
- B. Fasteners for wood products: Of size and type to suit application. Countersunk and filled with wood filler for paint or stain finish.

2.5 ACCESSORIES

- A. Thermoplastic Rubber Trim and Moldings: Trim products shall meet or exceed the performance requirements for resistance to heat/light aging, chemicals, and dimensional stability when tested to the methods, as described in, ASTM F1861.
 - 1. Fire Resistance: ASTM E648 Critical Radiant Flux (NFPA 253): Class I.
 - 2. Chemical Resistance: ASTM F925: Passes
 - 3. Resistance to Light: ASTM F1515 : Delta E<8
 - 4. Manufacturers:
 - a. AZEK Building Products, Inc; PVC Trim: www.azek.com or approved equal.
 - b. AZEK Building Products, Inc; Traditional Trim: www.azek.com or approved equal.
 - c. AZEK Building Products, Inc; Casing Moulding: www.azek.com or approved equal.
 - d. Tarkett; Rampart Chair Rail CHR-TA3-C: www.commercial.Tarkett.com or approved equal.
 - e. Substitutions: See Section 016000 - Product Requirements.
- B. Wood Filler: Solvent base, tinted to match surface finish color.

2.6 SITE FINISHING MATERIALS

- A. Finishing: Field finished as specified in Section 099000.

2.7 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.

- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- D. Install wood trim with nails at 16 inch on center.
- E. Install non-wood trim products with adhesive, in accordance with manufacturer's written instructions.

3.3 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Site Finishing: See Section 099000 - Painting and Coating.

3.4 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 064100
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Solid Surface window stools.
- D. Hardware.
- E. Preparation for installing utilities.

1.2 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 061053 - Miscellaneous Rough Carpentry: Support framing and concealed blocking.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- B. AWI (QCP) - Quality Certification Program Current Edition.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 4.0 2021.
- D. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
- E. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- F. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Provide the information required by AWMAC/WI (NAAWS).
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.

- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G. Sustainable Design Submittal: Documentation for sustainably harvested wood-based components and low-VOC adhesives.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - 2. Single Source Responsibility: Provide and install this work from single fabricator.
- B. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - 6. Replace, repair, or rework all work for which certification is refused.

1.6 MOCK-UP

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. See Section 014000 - Quality Requirements for additional requirements.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.8 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.1 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.

C. Cabinets:

1. Finish - Exposed Exterior Surfaces: Decorative laminate.
2. Finish - Exposed Interior Surfaces: Decorative laminate.
3. Finish - Semi-Exposed Surfaces: Decorative laminate
4. Finish - Concealed Surfaces: Manufacturer's option.
5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
6. Door and Drawer Front Retention Profiles: Fixed panel.
7. Casework Construction Type: Type A - Frameless.
8. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
9. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
10. Cabinet Style: Flush overlay.
11. Cabinet Doors and Drawer Fronts: Flush style.
12. Drawer Side Construction: Multiple-dovetailed.
13. Drawer Construction Technique: Dovetail joints.

2.2 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.3 LAMINATE MATERIALS

A. Manufacturers:

1. Wilsonart LLC: www.wilsonart.com.
2. Laminart; www.laminart.com.
3. Substitutions: See Section 016000 - Product Requirements.

- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

C. Provide specific types as follows:

1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as indicated, finish as indicated.
3. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, color as selected, finish as indicated.
4. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

- D. Refer to Finish Schedule and Millwork drawings for locations and finish requirements.

2.4 COUNTERTOPS

- A. Plastic Laminate Countertops: Medium density fiberboard substrate covered with HPDL, conventionally fabricated and self-edge banded.

- B. Solid Surface Window Stools:

2.5 SOLID SURFACE WINDOW STOOLS

- A. Solid Surface Materials: Solid surfacing sheet or plastic resin casting over continuous substrate.

- B. Flat Sheet Thickness: 1/2 inch, minimum.

- C. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - 1. Manufacturers:
 - a. Dupont: www.corian.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 2. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - 3. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - 4. Size, shape, and profiles as indicated on drawings.
 - 5. Color and Pattern: As indicated on drawings.
- D. Fabricate in accordance with manufacturer's standard requirements.

2.6 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's full range.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.7 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using recessed metal shelf standards or multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
- C. Fixed Specialty Workstation and Countertop Brackets:
 - 1. Material: Steel.
 - 2. Finish: Manufacturer's standard, factory-applied powder coat.
 - 3. Mounting: Surface mounted
 - 4. Color: Black.
 - 5. Manufacturers:
 - a. Rakks/Rangine Corporation; EH Series Brackets with Rounded Ends: www.rakks.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- D. Drawer and Door Pulls: "U" shaped, loft drawer pull, 6 5/8 inches long by 5/16 inch thick by 1 3/16 inch depth, satin nickel finish, (4) screws at 5 1/32 inch center to center and 6 5/16 inch center to center.
 - 1. Product: DP238A as manufactured by Doug Mockett & Company, Inc.
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.

- F. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self closing/stay closed type.
 - 6. Manufacturers:
 - a. Accuride International, Inc; Medium-Duty Drawer Slides: www accuride.com, or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- G. Hinges: European style concealed self-closing type, steel with nickel-plated finish.
 - 1. Manufacturers:
 - a. Blum, Inc; CLIP top BLUMOTION: www.blum.com, or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.8 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 - 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 - 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

- A. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.

- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.

3.3 ADJUSTING

- A. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 066100
CAST POLYMER FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cast fiberglass and polyurethane architectural units.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate dimensions, thicknesses, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, methods of support, and anchorages.
- C. Product Data: Provide data on cast fabricated column units.
- D. Manufacturer's Installation Instructions: Indicate preparation of opening required, rough-in sizes; tolerances for item placement, temporary bracing of components .

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site in original packages, containers or bundles bearing brand name and identification. Protect from damage by retaining shipping protection in place until installation.
- B. Store products under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight. Protect from moisture damage.
- C. Handle products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fiberglass Composite Architectural Columns, Balustrade Systems, Balusters, and Facade Elements:
 - 1. Products:
 - a. Edon Column Covers; Straight Shaft Column Covers; www.edon.com, or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

- A. Cast Polymer:
 - 1. Provide finished products having flame spread index of 35 and smoke developed index of 15, when tested in accordance with ASTM E84 in thickness of 3/4 inch.
 - 2. Resin: Polyester; integrally-colored, stain-resistant and resistant to domestic chemicals and cleaners.
 - 3. Filler Material: ASTM E84 Class A rated.
 - 4. Core Framing: Softwood lumber, clear and free of knots.

2.3 SITE FINISHING MATERIALS

- A. Finishing: Field finished as specified in Section 099000 - Painting and Coating.

2.4 FASTENINGS

- A. Fasteners: Of size and type to suit application, and as recommended by the manufacturer.

2.5 FABRICATION

- A. Fabricate components by mold to achieve shape and configuration.
- B. Cure components prior to shipment.
- C. Cast Plastic Fabrication Requirements
 - 1. Column Shaft Wall Thickness: 3/8 inch.
 - 2. Column Shaft Diameter or Width: As indicated on drawings.
 - 3. Column Overall Height: As indicated on drawings.

2.6 FINISH

- A. Site Finish: paint, see Section 099000 - Painting and Coating
- B. Refer to Finish Legend, Finish Schedule, and Finish Plans.

PART 3 EXECUTION

3.1 PREPARATION

- A. Provide anchoring devices for installation .

3.2 INSTALLATION

- A. Install components in accordance with approved shop drawings and manufacturer's instructions.
- B. Align work plumb and level.
- C. Rigidly anchor to substrate to prevent misalignment.

3.3 CLEANING

- A. Clean and prepare column enclosures for site finishing, in accordance with manufacturer's instructions.

END OF SECTION

SECTION 070151
INTEGRISCAN – ELECTRONIC LEAK DETECTION TESTING

PART 1 GENERAL

1.1 Section Includes:

- A. An electronic scanning system to perform a survey of membrane areas indicated below, and as scheduled at the end of this section, to verify membrane integrity. Testing to be performed in accordance with ASTM D8231 (Standard Practice for the Use of a Low Voltage Electronic Scanning System for Detecting and Locating Breaches in Roofing and Waterproofing Membranes)
 - 1. New waterproof membrane horizontal and vertical surfaces – all roof areas as shown on Drawings.
- B. Related Sections:
 - 1. 075423 – Thermoplastic Polyolefin (TPO) Membrane Roofing

1.2 Submittals

- A. Reference Section 013300 – Submittal Procedures; submit following items:
 - 1. Testing agency shall provide training certification from the testing equipment manufacturer. Testing agency shall show that the technician performing the electronic leak detection test is currently certified per the training program of the testing equipment manufacturer.
 - a. Training for Detec Systems equipment can be verified by calling Detec Systems at 1-855-753-3832 or emailing info@detecsystems.com.
 - 2. Closeout Submittals: Reference Section 017800 - Closeout Submittals; submit following items:
 - a. Daily Field Report (DFR).

1.3 Quality Assurance

- A. Qualifications:
 - 1. ELD Technician Qualifications: Certified by Detec Systems to perform testing as specified herein. Contact Detec Systems to verify ELD technician's certification. Call Detec Systems at 1-855-753-3832 or email info@detecsystems.com.

1.4 Project/Site Conditions

- A. Environmental Requirements: Do not perform testing during heavy rain or in freezing conditions.
- B. A hose connected to a water supply, and of sufficient length to reach all points on surfaces to be tested, shall be provided for the technician's use.
- C. Existing Conditions:
 - 1. Membranes to be tested must be broom-clean and free of overburden, construction materials, equipment and debris.

1.5 Warranty

- A. Electronic Leak Detection Testing: ELD testing verifies the integrity of the membrane or waterproofing only at the time of the test and gives no assurance of future condition. No warranty is expressed or implied.

PART 2 PRODUCTS

2.1 Testing Agency

- A. Detec Systems or a Detec Systems certified technician.
- B. Toll free: 1-855-753-3832, info@detecsystems.com

2.2 Equipment

- A. Roof Membrane IntegriScanner (RMIS): Wheel-mounted scanning platform.
- B. Vertical Scanning Unit (VSU): Handheld roller sensor.

PART 3 EXECUTION

3.1 Examination

- A. Examine surfaces to be tested.
- B. Verify availability of hose and water supply.
- C. Coordinate with responsible entity to correct unsatisfactory conditions.
- D. Commencement of work by technician is deemed as acceptance of installation conditions.

3.2 Testing procedure

- A. Electronic Leak Detection Testing: Testing to be performed in accordance with ASTM D8231 (Standard Practice for the Use of a Low Voltage Electronic Scanning System for Detecting and Locating Breaches in Roofing and Waterproofing Membranes). Test horizontal and vertical surfaces as specified including inside and outside corners of parapets and equipment curbs. Use Roof Membrane IntegriScanner (RMIS) and/or Vertical Scanning Unit (VSU) test units as appropriate to surfaces being tested and as selected by technician.
 - 1. Mark breach locations on membrane with approved marker.
 - 2. Retest repairs once fully cured.

3.3 Daily Field report

- A. Identify date, time, and weather conditions when test was conducted. Provide general description of test equipment and process. Describe membrane breaches located and areas not accessible by testing equipment. Document with photographs, plan view scale drawing with approximate location of breaches noted.

3.4 Schedule

- A. Perform ELD testing as follows:

1. Immediately following installation of roof membrane.

END OF SECTION

SECTION 070553
FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.2 REFERENCE STANDARDS

- A. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Partition Identification Labels:
 - 1. Fire Wall Signs, Inc: www.firewallsigns.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC).
- B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl sign with factory applied adhesive backing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.2 INSTALLATION

- A. Locate markings as required by ICC (IBC).
- B. Install adhered markings in accordance with manufacturer's instructions.
- C. Install neatly, with horizontal edges level.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 071326
SHEET WATERPROOFING MEMBRANE (UNDERSLAB SYSTEM)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Application of sheet waterproofing membrane system.
- C. Accessory Products

1.2 RELATED SECTIONS

- A. Section 031000 – Concrete Forming.
- B. Section 031500 – Concrete Accessories.
- C. Section 032000 – Concrete Reinforcing.
- D. Section 033000 - Cast-in-Place Concrete.
- E. Section 071326.01 - Self-Adhering Sheet Waterproofing (650 Membrane System)
- F. Section 076200 - Sheet Metal Flashing and Trim
- G. Section 079100 - Preformed Joint Seals
- H. Section 079200 - Joint Sealants
- I. Section 079513 - Expansion Joint Cover Assemblies
- J. Section 312000 – Earth Moving.

1.3 REFERENCES

- A. ASTM C 836 (06) - Standard Specification for High Solids Content, Cold Liquid Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
- B. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- C. ASTM D 570 - Standard Test Method for Water Absorption of Plastics.
- D. ASTM D 882 (02) - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
- E. ASTM D 903-98 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
- F. ASTM D 1000 - Standard Test Methods for Pressure-Sensitive, Adhesive-Coated Tapes used for Electrical and Electronic Applications.
- G. ASTM D 1434 – Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting.
- H. ASTM D 1876 - Standard Test Method for Peel Resistance of Adhesives (T Peel Test).

- I. ASTM D 1970 (01) - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
- J. ASTM D 4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- K. ASTM D 4716 (01) – Test Method for Determining the (In plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
- L. ASTM D 5385 (06) - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
- M. ASTM D 6574 (00) - Test Method for Determining the (In Plane) Hydraulic Transmissivity of a Geosynthetic by Radial Flow.
- N. ASTM E 96 (Method B) - Standard Test Methods for Water Vapor Transmission of Materials.
- O. ASTM E 154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- P. General Services Administration, Public Building Service: GSA-PBS-07115 Guide Specification for Elastomeric Waterproofing.
- Q. Radon Reduction Technology Laboratory - Resistance to Permeance by Radioactive Radon Gas; Resistance to Diffusion by Radioactive Radon Gas.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations. Include certification of data indicating VOC (Volatile Organic Compound) content of all components of waterproofing system.
- B. Samples: Submit representative samples of the following for approval:
 - 1. Sheet membrane
 - 2. Fabric Tape and Accessories.
- C. Sustainable Design Submittals:
 - 1. Submit invoices and documentation from manufacturer of the amounts of materials and content for products specified.
 - 2. Submit invoices and documentation showing manufacturing locations and origins of materials for products manufactured and sourced within 500 miles of project site.
- D. LEED Submittals:
 - 1. LEED Indoor Environmental Quality (IEQ) Credit 5 – Indoor Chemical and Pollutant Source Control: Design to minimize and control the entry of pollutants into buildings and later cross-contamination of regularly occupied areas.
 - 2. LEED Innovation in Design (ID) Credit 1 – The opportunity to achieve exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System.
 - 3. LEED Materials & Resources (MR) Credit 2 – Construction Waste Management: Provide documentation of reusable materials by weight and volume diverted back to manufacturing process or to appropriate sites.
 - 4. LEED Materials & Resources (MR) Credit 5 – Regional Materials: Provide documentation for cost of materials or products that have been extracted, harvested, or recovered and also manufactured within 500 miles of project site.

- a. If only a portion of the materials or products is extracted, harvested, or recovered and manufactured locally, then only provide percentage by weight for credit value.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Sheet Membrane Waterproofing Barrier System must be manufactured by a company with a minimum of ten (10) years of experience in the production and sales of membrane waterproofing materials.
- B. Applicator Qualifications: A firm having at least three (3) years of experience in applying these types of specified materials and specifically accepted in writing by the membrane system manufacturer.
- C. Materials: For each type of material required to complete the work of this section, provide primary materials which are the products of a single manufacturer.
- D. Pre-Application Conference: A pre-application conference shall be held to establish procedures and to review conditions, installation procedures and coordination with other related work. Meeting agenda shall include review of special details and flashing.
- E. Manufacturer's Representative: Arrange to have trained representative of the manufacturer on site periodically to review installation procedures.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Store adhesives at temperatures of 40o F (4oC) and above to facilitate handling.
- D. Store membrane cartons on pallets.
- E. Do not store at temperatures above 90o F (32oC) for extended periods.
- F. Keep away from sparks and flames.
- G. Completely cover when stored outside. Protect from rain.
- H. Protect materials during handling and application to prevent damage or contamination.
- I. Avoid use of products which contain tars, solvents, pitches, polysulfide polymers, or PVC materials that may come into contact with waterproofing membrane system.

1.7 PROJECT CONDITIONS

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the membrane manufacturer. Install Underslab Membrane when temperature is 25°F (-4°C) and rising.
- B. Proceed with installation only when substrate construction and preparation work is complete. Ensure that subsoil is approved by architect or geotechnical firm.
- C. Warn personnel against breathing of vapors and contact with skin and eyes; wear appropriate protective clothing and respiratory equipment.

- D. Keep flammable products away from spark or flame. Post “No Smoking” signs. Do not allow use of spark-producing equipment during application and until all vapors have dissipated.
- E. Maintain work area in a neat and workmanlike condition. Remove empty cartons and rubbish from the site daily.

1.8 WARRANTY

- A. Product will be replaced, at no charge, if proved to be defective within twelve (12) months of purchase, provided it has been applied in accordance with manufacturer written directions for uses recommended as suitable for this product. Proof of purchase must be provided. Provide a five (5) year system warranty. Contact Polyguard Products, Inc. for further details.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Polyguard Products Inc. P.O. Box 755 Ennis, TX 75120-0755; Phone: (214) 515-5000; Email: info@polyguard.com

2.2 SYSTEM MATERIALS

- A. High Strength Waterproofing: Shall be Polyguard® Underseal™ Underslab Membrane, a strong sheet membrane with a double-thickness, cross-laminated, high-density polyethylene (HDPE) backing laminated to a thick layer of proprietary waterproofing adhesive compound integrated into a high-strength, nonwoven geotextile fabric. Total membrane thickness is factory controlled at 85 mils. On the fabric side, a four (4) inch-wide lap of waterproofing adhesive compound is left exposed along one edge with a removable silicone coated release sheet, which creates a four (4) inch-wide self-adhesive overlap seam.

B. PHYSICAL PROPERTIES

PROPERTY	TEST METHOD	TYPICAL VALUE
FILM COLOR		BLACK/WHITE
MEMBRANE THICKNESS	ASTM D 1000	85 MILS
TENSILE STRENGTH	ASTM D 4632	80 LBS.
TENSILE STRENGTH, FILM	ASTM D 412	4,250 PSI
HYDRAULIC TRANSMISSIVITY OF A GEOSYNTHETIC USING A CONSTANT HEAD	ASTM D 4716	NO MEASURABLE FLOW
(IN-PLANE) HYDRAULIC TRANSMISSIVITY OF A GEOSYNTHETIC BY RADIAL FLOW	ASTM D 6574	NO WATER FLOW
BREAKING STRENGTH OF 1” WIDTH SAMPLE POLYETHYLENE GEOMEMBRANE LAYER	ASTM D 882	5470 PSI
ELONGATION – ULTIMATE FAILURE OF RUBBERIZED ASPHALT COMPOUND	ASTM D 412	> 460%

PERMEANCE TO WATER VAPOR TRANSMISSION	ASTM E 96 METHOD B	0.01 PERMS
CRACK CYCLING	ASTM C 836 TESTED @ -15°F	NO EFFECT
PEEL ADHESION TO CONCRETE	ASTM D 903	31.3 LBS./IN.
LAP PEEL ADHESION	ASTM D 1876	8.7 LBS./IN.
LOW TEMPERATURE FLEXIBILITY	ASTM D 1970 180° BEND OVER 1" MANDREL AT -20°F (-29°C)	NO EFFECT
PUNCTURE RESISTANCE (MINIMUM)	ASTM E 154	220 LBS.
RESISTANCE TO HYDROSTATIC HEAD (MINIMUM)	ASTM D 5385	231 FT.
EXPOSURE TO SOIL FUNGI	GSA-PBS 07115 (16 WEEKS)	NO EFFECT
RESISTANCE TO PERMEANCE BY METHANE GAS	ASTM D 1434 TESTED USING 99.99% PURITY	3.48 X 10 ⁻⁷ FT ³ /(FT ² • HR • PSI)
RESISTANCE TO RADIOACTIVE RADON GAS	RADON REDUCTION TECHNOLOGY LABORATORY % REDUCTION IN RADON GAS DIFFUSION	97.10%
WATER ABSORPTION (MAXIMUM)	ASTM D 570	0.1%

2.3 SYSTEM ACCESSORIES

A. Surface Primer Roller-Grade Adhesive:

1. Polyguard® 650 LT Liquid Adhesive: A rubber-based, tacky adhesive which is specifically formulated to provide excellent adhesion.
2. Polyguard® California Sealant: A rubber-based sealant which is specifically formulated to provide excellent adhesion. The VOC (Volatile Organic Compound) content meets the South Coast Air Quality Management District regulations established under the February 1, 1991 version of Rule 1168 ©) (2) Adhesion and Sealant Applications. California Sealant is classified as an Architectural Sealant Primer Porous, with VOC of 527 g/L. Current SCAQMD regulations for this type of sealant primer are 775 g/L.

B. Adhesive Tape:

1. Polyguard® Underseal® Fabric Tape: Rubberized asphalt waterproofing membrane laminated to polypropylene fabric backing. The membrane is wound onto a disposable silicone treated release sheet to prevent the membrane from sticking onto itself while in the roll. Polyguard Underseal Fabric Tape is used around pipe penetrations with an annular space of pipe through opening exceeding 1/2-inch end laps and for patching damaged areas.
2. Polyguard® 606 Tape: 606 Tape is a high-strength, double-sided tape comprised of rubberized asphalt. The tape utilizes both Kraft paper and plastic film release sheets which are removed prior to application to provide a fast, non-volatile solution for sealing seams and providing tie-in details.

C. Liquid Membranes:

1. Polyguard® LM-85 SSL (Semi-Self-Leveling): A two-component, semi-self-leveling, asphalt-modified, urethane material.
 2. Polyguard® LM-95 Liquid Membrane: A two-component, asphalt-modified, urethane.
- D. Detail Sealant:
1. Polyguard® Detail Sealant PW™: A single-component, STPE, 100% solid moisture-cured, elastomeric sealant. It is an environmentally friendly, non-isocyanate product that replaces silicone and urethane sealants. It is also a low VOC / HAPS-free, cold-applied, self-adhesive, elastomeric sealant.
- E. Corner Boots:
1. Polyguard® US Inside Corner Boot: 60-mil combination of rubberized asphalt bonded to polyethylene. The adhesive surface is covered with a release liner which will be removed prior to application on an inside corner to reinforce and seal corners of the Underslab Membrane.
 2. Polyguard® US Outside Corner Boot: 60-mil combination of rubberized asphalt bonded to polyethylene. The adhesive surface is covered with a release liner which will be removed prior to application on an outside corner to reinforce and seal corners of the Underslab Membrane.
 3. Polyguard® US Pit Top Corner Boot: 60-mil combination of rubberized asphalt bonded to polyethylene. The adhesive surface is covered with a release liner which will be removed prior to application on all corners to reinforce and seal corners of the Underslab Membrane.
- F. Drainage and Protection Board:
1. Polyguard® Polyflow 15: Polyflow® 15 Vertical Drainage Mat is two-part prefabricated geocomposite drain consisting of a formed polymeric core covered on one side with polymeric filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows the water to flow to designated drainage exits. Polyflow 15 is designed for vertical applications.
 2. Polyguard® Polyflow 18: Polyflow® 18 Horizontal Drainage Mat is two-part prefabricated geocomposite drain consisting of a formed polymeric core covered on one side with woven mono-filament filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows the water to flow to designated drainage exits. Polyflow 18 is designed for horizontal applications.
 3. Polyguard® Totalflow™: Totalflow is a combination of our Polyguard sheet drain products with our unique Totalflow™ product. In the Totalflow™ system, the sheet drain performs its normal function of water collection, while the Totalflow™ section provides both water collection and a high-profile section allowing for high-capacity water flow to designated drainage exits.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive sheet waterproofing membrane. Notify General Contractor if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.

- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer.
- D. Concrete surfaces must be clean, smooth, and free of standing water.

3.3 MEMBRANE APPLICATION

- A. Membrane Installation – Horizontal Surfaces (Typical):
 - 1. Horizontal application shall be in accordance with manufacturer's instructions.
 - 2. Install Underslab Membrane when temperatures are 25°F (-4°C) and rising.
 - 3. Unroll waterproofing membrane with longest dimension parallel to direction of pour.
 - 4. Place double-thick, high-strength, cross-laminated polyethylene backing to the soil and fabric to the concrete.
 - 5. Apply required preformed inside and outside corner boots prior to application of membrane according to manufacturer's details and specifications.
 - 6. Seal waterproofing membrane to foundation walls or footers.
 - 7. Overlap side seams using the four (4) inch edge trim seal. Clean polyethylene backing of waterproofing barrier membrane prior to application on the four (4) inch edge seal with 30% Isopropyl Alcohol.
 - 8. End laps should be overlapped a minimum of three (3) inches, maximum of four (4) inches, and addressed by applying a coat of liquid adhesive approximately 50 - 75 sq. ft. per gallon to fabric side of waterproofing barrier membrane and placing adjacent sheet on top. Roll to assure full adhesion.
 - 9. After application of end lap use liquid adhesive to prime seam and apply a twelve a. (12) inch piece of Fabric Tape centered over seam to seal extend out six (6) inches past side laps – roll with laminate roller.
 - 10. Pipe surface should be cleaned and roughened with sandpaper or a wire brush to insure adequate adhesion.
 - a. If the annular space of pipe through an opening exceeds 1/2–inch, a patch of Underslab Membrane is required to close the gap. The size of the patch should extend a minimum 6– inches in all directions from the penetration under the field sheet. Apply 650 LT Liquid Adhesive or California Sealant at a rate of 50 – 75 square feet per gallon. While the 650 LT Liquid Adhesive or California Sealant is still tacky, seal the pipe with the LM-95 or Detail Sealant PW. Apply a cant/ fillet with a min. 3/4–inch face of LM-95 or Detail Sealant PW extending onto the fabric side of the Underslab Membrane patch encapsulating the edge of the field membrane and onto the pipe a minimum of 3–inches. Allow LM-95 or Detail Sealant PW a minimum of 2 hours to cure.
 - b. Note: If pipes or penetrations are in tight clusters and a more flowable detailing liquid is required LM-85 SSL should be used, refer to US 16 Detail.
 - 11. If the annular space of pipe through an opening is 1/2–inch or less, apply 650 LT Liquid Adhesive or California Sealant to the fabric side of Underslab Membrane at a rate of 50 – 75 square feet per gallon. Apply a cant/fillet with a min. 3/4–inch face of LM-95 or Detail Sealant PW extending onto the fabric side of the Underslab Membrane and onto the pipe a minimum of 6–inches.
 - a. Note: If pipes or penetrations are in tight clusters and a more flowable detailing liquid is required LM-85 SSL should be used, refer to US 16 Detail.
 - 12. Steel reinforcements may be applied directly over the waterproofing barrier membrane. It is important that reinforcement (rebar) chairs used are compatible with the system. Blocks, pavers or dobies made of concrete or brick are clearly the best choice. Individual chairs are acceptable as long as they have a flat base or bolsters with rails. Contact Polyguard Technical Service for approval and written permission for other types of rebar chairs.

13. Precaution should be taken to protect the waterproofing barrier membrane during placement of reinforcing or concrete. Visually inspect waterproofing barrier membrane prior to pouring of concrete for any punctures or damage to membrane which needs to be repaired. Patch any damaged areas by applying the liquid adhesive at a rate of 50 - 75 sq. ft. per gallon to fabric side of waterproofing barrier membrane and liquid membrane provided by manufacturer, then apply a patch of Underseal® Fabric Tape.
 14. Prior to slab pour all standing water must be removed from the membrane.
 15. When pouring concrete, the concrete overlay that is applied over the Underslab Membrane must be a minimum 3 1/2-inches. The structural slab must be sound to avoid buckling. It is recommended that concrete be poured within 30 days of the membrane installation. Following proper ACI guidelines, concrete must be placed carefully and consolidated properly to avoid damage to the membrane. Never use a sharp object to consolidate the concrete.
- B. Membrane Installation – Vertical Surfaces:
1. Apply waterproofing membrane with the high-density backing to the drainage board.
 2. Install Underslab Membrane when temperatures are 25°F (-4°C) and rising...
 3. Application up to 20 feet should be done by applying pins with washers every 12 inches across the top lagging thru the membrane and drainage board, allowing the membrane to hang down the wall.
 4. For applications over 20 feet, contact the manufacturer for recommendations.
 5. Provide vertical wall terminations to protect the self-adhered membrane for critical future tie-in to other products, or for protection from trade damage. Review Polyguard's published details for critical detailing procedures at all top terminations.
 6. Side laps are furnished with edge trim of 4'. Apply powder-actuated fasteners every 16-to-24 inches and 1 inch in from the outside edge to secure membrane to wall. Prior to side lap application, remove any debris and dust on the polyethylene backing, clean the backing with 30% Isopropyl Alcohol, and then apply to the edge trim. Finish the seal by rolling with a laminate-type roller to obtain full adhesion.
 7. Prime end laps, and on adjoining sheets, with a minimum 6-inch heavy coat of 650 LT Liquid Adhesive or California Sealant at a coverage rate of 50 – 75 sq. ft. per gallon. Allow this adhesive to dry (until tacky) before membrane application. Install a reverse shingle lap with the Underslab Membrane on the vertical wall; at a maximum 4-inch and a minimum 3-inch overlap. Center and place a 12-inch-wide piece of Fabric Tape over the primed seam area. Apply even pressure with a roller to obtain full adhesion.
 8. If the annular gap between the rough opening and the pipe, bolt, or other penetration is 1/2-inch diameter or less, apply liquid adhesive to the fabric side of the surrounding field course of Underslab Membrane. Then apply a minimum 3/4-inch cant (fillet) of LM-95 Liquid Membrane, or Detail Sealant PW, around the pipe penetration extending a minimum of 3 inches onto both the prepared fabric side of the Underslab Membrane field course and the penetrating item. Allow the LM-95 Liquid Membrane or Detail Sealant PW to cure for 2 hours.
 9. If the annular gap between the rough opening and the pipe, bolt, or penetration exceeds 1/2-inch diameter, apply a patch of Underslab Membrane tight around the penetrating item with a minimum distance of 6 inches onto the surrounding field course of Underslab Membrane. Then seal with LM-95 Liquid Membrane or Detail Sealant PW as a minimum 3/4-inch cant (fillet) extending onto the Underslab Membrane skirt and the penetrating item a minimum distance of 3 inches. Then apply a heavy coat (approximately 50 – 75 sq. ft. per gallon) of Polyguard® 650 LT Liquid Adhesive or Polyguard® California Sealant onto the fabric side of the Underslab Membrane patch extending 6 inches onto the field coating of Underslab Membrane. Next apply a patch of Polyguard® Fabric Tape around the termination edges of the Underslab Membrane patch. Press or roll the patch firmly to obtain full adhesion to the field coating of Underslab Membrane. Apply another coat of Polyguard® 650 LT

- Liquid Adhesive or Polyguard® California Sealant to the Polyguard® Fabric Tape patch edges and apply liquid membrane at Fabric Tape edge terminations.
10. Visually inspect membrane prior to pouring of concrete for any punctures/damage.
 11. Repair damaged Underslab Membrane areas by applying Polyguard® 650 LT Liquid Adhesive or Polyguard® California Sealant at a rate of 50 -75 sq. ft. per gallon to the fabric side of the Blindside Membrane and apply LM-95 Liquid Membrane or Detail Sealant PW a minimum of 3 inches in each direction. Next, apply Polyguard® 650 LT Liquid Adhesive or Polyguard® California Sealant at a rate of 50 -75 sq. ft. per gallon over the Liquid Membrane and the Underslab Membrane field course to a minimum 6 inches in all directions from the damaged area. Apply a Polyguard Fabric Tape patch a minimum 6 inches larger than damaged area in all directions.

END OF SECTION

SECTION 071326.01
SELF-ADHERING SHEET WATERPROOFING (650 MEMBRANE SYSTEM)

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Application of self-adhering membrane system.

1.2 RELATED SECTIONS

- A. Section 031000 – Concrete Forming
- B. Section 031500 – Concrete Accessories
- C. Section 032000 – Concrete Reinforcing
- D. Section 033000 – Cast-in-Place Concrete
- E. Section 071326 – Sheet Waterproofing Membrane (Underslab System)
- F. Section 076200 – Sheet Metal Flashing and Trim
- G. Section 079100 – Preformed Joint Seals
- H. Section 079200 – Joint Sealants
- I. Section 079513 – Expansion Joint Cover Assemblies
- J. Section 312000 – Earth Moving
- K. Section 334600 – Subdrainage

1.3 REFERENCES

- A. ASTM C 836 – Standard Specification for High Solids Content, Cold Liquid Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
- B. ASTM D 146 – Standard Test Methods for Sampling and Testing Bitumen-Saturated Felts and Fabrics Used in Roofing and Waterproofing.
- C. ASTM D 412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
- D. ASTM D 570 – Standard Test Method for Water Absorption of Plastics.
- E. ASTM D 882 – Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
- F. ASTM D 903 – Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
- G. ASTM D 1000 – Standard Test Methods for Pressure-Sensitive, Adhesive-Coated Tapes used for Electrical and Electronic Applications.
- H. ASTM D 1876 – Standard Test Method for Peel Resistance of Adhesives.

1.4 ASTM D 1970 – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection – Section 7.6 Low Temperature Flexibility.

- A. ASTM D 5385 – Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes.
- B. ASTM E 96 (Method B) – Standard Test Methods for Water Vapor Transmission of Materials.
- C. ASTM E 154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- D. General Services Administration, Public Building Service: GSA-PBS-07115 Guide Specification for Elastomeric Waterproofing.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations.
- B. Samples: Submit representative samples of the following for approval:
 - 1. Sheet Membrane
 - 2. Protection Board
 - 3. Prefabricated Drainage Composite
 - 4. Perimeter Drainage Composite

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Sheet Membrane must be manufactured by a company with a minimum of ten (10) years of experience in the production and sales of membrane waterproofing materials.
- B. Applicator Qualifications: A firm having at least three (3) years of experience in applying these types of specified materials and specifically accepted in writing by the membrane system manufacturer.
- C. Materials: For each type of material required to complete the work of this section, provide primary materials which are the products of a single manufacturer.
- D. Pre-Application Conference: A pre-application conference shall be held to establish procedures and to review conditions, installation procedures and coordination with other related work. Meeting agenda shall include review of special details and flashing.
- E. Manufacturer's Representative: Arrange to have trained representative of the manufacturer on site periodically to review installation procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean, dry area in accordance with manufacturer's instructions.
- C. Store adhesives at temperatures of 40° F (5°C) and above to facilitate handling.
- D. Store membrane cartons on pallets.

- E. Keep away from sparks and flames.
- F. Completely cover when stored outside. Protect from rain.
- G. Protect materials during handling and application to prevent damage or contamination.
- H. Avoid use of products which contain tars, solvents, pitches, polysulfide polymers, or PVC materials that may come into contact with waterproofing membrane system.

1.8 PROJECT CONDITIONS

- A. Perform work only when existing and forecasted weather conditions are within the limits established by the membrane manufacturer. Do not apply membrane if the temperature is below 25°F (-4°C) or to a damp, frost covered, or otherwise contaminated surface.
- B. Proceed with installation only when substrate construction and preparation work is complete. If necessary, ensure that subsoil is approved by architect or geotechnical firm.
- C. Warn personnel against breathing of vapors and contact with skin and eyes; wear appropriate protective clothing and respiratory equipment.
- D. Keep flammable products away from spark or flame. Post “No Smoking” signs. Do not allow use of spark-producing equipment during application and until all vapors have dissipated.
- E. Maintain work area in a neat and workmanlike condition. Remove empty cartons and rubbish from the site daily.

1.9 WARRANTY

- A. Manufacturer warrants only that this product is free of defects, since many factors which affect the results obtained from this product are beyond our control; such as weather, workmanship, equipment utilized and prior condition of the substrate. We will replace, at no charge, proven defective product within twelve (12) months of purchase, provided it has been applied in accordance with our written directions for uses we recommended as suitable for this product. Proof of purchase must be provided. A five (5) year material or system warranty may be available upon request. Contact Polyguard Products, Inc. for further details.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Polyguard Products Inc. P.O. Box 755 Ennis, TX 75120-0755; Phone: (214) 515-5000, Email: info@polyguard.com.

2.2 SYSTEM MATERIALS

- A. Self-adhesive Membrane Waterproofing: Shall be Polyguard® 650 Membrane, a 60-mil rubberized-asphalt membrane consisting of a high-density polyethylene film bonded to a layer of rubberized-asphalt meeting or exceeding the following requirements:

B. PHYSICAL PROPERTIES

PROPERTY	TEST METHOD	TYPICAL VALUE
FILM COLOR		BLACK/WHITE
MEMBRANE THICKNESS	ASTM D 1000	60 MILS

TENSILE STRENGTH - MEMBRANE	ASTM D 412 MODIFIED DIE C	370 PSI
ELONGATION - ULTIMATE FAILURE OF RUBBERIZED ASPHALT	ASTM D 412	600%
TENSILE STRENGTH - FILM	ASTM D 882	7294 PSI
PERMEANCE	ASTM E 96 METHOD B	0.022 PERMS
CRACK CYCLING	ASTM C 836 TESTED @-15°F (-26°C)	NO EFFECT
PEEL ADHESION (TO CONCRETE)	ASTM D 903	17 LBS./IN. WIDTH
PEEL ADHESION (LAPS – MEMBRANE TO MEMBRANE)	ASTM D 903	19 LBS./IN. WIDTH
LAP PEEL ADHESION	ASTM D 1876	8.0 LBS./IN. WIDTH
LOW TEMPERATURE FLEXIBILITY (-15°F)	ASTM D 1970 MODIFIED	PASS
PLIABILITY	ASTM D 146 180° BEND OVER 1" MANDREL AT -25°F (-32°C)	NO EFFECT
PUNCTURE RESISTANCE - MEMBRANE	ASTM E 154	69 LBS.
RESISTANCE TO HYDROSTATIC HEAD	ASTM D 5385	231 FT.
EXPOSURE TO FUNGI IN SOIL	GSA-PBS 07115 (16 WEEKS)	NO EFFECT
WATER ABSORPTION	ASTM D 570	0.1%

2.3 SYSTEM ACCESSORIES

A. Surface Primer Roller-grade Adhesive:

1. Polyguard® 650 LT Liquid Adhesive: A rubber-based, tacky adhesive which is specifically formulated to provide excellent adhesion.
2. Polyguard® 650 WB Liquid Adhesive: A water-based, rubber-based adhesive which is specifically formulated to provide excellent adhesion.
3. Polyguard® California Sealant: A rubber-based sealant which is specifically formulated to provide excellent adhesion. The VOC (Volatile Organic Compound) content meets the South Coast Air Quality Management District regulations established under the February 1, 1991 version of Rule 1168 ©) (2) Adhesion and Sealant Applications. California Sealant is classified as an Architectural Sealant Primer Porous, with VOC of 527 g/L. Current SCAQMD regulations for this type sealant primer are 775 g/L.

B. Detail Tape:

1. Polyguard® Detail Tape: Rubberized-asphalt waterproofing membrane laminated to polypropylene backing. The membrane is wound onto a disposable, silicone-treated release sheet to prevent the membrane from sticking onto itself while in the roll. Use Detail Tape for applications (1) inside/outside corners and penetrating items (2) for patching damaged areas.

C. Liquid Membranes:

1. Polyguard® LM-85 SSL (Semi-Self-Leveling): A two-component, semi-self-leveling, asphalt-modified, urethane material.

2. Polyguard® LM-95 Liquid Membrane: A two-component, asphalt-modified, urethane.
- D. Detail Sealant:
 1. Polyguard® Detail Sealant PW™: A single-component, STPE, 100% solid moisture-cured, elastomeric sealant. It is an environmentally-friendly, non-isocyanate product that replaces silicone and urethane sealants. It is also a low VOC / HAPS-free, cold-applied, self-adhesive, elastomeric sealant.
- E. Drainage Composite:
 1. Polyguard® BD Drainage Mat: A sheet molded drainage for balcony decks with less than 3-inches of concrete and foot traffic only. It is manufactured with a geocomposite of a formed impermeable polymeric core covered on one side with a non-woven filter fabric that allows water to flow to designated drainage exits.
 2. Polyflow® 10 Drainage Mat: Vertical use. Two-part, prefabricated, geocomposite drain consisting of a formed polymeric core covered on one side with polymeric filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows the water to flow to designated drainage exits.
 3. Polyguard® Polyflow® 15 Drainage Mat: Two-part, prefabricated, geocomposite drain consisting of a formed polymeric core covered on one side with polymeric filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows water to flow to designated drainage exits.
 4. Polyguard® Polyflow® 18 Drainage Mat: Two-part, prefabricated, geocomposite drain consisting of a formed polymeric core covered on one side with woven mono-filament filter fabric. The fabric allows water to pass into the drain core while restricting the movement of soil particles which might clog the core. The core allows the water to flow to designated drainage exits.
 5. Polyguard® Totalflow™: Totalflow is a combination of our Polyguard sheet drain products with our unique Totalflow™ product. In the Totalflow™ system, the sheet drain performs its normal function of water collection, while the Totalflow™ section provides both water collection and a high-profile section allowing for high-capacity water flow to designated drainage exits.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive self-adhering membrane. Notify the general contractor if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Protect adjacent surfaces not designated to receive waterproofing.
- B. Clean surfaces to receive waterproofing in accordance with manufacturer's instructions.
- C. Do not apply waterproofing to surfaces unacceptable to manufacturer.
- D. Concrete surfaces must be clean, smooth, and free of standing water.
- E. Patch all holes and voids and smooth out any surface misalignments.
- F. Cast-In-Place Concrete:

1. Normal weight structural concrete must be allowed to cure a minimum of seven (7) days. For lightweight structural concrete, the minimum cure time is fourteen (14) days. All concrete surfaces must be dry to the touch before proceeding with the installation of the waterproofing system.
2. Fill all form tie holes. Finish flush with the surrounding surface.
3. Fill and repair cracks, single bug holes of 1/2-inch or greater, or cavities in concrete with a Portland cement grout or concrete. Single bug holes can also be filled with Polyguard Detail Sealant PW™ or LM-95 Liquid Membrane. Finish flush with the surrounding surface.
4. All cracks over 1/16-inch in width, and any moving cracks under 1/16-inch, shall be routed out to a minimum of 1/4-inch width and sealed using a high-performance polyurethane sealant. Allow adequate curing time per the manufacturer's directions. Upon cure install an 8-inch wide strip of Polyguard® 650 Membrane over the crack.

G. Masonry Surfaces:

1. Striking off joints flush with surface is also required. Concrete masonry walls or brick with deeply recessed mortar joints require a well-adhered parge coat before application of membrane.

3.3 APPLICATION

A. Priming:

1. Apply primer to a cleaned, dust free surface. Apply by roller or spray. Apply Polyguard® 650 LT Liquid Adhesive or Polyguard® California Sealant at a rate of 250-300 sq. ft. per gallon or Polyguard® 650 WB Liquid Adhesive at a rate of 350-400 sq. ft. per gallon. Allow to dry per manufacturer's directions. Do not prime underneath Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane.

B. Membrane Installation - Vertical Surfaces:

1. All inside and outside corners shall be treated either with a 12-inch wide strip of Detail Tape centered along the vertical axis, or by applying a 90-mil thick application of Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane.
2. Install a 3/4-inch, 45-degree angle cant (fillet) of Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane at all changes in plane including inside corners to 6" vertically and horizontally beyond the cant (fillet). Do not use wood or fiber cant strips.
3. Waterproofing membrane should be applied vertically in sections of 8 feet in length or less. When vertical walls sections of more than 8-feet are to be waterproofed, apply 650 Membrane in sections no longer than 8-feet, starting from the lower foundation base and rising to the top with the 6-inches overlap, shingling down on each ply of membrane.
4. Side laps should be 2-1/2 inches minimum and staggered end laps should be 6 inches minimum.
5. Use a hard roller or firmly press in the material as it is placed on the vertical surface.
6. At penetrations, posts, or projections, seal with Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane 6 inches onto concrete and 3 inches onto penetrating item; then apply a second flashing sheet over the penetration extending a minimum of 6 inches from the detail. The seal the cut edges of all terminations must be sealed with Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane.
7. Pipes which are wired together and touching, cannot properly be waterproofed. Ensure all pipes have proper spacing. Recommended spacing for pipe penetrations is 2-inches. The minimum allowed is 1-inch.
8. All terminations of the membrane should receive a troweled bead of Polyguard® Detail Sealant PW™, LM-95 Liquid Membrane to a flat surface approximately 1/8-

inch thick by 3/4-inch wide.

9. Inadequately lapped seams and damaged areas should be patched with Polyguard® Detail Tape. Patched areas should extend at least 6 inches in each direction beyond the defect.
10. Fishmouths and/or severe wrinkles should be slit, flaps overlapped, and repaired.

C. Membrane Installation – Horizontal Surfaces:

1. All inside and outside corners shall be treated either with 12-inch strips of membrane or a 12-inch wide by 90-mil thick application of Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane. The field membrane should be centered over the corner. All inside corners shall have a minimum 3/4-inch fillet of Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane or latex modified cement mortar.
2. Apply waterproofing membrane to the primed surface starting at the low point and working to the high point in a shingling technique for maximum drainage.
3. Side laps should be 2-1/2 inches minimum and staggered end laps should be 6-inches minimum. Refer to Polyguard slope and/or zero-slope applications for Balconies and proper lap adhesion requirements.
4. Firmly roll the entire membrane with a minimum 75 lb. linoleum roller immediately after application. This will insure excellent adhesion and minimize air pockets between the substrate and membrane.
5. At penetrations, posts, or projections, seal with Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane 6-inches onto concrete and 3-inches onto penetrating item; then apply a second flashing sheet over the penetration extending a minimum of 6 inches from the detail. The seal the cut edges of all terminations must be sealed with Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane.
6. At drains, apply Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane around the inside edge of the drain out onto substrate at least 6 inches then overlap with sheet membrane a minimum of 6 inches. Seal all permanently-exposed cut edge terminations with Polyguard® Detail Sealant PW™ or Polyguard® LM-95 Liquid Membrane.
7. Membrane turned up on walls shall be terminated. Firmly press the terminated edge with a hand roller and protect with a troweled bead of Detail Sealant PW or LM-95 Liquid Membrane.
8. Inadequately lapped seams and damaged areas should be patched with additional membrane. Extend patch at least 6 inches beyond the defect.
9. Slit all "fishmouths," overlap the pieces, place patch over area and roll in place. Air blisters are typically caused by exposure and heat; this condition will subside as the sun no longer heats the membrane. This condition does not need attention unless blisters are large or excessive, softball size, and do not dissipate. Puncture large air blisters, expel the air, prime and cover with patch. Extend the patch material at a minimum of 6 inches in all directions beyond the repair area, then seal the patch edges with Detail Sealant PW or LM-95 Liquid Membrane.
10. Upon completion of horizontal membrane application, Polyguard recommends a flood test or appropriate leak detection method be completed on the surface with 2 inches of water for 24 hours. Check with the structural engineer to make sure the deck structure will withstand the weight of the flood test. Mark any leak areas found during flood test and make repairs.

D. Protection and Drainage Course:

1. Apply protection board and/or drainage composite and perimeter drainage composite in accordance with manufacturer's written directions.

END OF SECTION

SECTION 072100
THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation at perimeter foundation wall, underside of floor slabs, and exterior wall behind EIFS wall finish.
- B. Batt insulation in exterior wall and ceiling construction.
- C. Batt insulation for filling perimeter window and door shim spaces.

1.2 RELATED REQUIREMENTS

- A. Section 072419 - Exterior Insulation Finish System: Installation requirements for exterior insulation board as part of the EIFS system.
- B. Section 072726.02 - Fluid-Applied Membrane Weather Barriers, Vapor Permeable: Separate weather barrier.
- C. Section 072701 - Interior Air and Vapor Control Layer: Separate air and vapor control barrier.

1.3 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013 (Reapproved 2019).
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- E. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage 2013 (Reapproved 2019).
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- G. ASTM E2430 - Standard Specification for Expanded Polystyrene ("EPS") Thermal Insulation Boards for Use in Exterior Insulation and Finish Systems ("EIFS") 19.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

- C. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.
- F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.
- G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of contractor accreditation and installer certification on project site during and after installation. Present on-site documentation upon request.

1.5 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
 - 1. Installer Qualification: Use accredited contractors, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.6 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Over Metal Stud Framed Walls, Continuous: Expanded Polystyrene (EPS) board for Exterior Insulation Finish Systems.
- D. Insulation in Metal Framed Walls: Batt insulation with no vapor retarder.

2.2 FOAM BOARD INSULATION MATERIALS

- A. Expanded Polystyrene (EPS) Board Insulation: Complies with ASTM C578.
 - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Size: 24 inch by 48 inch.
 - 4. Board Thickness: 4 inches, or as indicated on drawings. 1 inch minimum.
 - 5. Board Edges: Square.
 - 6. Type and Compressive Resistance: Type I, 10 psi (69 kPa), minimum.
 - 7. Meeting the requirements of Dryvit Specification DS131 and ASTM E2430

8. Products:
 - a. InsulFoam LLC; InsulFoam: www.insulfoam.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88) per 1 inch thickness at 75 degrees F mean temperature.
 5. Board Edges: Square.
 6. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
 7. Products:
 - a. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.3 FIBERBOARD INSULATION MATERIALS

- A. Mineral Fiberboard Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 2. Products:
 - a. Thermafiber, Inc; Safing: www.thermafiber.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.4 BATT INSULATION MATERIALS

- A. Mineral Fiber Batt Insulation: Semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
 3. Thermal Resistance: R-value of 10.
 4. Thickness: 2-1/2 inch.
 5. Products:
 - a. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.5 ACCESSORIES

- A. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Adhere a 6 inches wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
 - 1. Tape seal joints.
 - 2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
 - 1. Three continuous beads per board length.
- C. Install boards horizontally on foundation perimeter.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- D. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- E. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Install rigid insulation boards directly over exterior weather barrier membrane, in strict accordance with EIFS manufacturer's instructions and ASTM C1397. Refer to Dryvit system application instructions, DS218.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Coordinate work of this section with requirements for vapor retarder, see Section 072500.
- F. Coordinate work of this section with construction of air barrier seal, see Section 072500.

3.6 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 072160
STRUCTURAL THERMAL BREAK MATERIAL

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section including the following.
 - 1. Structural thermal breaks fabricated from the following material:
 - a. Polyurethane. (Armatherm 500-150, 500-200, 500-280)
 - 2. Thermal breaks at the following locations:
 - a. Canopies.
 - b. Façade connections.
 - c. Roof penetrations.
- B. Related Work: The following items are not included in this Section and are specified under the designated Sections:
 - 1. Section 033000 - CAST-IN-PLACE CONCRETE for coordination with concrete.
 - 2. Section 042000 - UNIT MASONRY for coordination with masonry construction.
 - 3. Section 051200 - STRUCTURAL STEEL FRAMING for coordination with framing.
 - 4. Section 072100 - THERMAL INSULATION for building insulation.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.
- B. Schedule: Submit a list of locations where structural thermal breaks are to be used, and the specific product and thickness to be used at each location.
- C. Shop Drawings: Submit shop drawings showing details of construction, and relationship of structural thermal break material with adjacent construction including fastening and/or anchorage connection details, Armatherm thermal break material size and thickness.
- D. Thermal Design: Wall assembly or interface detail shall meet the ASHRAE 90.1 requirements for continuous insulation and shall not have structural connections (beams, support framing, sub girts, clips) which create thermal bridging. Effective U values of wall, roof and foundation assemblies shall meet or exceed the design requirements per code. Effective U value calculation or modeling shall be performed in accordance with ASHRAE guidelines.
- E. Structural Design: Design structural thermal break connections and/or façade attachment support framing using performance requirements and design criteria indicated. Provide comprehensive engineering analysis by a qualified professional engineer.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Minimum of 5 years' experience producing similar products.
- B. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Storage and Handling: Comply with manufacturer's recommendations for storage and handling. Protect from weather damage.

1.5 WARRANTY

- A. Warranty: Provide manufacturer's standard limited warranty against defects in manufacturing.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Basis-of-Design Manufacturer: Armatherm, 1 Titleist Dr, Acushnet MA 02743. Tel: 844-360-1036. Email: sales@armatherm.com. Web: www.armatherm.com.

2.2 POLYURETHANE THERMAL BREAKS

- A. Structural Thermal Break Material: Armatherm 500-150 high-strength, polyurethane with the following attributes:
 - 1. Compressive strength: ASTM D1621 560 psi.
 - 2. Compressive modulus: ASTM D1621 18,130 psi.
 - 3. Shear strength: ASTM C273 167 psi.
 - 4. Thermal conductivity: ASTM C518 0.32 BTU in/ hr sf degree F.
 - 5. Coefficient of thermal expansion: ASTM E831 33 x 10e-6 in/in/degree F.
 - 6. Thermal resistance (R-Value): ASTM C518 3.3 hr sf degree F/ BTU.
 - 7. Accessories: Armatherm FRR bushings and washers as applicable to location. Armatherm washers shall be minimum 0.25 inch thick. Armatherm bushing and washer to provide thermal break between steel washer/bolt and internal structural steel.
 - 8. Thickness: As indicated on the Drawings.
NOTE: Select thermal break material thickness as required to suit project requirements.
- B. Structural Thermal Break Material: Armatherm 500-200 high-strength, polyurethane with the following attributes:
 - 1. Compressive strength: ASTM D1621 1,131 psi.
 - 2. Compressive modulus: ASTM D1621 29,000 psi.
 - 3. Shear strength: ASTM C273 257 psi.
 - 4. Thermal conductivity: ASTM C518 0.40 BTU in/ hr sf degree F.
 - 5. Coefficient of thermal expansion: ASTM E831 25 x 10e-6 in/in/degree F.
 - 6. Thermal resistance (R-Value): ASTM C518 2.5 hr sf degree F/ BTU.
 - 7. Accessories: Armatherm FRR bushings and washers as applicable to location. Armatherm washers shall be minimum 0.25 inch thick. Armatherm bushing and washer to provide thermal break between steel washer/bolt and internal structural steel.
 - 8. Thickness: As indicated on the Drawings.
NOTE: Select thermal break material thickness as required to suit project requirements.

- C. Structural Thermal Break Material: Armatherm 500-280 high-strength, polyurethane with the following attributes:
1. Compressive strength: ASTM D1621 2,233 psi.
 2. Compressive modulus: ASTM D1621 49,312 psi.
 3. Shear strength: ASTM C273 310 psi.
 4. Thermal conductivity: ASTM C518 0.45 BTU in/ hr sf degree F.
 5. Coefficient of thermal expansion: ASTM E831 25×10^{-6} in/in/degree F.
 6. Thermal resistance (R-Value): ASTM C518 2.22 hr sf degree F/ BTU.
 7. Accessories: Armatherm FRR bushings and washers as applicable to location. Armatherm washers shall be minimum 0.25 inch thick. Armatherm bushing and washer to provide thermal break between steel washer/bolt and internal structural steel.
 8. Thickness: As indicated on the Drawings.
NOTE: Select thermal break material thickness as required to suit project requirements.
- D. Structural Performance: Exterior steel to interior steel or any structural connection that bypasses the continuous insulation. Provide structural thermal break material and connections capable of withstanding and/or transferring the following design loads:
1. Shear, moment, and wind loads as indicated.
 2. Design structural thermal break to allow for fabrication and construction tolerances, accommodate live load deflection, shrinkage and creep of the building structure and other building movements as required by (applicable building code). Maintain structural steel deflections per AISC 360.
 3. Specify type of Armatherm 500 material and allowable load capacity based on manufacturer's data.
- E. Thermal Performance – Column Base Insulation Blocks: Effective R values of floor shall meet or exceed the design requirements per code. Effective R value calculation or modeling must be done in accordance with the IACSC “Energy Modeling Guideline for Cold Storage and Refrigeration Warehouse Facilities”, Table 4.4.1-1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install thermal breaks in accordance with manufacturer's instructions and approved submittals and the following:
- B. Install in proper relationship with adjacent materials.
1. Include accessory products including bushings and washers.
 2. Protect from damage until acceptance.

END OF SECTION

SECTION 072419
EXTERIOR INSULATION FINISH SYSTEM – DRYVIT SYSTEMS, INC.

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. This document is to be used in preparing specifications for an Exterior Insulation and Finish System (EIFS) with Moisture Drainage and an air and water-resistive barrier.

B. Related Requirements:

1. 033000 Cast-in-place Concrete
2. 034000 Precast Concrete
3. 042000 Unit Masonry
4. 054000 Cold-formed Metal Framing
5. 061100 Wood Framing
6. 061600 Sheathing
7. 072100 Thermal Insulation: Exterior board insulation installed in this section.
8. 072701 Interior Air and Vapor Control Layer
9. 072726.02 Fluid-Applied Membrane Weather Barriers
10. 076200 Sheet Metal Flashing and Trim
11. 079000 Joint Protection
12. 084000 Entrances, Store Fronts, and Curtain Walls
13. 085000 Windows

1.2 REFERENCES

A. Reference Standards:

1. ASTM Standards:
 - a. Standard Practice for Operating Salt Spray (Fog) Apparatus
 - b. Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
 - c. Standard Specification for Portland Cement
 - d. Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
 - e. Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement Plaster.
 - f. Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
 - g. Standard Specification for Gypsum Board
 - h. Standard Practice for Application of Class PB Exterior Insulation and Finish System (EIFS) and EIFS with Drainage
 - i. Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
 - j. Standard Specification for Rigid PVC and CPVC Compounds
 - k. Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 - l. Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
 - m. Standard Test Method for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
 - n. Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

- o. Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
- p. Standard Methods of Conducting Strength Tests Of Panels For Building Construction
- q. Standard Test Method for Surface Burning Characteristics of Building Materials
- r. Standard Test Methods for Water Vapor Transmission of Materials
- s. Standard Method for Fire Tests of Building Construction and Materials
- t. Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen
- u. Test Method for Structural Performance of Exterior Windows, Doors and Curtain Walls by Uniform Static Air Pressure Difference
- v. Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Uniform Static Air Pressure Difference
- w. Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential
- x. Test Method for Determining the Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to Sodium Hydroxide Solution
- y. Test Method for Evaluating the Tensile-Adhesion Performance of Exterior Insulation and Finish Systems (EIFS)
- z. Standard Test Method for Air Permeance of Building Materials
- aa. Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies
- bb. Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- cc. Standard Specification for Expanded Polystyrene (EPS) Thermal Insulation Boards for use in Exterior Insulation and Finish Systems (EIFS)
- dd. Standard Test Method for Freeze-Thaw Resistance of Exterior Insulation and Finish Systems (EIFS) and Water-Resistive Barrier Coatings
- ee. Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS)
- ff. Standard Specification for PB Exterior Insulation and Finish Systems
- gg. Standard Test Method for Evaluating Water-Resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage
- hh. Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
- ii. Standard Practice for Operating-Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials
- 2. National Fire Protection Association (NFPA) Standards:
 - a. Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Source
 - b. Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load Bearing Wall Assemblies Containing Combustible Components
- 3. Manufacturer's Standards and Documents:
 - a. Dryvit Expanded Polystyrene Insulation Board Specification
 - b. Dryvit Cleaning and Recoating
 - c. Dryvit Expansion Joints and Sealants

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meetings

B. Sequencing

1. Provide jobsite grading prior to installation of Exterior Insulation and Finish System with moisture drainage so that the system may be terminated at 8 in above grade or as required by code.
2. Coordinate installation of foundation waterproofing, roofing membrane, windows, doors, and other penetrations of the exterior walls to provide a continuous air and water-resistive barrier.
3. Provide protection of rough openings before installing windows, doors, and other penetrations of the exterior walls.
4. Coordinate installation of windows and doors so air and water-resistive barrier components are connected to them to provide a continuous barrier.
5. Install window and door head flashings immediately after windows and doors are installed.
6. Install diverter flashings wherever water can enter the wall assembly to direct water to the exterior.
7. Install copings and sealants immediately after installation of the Exterior Insulation and Finish System with moisture drainage and when EIFS coatings are dry.
8. Attach penetrations through Exterior Insulation and Finish System to structural support and provide water-tight seals at penetrations.

1.4 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

- A. Submit product data as required by Section 013300, Administrative Requirements.
- B. Submit shop drawings for all EIFS with moisture drainage system conditions, including, but not limited to, the following: wall/panel layout, inside and outside corners, connections, details, expansion joints, penetrations, window and door openings, terminations and installation sequence. All shop drawings shall be project specific and shall be drawn no smaller than half-scale (6 inches equals one foot). Standard manufacturer details that do not reflect actual project conditions will not be accepted.
- C. Submit two (2) samples of the Exterior Insulation and Finish System with moisture drainage for each finish, texture, and color to be used on the project. Use the same tools and techniques proposed for the actual installation. Make the samples of sufficient size to accurately represent each color and texture being utilized on the project.
- D. Submit a current copy of the manufacturer's Trained Contractor Certificate for the system specified.
- E. Submit Owner/Architect-requested test results verifying the performance of the Exterior Insulation and Finish System with Moisture Drainage. Refer to Outsulation Plus MD System Performance Criteria Data Sheet DS852.
- F. Submit a copy of the manufacturer's installation details and application instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Submit a copy of the manufacturer's recommended maintenance and repair manual.
- B. Submit a copy of the Exterior Insulation and Finish System with Moisture Drainage manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 1. A member in good standing of the EIFS Industry Members Association (EIMA).

2. Manufacture Exterior Insulation and Finish System with moisture drainage materials at a facility covered by a current ISO 9001:2015 and ISO 14001:2015 certification. Certification of the facility is done by a registrar accredited by the American National Standards Institute, Registrar Accreditation Board) ANSI-RAB).
 - B. Contractor Qualifications:
 1. Knowledgeable in the proper installation of the Exterior Insulation and Finish System with Moisture Drainage.
 2. Possess a current Outsulation Plus MD System Trained Contractor Certificate* issued by Dryvit Systems, Inc.
 3. Successfully complete a minimum of three (3) projects of similar scope and scale to the specified project.
 - C. Insulation Board Manufacturer Qualifications:
 1. Listed by Dryvit Systems, Inc., and capable of producing the Expanded Polystyrene (EPS) in accordance with the current Dryvit Specification for Insulation Board, DS131.
 2. Subscribe to the Dryvit Third Party Certification and Quality Assurance Program.
 - D. Panel Fabricator Qualifications:
 1. Experienced and competent in the fabrication of architectural wall panels.
 2. Possess a current Outsulation Plus MD System Trained Contractor Certificate* issued by Dryvit Systems, Inc.
 - E. Panel Erector Qualifications:
 1. Experienced and competent in the installation of architectural wall panel systems.
 2. Shall be:
 - a. The panel fabricator or
 - b. An erector approved by the panel fabricator or
 - c. An erector under the direct supervision of the panel fabricator
 - F. Mock-Up:
 1. Provide the owner/architect with a mock-up for approval.
 - a. Of suitable size as required to accurately represent the products being installed, as well as each color and texture to be utilized on the project.
 - b. Prepared with the same products, tools, equipment and techniques required for the actual applications. Use finish from the same batch that is being used on the project.
 - c. Available and maintained at the jobsite.
 - G. Regulatory Requirements:
 1. Separate the EPS insulation board from the interior of the building by a minimum 15-minute thermal barrier.
 2. Comply with local building codes for the use and maximum thickness of EPS insulation board.
 - H. Inspections:
 1. Cooperate with independent, third-party inspectors when required by code or by contract documents.
- 1.7 DELIVERY, STORAGE AND HANDLING
- A. Deliver all Exterior Insulation and Finish System with moisture drainage components and materials to the job site in the original, unopened packages with labels intact.
 - B. Inspect all Exterior Insulation and Finish System with moisture drainage components and materials upon arrival for physical damage, freezing or overheating. Do not use questionable

materials.

- C. Store all Exterior Insulation and Finish System with moisture drainage components and materials at the jobsite in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Maintain minimum and maximum storage temperature as stated in the product data sheets or specifications for the materials selected. NOTE: Finishes exposed to temperatures over the published maximum storage temperature for even short periods may exhibit skinning and increased viscosity.
- D. Protect all products from inclement weather and direct sunlight.

1.8 SITE CONDITIONS

- A. Ambient Conditions
 - 1. Do not apply wet materials during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
 - 2. Verify the minimum air and wall surface temperatures at the time of application as stated in the product data sheets or specifications for the materials selected.
 - 3. Maintain these temperatures with adequate air ventilation and circulation for a minimum of 24 hours (48 hours for Weatherlastic® Finishes, Ameristone™, TerraNeo® and Limestone™) thereafter, or until the products are completely dry.

1.9 WARRANTY

- A. Manufacturer's Warranty
 - 1. Provide manufacturer's standard warranty.
- B. Contractor Warranty
 - 1. Sub-contractor to provide warranty of installation. Manufacturer assumes no liability for installation of Exterior Insulation and Finish System with moisture drainage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers List
 - 1. Basis of Design: Dryvit Systems, Inc. One Energy Way, West Warwick, RI 02893, 800-556-7752, www.dryvit.com.
 - 2. An approved equal.
- B. System Product and Material Substitution Limitations
 - 1. All components of the EIFS system shall be supplied or obtained from the system manufacturer or its authorized distributors. All products and materials used in the system shall be approved by the manufacturer for use to ensure compatibility without voiding the system warranty.
- C. System Installation
 - 1. EIFS system shall be Field Applied: All system components shall be applied to the substrate in place.
 - 2. All EIFS system components shall be installed in strict accordance with manufacturer's written installation instructions, approved system details and installation methods.

2.2 DESCRIPTION

- A. System Description:

- B. The Dryvit Outsulation Plus MD System is an Exterior Insulation and Finish System (EIFS) with Moisture Drainage; consisting of:
1. A fluid-applied air/water-resistive barrier (weather barrier).
 2. Adhesive – installed in vertical ribbons to facilitate egress of incidental moisture
 3. Expanded Polystyrene (EPS) insulation board
 4. Base Coat
 5. Reinforcing Mesh
 6. Finish Coat
- C. Materials:
1. Air and Water-Resistive Weather Barrier:
 - a. Refer to Section 072726.02 - Fluid-Applied Membrane Weather Barrier, Vapor Permeable
 2. Flashing:
 - a. AquaFlash® fluid-applied water-based polymer coating.
 - b. AquaFlash polyester reinforcing mesh.
 - c. Dryvit Flashing Tape™ rubberized asphalt adhesive available in rolls 4 in (102 mm), 6 in (152 mm) and 9 in (229 mm) wide by 75 ft (23 m) long.
 - d. Dryvit Flashing Tape Surface Conditioner™ water-based surface conditioner and adhesion promoter.
 3. Drainage:
 - a. Drainage Track UV treated PVC “J” channel perforated with weep holes, complying with ASTM D 1784 and ASTM C 1063
 - b. Acceptable manufacturers of drainage track:
 - 1) Starter Trac STWP – without drip edge by Plastic Components, Inc.
 - c. Starter Trac STDE – with drip edge by Plastic Components, Inc.
 - 1) Universal Starter Track by Wind-lock Corporation
 - 2) Sloped Starter Strip with Drip by Vinyl Corp.
 - d. Dryvit Drainage Strip™ corrugated plastic strip.
 - e. Dryvit AP Adhesive™ urethane-based adhesive used to attach Drainage Track and Dryvit Drainage Strip to the sheathing.
 4. Adhesives:
 - a. Liquid polymer-based adhesive field mixed with Portland cement.
 - 1) Dryvit Primus®
 - 2) Dryvit Genesis®
 - b. Ready mixed dry blend cementitious, copolymer-based adhesive field mixed with water.
 - 1) Dryvit Primus® DM
 - 2) Dryvit Genesis® DM
 - 3) Dryvit Genesis® DMS
 - 4) Rapidry DM™ 35-50
 - 5) Rapidry DM™ 50-75
 5. Insulation Board:
 - a. Expanded Polystyrene; minimum thickness 25 mm (1 in); meeting Dryvit Specification DS131 and ASTM E 2430.
 - b. Refer to Section 072100 - Thermal Insulation.
 6. Base Coat:
 - a. Liquid polymer-based adhesive field mixed with Portland cement.
 - 1) Dryvit Primus
 - 2) Dryvit Genesis
 - b. Ready mixed dry blend cementitious, copolymer-based adhesive field mixed with water.
 - 1) Dryvit Primus DM
 - 2) Dryvit Genesis DM

- 3) Dryvit Genesis DMS
- 4) Rapidry DM 35-50
- 5) Rapidry DM 50-75
7. Reinforcing Mesh:
 - a. Open-weave, glass fiber fabric treated for compatibility with other system materials.

Reinforcing Mesh ¹ /Weight oz/yd ² (g/m ²)	Minimum Tensile Strengths	EIMA Impact Classification	EIMA Impact Range in-lbs (Joules)		Impact Test Results in-lbs (Joules)	
Standard - 4.3 (146)	150 lbs/in (27 g/cm)	Standard	25-49	(3-6)	36	(4)
Standard Plus - 6 (203)	200 lbs/in (36 g/cm)	Medium	50-89	(6-10)	56	(6)
Intermediate TM - 12 (407)	300 lbs/in (54 g/cm)	High	90-150	(10-17)	108	(12)
Panzer [□] 15 ¹ - 15 (509)	400 lbs/in (71 g/cm)	Ultra High	> 150	(> 17)	162	(18)
Panzer 20 ¹ - 20.5 (695)	550 lbs/in (98 g/cm)	Ultra High	> 150	(> 17)	352	(40)
Detail Mesh [□] Short Rolls - 4.3 (146)	150 lbs/in (27 g/cm)	n/a	n/a	n/a	n/a	n/a
Corner Mesh TM - 7.2 (244)	274 lbs/in (49 g/cm)	n/a	n/a	n/a	n/a	n/a
* It shall be colored blue and bear the Dryvit logo for product identification						
1. Shall be used in conjunction with Standard Mesh (recommended for areas exposed to high traffic)						

8. Site Coated EPS Shapes and Starter Boards: Shall be coated on site utilizing the same materials (EPS, base material mixture, reinforcing mesh, and finish) as specified for the project.
9. Machine Coated EPS Shapes and Starter Boards: Shall be supplied by a manufacturer that subscribes to the Dryvit third party certification and quality assurance program.
10. Finish:
 - a. Hydrophobic (HDPTM) Finishes: 100% acrylic coating with integral color and texture and formulated with hydrophobic properties:
 - 1) Texture:
 - a) LimestoneTM HDP
 - 2) Colors: Provide finishes in up to (3) different colors, to match Architect-approved sample.
11. Coatings, Primers, and Sealants:
 - a. Demandit® Smooth
 - b. Demandit® Sanded
 - c. Demandit® AdvantageTM
 - d. HDP Water-Repellent Coating
 - e. Weatherlastic® Smooth
 - f. Tuscan GlazeTM
 - g. Color Prime
 - h. Prymit®

- i. SealClear™
- 12. Jobsite-Mixed Materials:
 - a. Portland cement: verify is Type I or II, meeting ASTM C 150, white or gray in color, fresh and free of lumps.
 - b. Water: verify is clean and free of foreign matter.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
- B. Verify access to electric power, clean water and a clean work area at the location where the Dryvit materials are to be applied.
- C. Verify that wall surface on which Exterior Insulation and Finish System is to be installed is a manufacturer-approved substrate:
 - 1. Exterior grade gypsum sheathing meeting ASTM C 1396.
 - 2. Exterior glass-mat gypsum sheathing meeting ASTM C 1177.
 - 3. Exterior fiber reinforced cement or calcium silicate boards.
 - 4. APA Exterior or Exposure 1 Rated Plywood, Grade C-D or better, nominal 12.7 mm (1/2 in), minimum, installed with the C face out.
 - 5. APA Exterior or Exposure 1 Fire Retardant Treated (FRT) Plywood, Grade C-D or better, nominal 12.7 mm (1/2 in), minimum, installed with the C face out.
 - 6. APA Exposure 1 Rated Oriented Strand Board (OSB) nominal 12.7 mm (1/2 in), minimum.
 - 7. Unglazed brick, cement plaster, concrete or masonry.
 - 8. Pre-engineered metal building panels with an acceptable substrate as noted in Section 1.04.C.1.a through f.
- D. Verify the deflection of the substrate is does not exceed 1/240 times the span. Verify substrate is flat within 1/4 in (6.4 mm) in a 4 ft (1.2 m) radius.
- E. Verify substrate is sound, dry, connections are tight; has no surface voids, projections, or other conditions that may interfere with the Exterior Insulation and Finish System with moisture drainage installation or performance.
- F. Verify the slope of inclined surfaces are not less than 6:12 (27 o), and the length of the slope does not exceed 12 in (305 mm).
- G. Verify metal roof flashings have been installed in accordance with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) standards.
- H. Verify all rough openings are flashed in accordance with the Exterior Insulation and Finish System with moisture drainage manufacturer's installation details, or as otherwise necessary to prevent water penetration. Verify chimneys, balconies and decks have been properly flashed as necessary to prevent water penetration.
- I. Verify windows and doors are installed and flashed per manufacturer's requirements and installation details.
- J. Notify general contractor of all discrepancies prior to the installation of the Exterior Insulation and Finish System with moisture drainage.
- K. Verify that expansion joints are installed:
 - 1. Where expansion joints occur in the substrate system.
 - 2. Where building expansion joints occur.
 - 3. At floor lines in wood frame construction.

4. At floor lines of non-wood framed buildings where significant movement is expected.
5. Where the Exterior Insulation and Finish System with moisture drainage abuts dissimilar materials.
6. Where the substrate type changes.
7. Where prefabricated panels abut one another.
8. In continuous elevations at intervals not exceeding 75 ft (23 m).
9. Where significant structural movement occurs, such as changes in roof line, building shape or structural system.

3.2 PREPARATION

- A. Protect the Exterior Insulation and Finish System with moisture drainage materials by permanent or temporary means from inclement weather and other sources of damage prior to, during, and following application until completely dry.
- B. Protect adjoining work and property during installation of the Exterior Insulation and Finish System with moisture drainage.
- C. Prepare the substrate to be free of foreign materials, such as oil, dust, dirt, form-release agents, efflorescence, paint, wax, water repellants, moisture, frost, and any other condition that may inhibit adhesion.

3.3 INSTALLATION

- A. Install the system in accordance with ASTM C1397 and the Dryvit Outsulation Plus MD System Application Instructions, DS218.
- B. Apply base coat sufficient to fully embed the reinforcing mesh. The recommended method is to apply the base coat in two (2) passes.
- C. Apply sealant only to base coat treated with Dryvit Demandit Smooth or Color Prime coatings.
- D. Install high impact reinforcing mesh as specified at ground level, high traffic areas and other areas exposed to or susceptible to impact damage as designated on contract drawings.
- E. Install Pre-Coated EPS Shapes in accordance with Dryvit Publication DS854.

3.4 SITE QUALITY CONTROL

- A. Independent Testing/Inspection Agency: Inspection agency employed and paid by Owner, will examine water resistive barrier coating applied over sheathing complies with ASTM E2570/E2570M.
- B. Exterior Insulation and Finish System with moisture drainage manufacturer assumes no responsibility for on-site inspections or application of its products.
- C. EIFS sub-contractor to certify in writing the quality of work performed relative to the substrate system, details, installation procedures, and as to the specific products used.
- D. EPS supplier, if requested, to certify in writing that the EPS meets the Exterior Insulation and Finish System manufacturer's specifications.
- E. The sealant contractor, if requested, to certify in writing that the sealant application is in accordance with the sealant manufacturer's and the Exterior Insulation and Finish System manufacturer's recommendations.

3.5 CLEANING

- A. Remove all excess Exterior Insulation and Finish System materials from the job site by the contractor in accordance with contract provisions and as required by applicable law.
- B. Leave all surrounding areas, where the Exterior Insulation and Finish System with moisture drainage has been applied, free of debris and foreign substances resulting from the EIFS sub-contractor's work.

END OF SECTION

SECTION 072701
INTERIOR AIR AND VAPOR CONTROL LAYER

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior air and vapor control layer, including surface preparation.

1.2 RELATED SECTIONS

- A. Section 072100 – Thermal Insulation
- B. Section 072726.02 – Fluid-Applied Water Resistive Weather Barrier
- C. Section 075423 – TPO Membrane Roofing: Vapor retarder installed as part of the roofing system.

1.3 REFERENCES

- A. ISO 9972:2006 / EN 13829 — Determination of air permeability of buildings, Fan pressurization method
- B. ASTM E779 – Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
- C. ASTM E84 - Standard test method for surface burning characteristics of building materials.
- D. ASTM E2178 - Standard Test method for. Air Permeance of Building Materials
- E. AATCC 127 – Hydrostatic pressure test
- F. ISO 12572 - Hygrothermal performance of building materials and products
- G. EN 1849-2 - Flexible sheets for waterproofing - Determination of thickness and mass per unit area
- H. EN 12114 - Thermal performance of buildings - Air permeability of building components and building elements
- I. EN 12310-1 - Flexible sheets for waterproofing. Determination of resistance to tearing (nail shank)
- J. EN 12311-2 - Flexible sheets for waterproofing. Determination of tensile properties.
- K. EN 13859-1 - Flexible sheets for waterproofing - Underlays for discontinuous roofing/(sheathing)
- L. EN 1296 - Flexible sheets for waterproofing - Method for artificial ageing by long term exposure to elevated temperature
- M. EN 1931: Determination of water vapor transmission properties

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Installation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
- C. Verification Samples: For each product specified, two samples.
 - 1. Membranes: minimum size 6"x8"
 - 2. Tapes: minimum length 5"
 - 3. Gaskets, adhesives, accessories: one each

1.5 QUALITY ASSURANCE

- A. Performance target: required airtightness level for this project is 0.6 air changes per hour (ACH50) or 0.005 CFM/sf75. Minimum acceptable air-tightness level is 1.0 ACH50 or 0.15CFM/sf75 for buildings over 20,000SF
- B. Installer Qualifications: Comply with one of the following requirements:
 - 1. The (sub-)contractor installing the interior airtight layer shall have as minimum experience with at least two buildings that was independently tested below 1.0ACH or 0.15CFM/sf75
 - 2. The (sub-)contractor has completed the "Make it tight" training with 475 High Performance Building Supply
- C. Due to their superior technical performance and durability, only products made by Pro Clima in Germany are acceptable for the construction of the interior airtight layer.
- D. Mock-Up: Provide a mock-up for evaluation of installation techniques and application workmanship.
 - 1. Prior to installation of airtight layer, mock up airtight layer as follows to verify details and to demonstrate connections to adjoining construction elements, and other termination conditions.
 - 2. Install mockup of airtight layer in location designated by Architect.
 - 3. Do not proceed with remaining work until workmanship and application technique are approved by Architect.
 - 4. Construct typical interior wall, 8 feet wide by 8 feet long, illustrating materials interface and connections (tape, adhesives, gaskets), incorporating specified options including but not limited to the following:
 - a. junctions of walls, foundations, ceilings, floors and roof,
 - b. corner conditions
 - c. window and doorframe connections, and
 - d. blow-in insulation seals/battens.
- E. Cooperate and coordinate with the owner's inspection and (blowerdoor) testing agency. Do not cover (with sheetrock, blocking, mechanical equipment or other elements that would restrict access to the airtight membrane) any components of the mock up (installed airtight layer membrane or other airtight elements) until it has been inspected, blowerdoor tested and approved.

1.6 PRECONSTRUCTION MEETING

- A. Preconstruction Meeting: Convene a meeting with all subcontractors affected by the Work of this Section a minimum of one week prior to commencing work of this section. Agenda shall include materials, details of construction, compatibility of materials, sequencing of

construction/installation of membranes, the airtightness goal and emphasize that the success during the blowerdoor test is dependent on the collaboration of all subcontractors.

- B. Coordinate Work with other subcontractors (plumbers, electricians, carpenters, HVAC), operations and installation of finish materials to install correct-sized gaskets on pipes, ducts and cable when these elements pass through the interior airtight layer, and to avoid damage to installed materials. Before they commence work on site, provide each effected trade with sufficient gaskets.
- C. After meeting, post the following warning in a prominent location at all building entrances and top of each stair – 1/2” letter height minimum for header, 1/4” for all other text
 - 1. AIRTIGHT BUILDING
 - 2. No drilling, airtight construction: no cutting, airtight membranes
 - 3. Report all penetrations to supervisor
 - 4. Translate into additional languages if required/as appropriate. (Available from foursevenfive.com)

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials on pallets. in clean and dry areas, not exposed to direct sunlight and in accordance with manufacturer's instructions. Store adhesives and primers at temperatures at or above 40 degrees Fahrenheit (4 degrees Celsius) to facilitate handling.
- C. Protect materials during handling and application to prevent damage, puncturing or contamination.

ENVIRONMENTAL CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) as per manufacturers recommendations. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Minimize exposure of airtight membranes to direct sunlight. Use blinds or covers over window openings to block direct sunlight to prevent UV damage to membranes, if membranes will not be covered by sheetrock within 2 weeks or use exterior grade products (INTELLO X or SOLITEX line)
- C. Minimize exposure to water. If exposure is likely, expected or cannot be avoided, use exterior grade products (INTELLO X or SOLITEX Line).

PART 2 PRODUCTS

3.1 MANUFACTURERS

- A. Acceptable Manufacturer: Pro Clima/Moll bauökologische Produkte GmbH, 68723 Schwetzingen Germany. Imported by 475 High Performance Building Supply, 334 Douglass street, Brooklyn NY,
 - 1. Tel: 718-622-1600; Email; info@foursevenfive.com; Web: www.foursevenfive.com / www.foursevenfive.ca
- B. Substitutions: Not permitted.

3.2 AIRTIGHT LAYER SYSTEMS

A. INTELLO X:

1. Description: High performance vapor variable (Hydrosafe) membrane and temporary WRB for commercial buildings. Made from Polyethylene-Copolymer protected with two robust PP fleex
2. 3 layer material – includes two robust PP protection fleeces that protect smart vapor retarder. Suitable to use as temporary roof or WRB during construction.
3. Class A rated material per ASTM E84 (Flame spread: 0, SDI:105)
4. Airtight material per ASTM E2178: 0.00005cfm/sf
5. Appearance: Translucent white
6. Weight 0.6 oz/sf \pm 0.5 g/m² (150g/m²) EN1849-2
7. Thickness: 18 mils (0.45 mm \pm 0.05 mm) EN1849-2
8. Perm rating: 13.20 to 0.13 (Sd value from 0.25m to >25m) ISO 12572
9. Temperature exposure limits: -40 to 176 degrees F (-40 to 80C)
10. Tensile Strength (EN13859-1)
 - a. 250 N/50 mm MC
 - b. 170 N/50 mm DC
11. Elongation (EN13859-1)
 - a. 60% (MC)
 - b. 60% (DC)
12. Nail Tear Resistance: 27/27 lbf 120N/120N (MC/DC) EN 13859-1
13. Permeability consistent after artificial age testing: Pass – DIN EN 1296/1931
14. Water column 8.2ft (2.5m) AATCC 127 – DIN EN 20811
15. UV and weather exposure: 2 months

B. Airtight interior tape: TESCON VANA:

1. Solid Acrylic tape with PP carrying fleece
2. Perm rate: 8 (sd-value 0.4m) DIN EN1931
3. Adhesion (ASTM D3330): 4.45Lbs/lin.inch INTELLO, 3.34lbs/lin/inch OSB
4. Artificial age test: 100 years (per DIN 4108-7)
5. Living Building Challenge Declare label – red list free
6. Free of VOCs

C. Airtight interior corner tape: TESCON Profil or TESCON Profect, Solid Acrylic tape with PP carrying fleece and split release paper: Living Building Challenge Declare label – red list free, free of VOCs

D. Airtight window tape: CONTEGA SOLIDO SL(-D): vapor retarding window tape with multiple release papers for specific or blind taped window airsealing.

E. Airtight adhesive: CONTEGA HF (contains VOC's/bio-ethanol) or CONTEGA Classic (VOC free), CONTEGA MULTIBOND (pre-cure adhesive on roll): non-embrittling adhesives for membrane connections to concrete, plywood floors and very rough/split wood.

3.3 ACCESSORIES

A. PRESSFIX tape pressurization tool.

B. Primer: TESCON Primer RP (for brick or concrete):

1. Acrylic-copolymer based primer
2. Application Temperature: Above 15 degrees Fahrenheit (-10 degrees Celsius)
3. VOC free

C. Pipe, duct, cable sealing: ROFLEX and KAFLEX gaskets

1. EPDM gaskets per specific pipe sizes
 2. Tape with TESCON VANA to airtight layer
- D. Outlet sealing (recessed): INSTAABOX / LESSCO boxes
1. Self sealing airtight outlet box
 2. Tape with TESCON VANA to airtight layer
- E. Metal studs: Fastweb strips or cap screws

PART 3 EXECUTION

4.1 EXAMINATION

- A. Do not begin installation until substrates/surfaces have been properly prepared and cleaned from dust, silicones, oils and grease. Before installation, verify substrate is free of splinters, nails or other objects that could puncture membranes.
- B. If window or door opening preparation is the responsibility of another installer, notify architect of unsatisfactory preparation before proceeding.
- C. If there are unexpected pipes, ducts or wires in the installation area/airtight layer or these penetrations do not have ROFLEX/KAFLEX gaskets around them, notify architect of unsatisfactory preparation before proceeding.
- D. If floor, walls or ledger boards have been built that interfere with the airtight layer and a drawn/planned pre-installed airtight membrane was not installed as per sequencing plan, notify architect of unsatisfactory preparation before proceeding.
- E. If long term exposure to UV or liquid water is likely or can be expected – USE INTELLO X or SOLITEX membranes only.
- F. Acceptance of Conditions: Beginning of installation constitutes acceptance of existing conditions.

4.2 PREPARATION

- A. Clean and prepare surfaces to receive air/vapor barrier in accordance with manufacturer's installation guidelines.
- B. All surfaces must be clean, smooth and dry and must be clean of oil, dust, and silicone.
- C. Batt installation: install membrane immediately after batt insulation is installed in winter.
- D. Properly ventilate space or use dehumidifier to prevent high humidity conditions after concrete pours, sheetrock compounding and tile work . Monitor humidity if needed to ensure it stays below 60% relative humidity.

4.3 APPLICATION

- A. Apply airtight layer/vapor retarder in accordance with manufacturer's instructions.
- B. Install membranes taut and without creases along the substrate.
- C. Overlap subsequent courses of membrane. Use the printed lines on the membrane as a guide.
- D. Mechanically fasten as per 475 installation manuals

- E. Battens for service cavities for densepacking should be spaced less than 20" o.c. and be perpendicular to the direction of the structure behind. Or other means should be employed to mechanically fix the membrane sufficiently to the substructure to long term support the weight/force exerted by the insulation – please contact 475 for additional means and methods.
- F. Tape all overlaps. Use a PRESSFIX tape pressurization tool to ensure there is sufficient back-pressure when applying the pressure sensitive Pro Clima tapes. Make sure that tape joints are not permanently under stress, ie are supported by a batten or by cross taping the taped joint with 12" long pieces of tape every 12"
- G. Overlap the membrane a minimum of 2" over dissimilar airtight materials (concrete, plaster).
- H. Use CONTEGA HF (for below 0F application) or CONTEGA classic (VOC free) or MULTIBOND to adhere membranes to concrete, brick, plaster or rough OSB. Leave some slack in the membrane to allow for expansion and contraction between these dissimilar materials. Prime substrates with TESCON Primer RP if necessary.
- I. If taping to membrane to porous or unknown substrates, they should be free of oil, silicone and dust. Do an adhesion test when in doubt. Primer recommended for application to brick, concrete, wood fiber insulation board and certain OSB brands.
- J. Cut membrane with a utility knife in detail around penetrations.
- K. Seal membranes to windows, joist and beams with TESCON Profil or CONTEGA line of airtight window tapes. Follow application guides of specific tapes.
- L. Seal all penetrations with gaskets (ROFLEX or KAFLEX) taped with TESCON VANA airtight tape to airtight layer. Air seal around pre-existing penetrations (pipes, ducts or cables) with TESCON VANA tape in step like fashion, avoiding creases in tape.
- M. Apply blown in insulation directly after installing interior airtight membranes.
- N. Inspect membrane before blowerdoor test and/or dense-packing insulation. Ensure:
 - 1. each overlap is taped and has been pressurized
 - 2. staples applied at appropriate intervals
 - 3. counter battens at recommended distances
 - 4. tears and punctures repaired with Pro Clima tape
 - 5. adhesives (CONTEGA HF or classic) have had 48 hours to set up before test.

4.4 TESTING

- A. Do a blowerdoor test as soon as the airtight layer is completely installed. During the test search for any detectible leaks with hands, IR or smoke pencils.
- B. Document any leaks, and repair with Pro Clima tapes, adhesives and accessories.
- C. Repeat test until building complies with project airtightness (ACH50 or CFM/SF75) goal, but at a minimum better than 1.0ACH50 or 0.15CFM/SF75
- D. Re-do blowerdoor test if more than 2 holes/penetrations are made following completion of blowerdoor test above, or at the request of the architect.

4.5 PROTECTION

- A. Protect installed products until completion of project.

- B. Repair tears, punctures or burns (e.g. from sweating copper pipe) and/or replace damaged products before covering materials. Re-do blowerdoor test if more than 3 holes are made or by request of architect.
- C. To protect interior airtight layer/membranes, apply service cavity insulation and sheetrock as soon as possible, and not later than specified exposure limit of used materials. Use tarps or other means of blocking UV if exposure times will be exceeded to protect membranes.

4.6 FINAL TEST

- A. Blowerdoor test the installed membrane/interior airtight layer when:
 - 1. All penetrations have been made and sealed.
 - 2. Sheetrock and other finishes on exterior walls have been installed.
- B. Find and repair leaks.
- C. Repeat testing and repairs until the project complies with the project airtightness goal.

END OF SECTION

SECTION 072726.02
FLUID-APPLIED MEMBRANE WEATHER BARRIERS, VAPOR-PERMEABLE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fluid-applied, vapor-permeable membrane weather barriers.

1.2 RELATED REQUIREMENTS

- A. Division 01 Section "Sustainable Design Requirements" for additional requirements, including LEED documentation requirements.
- B. Section 054000 Cold-Formed Metal Framing: "Exterior Wall Sheathing" for air barrier substrates.
- C. Division 07 roofing Sections for roof assembly air barriers and interface coordination.
- D. Division 08 exterior openings sections for framing for aluminum-framed entrances and storefronts, aluminum windows, louvers, and vents receiving air barrier transition assembly specified in this Section.

1.3 REFERENCES

- A. References, General: Versions of the following standards current as of the date of issue of the project apply to the Work of this Section.
- B. ASTM International (ASTM): www.astm.org:
 - 1. ASTM A 240/A 240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 2. ASTM C 920 - Standard Specification for Elastomeric Joint Sealants
 - 3. ASTM C 1193 - Guide for Use of Joint Sealants
 - 4. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
 - 5. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials
 - 6. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials
 - 7. ASTM E 162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source
 - 8. ASTM E 783 - Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors
 - 9. ASTM E 1186 - Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
 - 10. ASTM E 2178 - Standard Test Method for Air Permeance of Building Materials
 - 11. ASTM E 2357 - Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
- C. UL Environment Greenguard Certification: www.greenguard.org
 - 1. Greenguard Certification Product Guide
- D. National Fire Protection Association (NFPA): www.nfpa.org:

1. NFPA 285 - Standard Fire Test Method For Evaluation Of Fire Propagation Characteristics Of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
 - E. U.S. Environmental Protection Agency (EPA): www.epa.gov:
 1. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings
 - F. US Green Building Council (USGBC): www.usgbc.org:
 1. Leadership in Energy and Environmental Design (LEED) Green Building Rating System
- 1.4 ADMINISTRATIVE REQUIREMENTS
- A. Coordination: Coordinate installation of joint sealants with cleaning of joint sealant substrates and other operations that may impact installation or finished joint sealant work.
 - B. Preinstallation Conference: Conduct conference at Project Site.
 1. Review requirements for weather barrier products and installation, project and manufacturer's details, mockups, testing and inspection requirements, and coordination and sequencing of weather barrier work with work of other Sections.
 2. Review manufacturer's instructions for weather barrier application meeting Project requirements for substrates specified, including three-dimensional video model demonstrating proper application of components at wall openings.
- 1.5 ACTION SUBMITTALS
- A. Product Data: For each type of weather barrier product specified, including:
 1. Technical data indicating compliance with requirements.
 2. Substrate preparation instructions and recommendations.
 3. Installation instructions.
 - B. LEED Submittals:
 1. LEED NC Credit IEQ 4.1: Product data for weather barrier components applied inside the weather envelope. Including statement of VOC content.
 - C. Shop Drawings: Show locations for weather barrier. Show details for each type of substrate, joints, and edge conditions, including flashings, counterflashings, penetrations, transitions, and terminations.
 1. Show location of transition and accessory materials providing connectivity throughout the assemblies.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer, manufacturer, and Air Barrier Inspector.
 1. Certification of manufacturer's approval of Installer.
 - B. Manufacturer's Product Compatibility Certificate: Certify compatibility of weather barrier products with adjacent materials.
 - C. Low-Emitting Product Certificate: For weather barrier products specified to meet volatile organic emissions standards, submit Greenguard Children and Schools Certification or comparable certification acceptable to Architect.
 - D. Product Test Reports: Test data for weather barrier products and weather barrier assembly, by qualified testing agency, indicating proposed membrane weather barrier meets performance requirements, when requested by Architect.

- E. Warranty: Sample of unexecuted manufacturer and installer special warranties.
- F. Field quality control reports.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm with minimum three years' experience in installation of specified products in successful use on similar projects, employing workers trained by manufacturer, including a full-time on-site supervisor with a minimum of three years' experience installing similar work, able to communicate verbally with Contractor, Architect, and employees.
- B. Manufacturer Qualifications: A qualified manufacturer listed in this Section with minimum five years' experience in manufacture of air barrier membrane as one of its principal products.
 - 1. Manufacturer's product submitted has been in satisfactory operation on five similar installations for at least five years.
 - 2. Manufacturer is accredited by the Air Barrier Association of America.
 - 3. Approval of Manufacturers and Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:
 - a. Completed and signed Substitution Request form.
 - b. Product data, including certified independent test data indicating compliance with requirements.
 - c. Approval letter from EIFS manufacturer for compatibility with EIFS system to be installed.
 - d. Sample shop drawings from similar project.
 - e. Project references: Minimum of five installations of similar system not less than five years old, with Owner and Architect contact information.
 - f. Certificate of ABAA accreditation if required for Project.
 - g. Sample warranty.
- C. Air Barrier Inspector Qualifications: A technical representative of manufacturer not engaged in the sale of products and experienced in the installation and maintenance of the specified air barrier system, qualified to perform observation and inspection specified in Field Quality Control Article, to determine Installer's compliance with the requirements of this Project, and approved by the manufacturer to issue warranty certification. The Inspector shall be one of the following:
 - 1. An authorized full-time technical employee of the manufacturer.
 - 2. An independent party certified as an air barrier inspector by the ABAA or other certifying organization acceptable to Architect, retained by the Contractor.
- D. Mockups: Provide air barrier mockup application within mockups required in other sections, or if not specified, in an area of not less than 150 sq. ft. of wall surface, where directed by Architect for each type of backup wall construction. Include examples of surface preparation, crack and joint treatment, weather barrier application, and flashing, transition, and termination conditions, to set quality standards for execution.
 - 1. Include intersection of wall weather barrier with roof weather barrier and with foundation wall waterproofing intersection.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Accept materials on site in manufacturer's unopened original packaging.
- B. Store products in weather protected environment, clear of ground and moisture, within temperature ranges recommended by air barrier manufacturer.

- C. Construction Waste: Store and dispose of packaging materials and construction waste in accordance with requirements of Division 01 Section "Construction Waste Management."

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Environmental Limitations: Apply weather barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.
 - 1. Protect substrates from environmental conditions that affect weather barrier performance.
 - 2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

1.10 SCHEDULING

- A. Coordinate installation of membrane weather barrier with completion of roofing and other work requiring interface with air barrier.
- B. Schedule work so weather barrier applications may be inspected prior to concealment.
- C. Ensure weather barrier materials are cured before covering with other materials.

1.11 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which air barrier manufacturer agrees to furnish and install air barrier material to repair or replace those materials installed according to manufacturer's written instructions that exhibit material defects or otherwise fail to perform as specified under normal use within warranty period specified.
 - 1. Access for Repair: Owner shall provide unimpeded access to the Project and the weather barrier system for purposes of testing, leak investigation, and repair, and shall reinstall removed cladding materials upon completion of repair.
 - 2. Cost Limitation: Manufacturer's obligation for repair or replacement shall be limited to the original installed cost of the work.
 - 3. Warranty Period: 10 years date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of air barrier materials from the following:
 - 1. Movement of the structure caused by structural settlement or stresses on the air barrier exceeding manufacturer's written specifications for elongation.
 - 2. Mechanical damage caused by outside agents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Products: Provide weather barrier products manufactured by Tremco, Inc., Commercial Sealants and Waterproofing Division, An RPM Company, Beachwood OH; (866) 321-6357; email: techresources@tremcoinc.com; www.tremcosealants.com, or comparable products of other manufacturer approved by EIFS manufacturer and Architect in accordance with Instructions to Bidders and Division 01 General Requirements.

2.2 MATERIALS, GENERAL

- A. VOC Content: 250 g/L maximum per 40 CFR 59, Subpart D (EPA Method 24) and complying with requirements of authorities having jurisdiction.

- B. Compatibility: Provide membrane weather barrier materials that are compatible with one another and with adjacent materials under conditions of service and application required, as demonstrated by membrane air barrier manufacturer based on testing and field experience. Weather barrier must be proven to be compatible with EIFS system and shall be approved for use by the EIFS manufacturer.

2.3 PERFORMANCE REQUIREMENTS

- A. General: Membrane weather barrier shall be capable of performing as a continuous vapor-permeable air barrier and as a moisture drainage plane transitioned to adjacent flashings and discharging water to the building exterior. Membrane weather barriers shall accommodate substrate movement and seal expansion and control joints, construction material transitions, opening transitions, penetrations, and perimeter conditions without moisture deterioration and air leakage exceeding performance requirements.
- B. Weather Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. of surface area at 75-Pa pressure difference, when tested according to ASTM E 2357.

2.4 MEMBRANE WEATHER BARRIER

- A. Fluid-Applied, Vapor-Permeable Membrane Weather Barrier: Elastomeric, UV-resistant, synthetic membrane, formulated for application in a range of 48 - 70 mils (wet), 25 - 35 mils (dry)
 - 1. Basis of Design Product: Tremco, Inc., ExoAir 230.
 - 2. Air Permeance, ASTM E 2178: 0.004 cfm/sq. ft of surface area at 1.57-lbf/sq. ft. of surface area at 75-Pa pressure difference, maximum.
 - 3. Vapor Permeance, ASTM E 96/E96M: Minimum 12 perms.
 - 4. Elongation, Ultimate, ASTM D 412, Die C: 600 percent, minimum.
 - 5. Combustion Characteristics: Class A, flame spread, not greater than 25; smoke developed, not greater than 450, per ASTM E 84.
 - 6. UV Resistance, QUV-B: Over 160 cycles of UV and water spray with no observable deterioration.
 - 7. VOC Content: Less than 50 g/L.

2.5 ACCESSORY MATERIALS

- A. General: Accessory materials as described in manufacturer's written installation instructions, recommended to produce complete air barrier assembly meeting performance requirements, and compatible with air barrier membrane material and adjacent materials.
- B. Primer: Liquid primer meeting VOC limitations, recommended for substrate by membrane air barrier manufacturer, when installing modified bituminous self-adhered membranes.
 - 1. Basis of Design Product: Tremco, Inc., ExoAir Primer
- C. Transitions:
 - 1. Counterflashing Strip: Modified bituminous, 40 mils thick self-adhering composite sheet consisting of 32 mils of SBS rubberized asphalt laminated to an 8 mils high-density, cross-laminated polyethylene film, for counterflashing of metal flashings and for substrate transitions and for termination of air barrier to bituminous roof membranes and to air barrier terminations at openings.
 - a. Basis of Design Product: Tremco, Inc., ExoAir TWF Thru-Wall Flashing.
 - 2. High Temperature Flashing Strip and Underlayment: Butyl, 24 mil thick self-adhering composite sheet consisting of 20 mils of butyl laminated to 4 mil polyethylene film; thermally stable under intermittent, non-continuous exposure up to

- 240 deg F .
 - a. Basis of Design Product: Tremco, Inc., ExoAir 110AT.
- 3. Flashing Strip: Butyl, 22 mil thick self-adhering composite sheet consisting of 16 mils of butyl laminated to 6 mil polypropylene film; thermally stable under intermittent, non-continuous exposure up to 240 deg F.
- 4. Opening Transition Assembly: Cured low-modulus silicone extrusion, with reinforcing ribs, sized to fit opening widths, with aluminum race for insertion into aluminum framing extrusions, with the following characteristics:
 - a. Basis of Design Product: Tremco, Inc., Proglaze ETA Engineered Transition Assembly. Tear Strength: 110 lb/in (19.3 kN/m)
- 5. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with manufacturer's recommended silicone sealant for bonding extrusions to substrates.
 - a. Basis of Design Product: Tremco, Inc.; Spectrem SimpleSeal.
- D. Reinforcing Fabric: High strength mesh fabric consisting of open-weave glass fiber saturated with synthetic resins formulated for high moisture resistance, for reinforcing of liquid applications; not less than 2.5 oz/sq. yd.
 - 1. Basis of Design Product: Tremco, Inc., Tremco 2011.
- E. Liquid Joint Sealants:
 - 1. ASTM C 920, single-component polyurethane, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories.
 - a. Basis of Design Product: Tremco, Inc., Dymonic 100.
 - 2. ASTM C 920, single-component, neutral-curing silicone, approved by air barrier manufacturer for adhesion and compatibility with membrane air barrier and accessories post installation of the membrane.
 - a. Basis of Design Product: Tremco, Inc., Spectrem 1.
- F. Sprayed Polyurethane Foam Sealant: Sprayed Polyurethane Foam Sealant: Foamed-in-place, 1.5- to 2.0-lb/cu. ft. density, with flame-spread index of 25 or less per ASTM E 162, for filling of gaps at openings and penetrations.
 - 1. Basis of Design; Tremco Inc., Flexible Low Expanding Foam (LEF)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Surface Condition: Before applying weather barrier materials, examine substrate and conditions to ensure substrates are fully cured, smooth, clean, dry, and free from high spots, depressions, loose and foreign particles and other deterrents to adhesion, and conditions comply with manufacturer's written recommendations.
 - 1. Verify concrete and masonry surfaces are visibly dry, have cured for time period recommended by membrane air barrier manufacturer, and are free from release agents, curing agents, and other contaminants.
 - 2. Test for capillary moisture by method recommended in writing by air barrier manufacturer..
 - 3. Verify masonry joints are filled with mortar and struck flush.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INTERFACE WITH OTHER WORK

- A. Commencement of Work: Commence work once weather barrier substrates are adequately protected from weather and will remain protected during remainder of construction.

- B. Sequencing of Work: Coordinate sequencing of weather barrier work with work of other sections that form portions of building envelope air barrier to ensure that flashings and transition materials can be properly installed and inspected. Roofing systems shall be capped and sealed, or top of walls protected, in such a way as to eliminate the ability of water to saturate the wall or interior space, both before and after, weather barrier system installation. Coordinate installation of EXOAIR® 230 with the roofing trade to ensure compatibility and continuity with the roofing system.
- C. Subsequent Work: Coordinate weather barrier work with work of other sections installed subsequent to weather barrier to ensure complete inspection of installed weather barrier and sealing of weather barrier penetrations necessitated by subsequent work.

3.3 PREPARATION

- A. Clean, prepare, and treat substrate in accordance with weather barrier manufacturer's written instructions.
 - 1. Mask adjacent finished surfaces.
 - 2. Remove contaminants and film-forming coatings from substrates.
 - 3. Remove projections and excess materials and fill voids with substrate patching material.
 - 4. Prepare and treat joints and cracks in substrate per ASTM C 1193 and membrane air barrier manufacturer's written instructions.

3.4 APPLICATION OF ACCESSORY MATERIALS

- A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions. Install transition materials and other accessories to form connect and seal membrane air barrier material to adjacent components of building air barrier system, including, but not limited to, roofing system air barrier, exterior fenestration systems, door framing, and other openings.
- B. Primer: Apply primer to substrates when recommended by weather barrier manufacturer at required rate for those substrates that will be receiving a modified bituminous self-adhered membrane. Reprime areas not covered within 24 hours.
- C. Assembly Transitions: Connect and seal exterior wall air barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
 - 1. Opening Transitions: Fill gaps at perimeter of openings with foam sealant and apply approved transition or accessory material
 - 2. Penetrations: Fill gaps at perimeter of penetrations with foam sealant and level with approved sealant. or seal transition strips around penetrating objects and terminate with approved sealant.
 - 3. Joints: Bridge and cover isolation joints, expansion joints, and discontinuous joints between separate assemblies utilizing approved transition or accessory materials.
 - 4. Changes in Plane: Apply approved sealant beads at corners and edges to form smooth transition.
 - 5. Substrate Gaps: Cover gaps with stainless steel sheet mechanically attached to substrate and providing continuous support for air barrier.
- D. Flashings: Seal top of through-wall flashings to membrane weather barrier with a continuous bead of approved sealant recommended by weather barrier manufacturer.

- E. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following weather barrier manufacturer's recommendations and extend repair beyond repaired areas to maintain continuity.

3.5 FLUID WEATHER-BARRIER MEMBRANE INSTALLATION

- A. General: Apply fluid weather-barrier material to form a seal with transition materials and accessories to achieve a continuous weather barrier according to weather-barrier manufacturer's written instructions. Apply fluid weather-barrier material within manufacturer's recommended application temperature ranges.
- B. Membrane Weather Barrier: Apply fluid weather barrier material in full contact with substrate to produce a continuous seal according to membrane weather barrier manufacturers written instructions.
 - 1. Vapor-Permeable Membrane Weather Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, in a range of 25 – 35 mils dry film thickness depending on substrate, applied in one or more equal coats, roller- or spray- applied.
- C. Connect and seal exterior wall weather-barrier membrane continuously to subsequently-installed roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, wall openings, and other construction used in exterior wall openings, using approved transitions and accessory materials.
- D. Wall Openings: Apply approved sealant to adhere silicone extrusion to perimeter of windows, curtain walls, storefronts, doors, and louvers. Apply opening transition assembly according to weather barrier transition manufacturer's written instructions.
- E. Seal punctures, voids, and seams. Patch with approved transition and accessory materials following weather barrier manufacturer's recommendations and extend repair beyond repaired areas to maintain continuity.
- F. Do not cover weather barrier until it has been tested and inspected by testing agency.
- G. Correct deficiencies in or remove weather barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified Inspector to perform tests and inspections, including documenting of membrane weather barrier prior to concealment.
- B. Inspections and testing shall be carried out at the following rate:
 - 1. Up to 10,000 sq. ft. : One inspection.
 - 2. 10,001 to 35,000 sq. ft.: Two inspections.
 - 3. 35,001 to 75,000 sq. ft.: Three inspections.
 - 4. 75,001 to 125,000 sq. ft.: Four inspections.
 - 5. 125,001 to 200,000 sq. ft. : Five inspections.
 - 6. Over 200,000 sq. ft.: Six inspections.
- C. Scope of Testing: Testing shall include the following:
 - 1. Qualitative air-leakage testing per ASTM E 1186.
 - 2. Quantitative air-leakage testing per ASTM E 783.
 - 3. Photo documentation of work to be subsequently concealed.

- D. Coordination of Testing: Cooperate with testing agency. Allow access to work areas and staging. Notify testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection.
 - 1. Do not cover Work until testing and inspection is completed and accepted.
- E. Reporting: Forward written inspection reports to the Architect within 10 working days of the inspection and test being performed.
- F. Correction: Correct deficient applications not passing tests and inspections, make necessary repairs, and retest as required to demonstrate compliance with requirements.

3.7 CLEANING AND PROTECTING

- A. Clean spills, stains, and overspray resulting application utilizing cleaning agents recommended by manufacturers of affected construction. Remove masking materials.
- B. Protect membrane weather barrier from damage from subsequent work. Protect membrane materials from exposure to UV light for period in excess of that acceptable to membrane weather barrier manufacturer; replace overexposed materials and retest.

END OF SECTION

SECTION 074400
FACED PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Decorative high-pressure compact laminate panels.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- B. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods and instructions.
- C. Samples: For each finish product specified, provide two complete sets of color samples representing manufacturer's full range of available colors and patterns, including the following:
 - 1. Faced Panels: Two of each type; 12 by 12 inches.

1.4 MOCK-UP

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Construct mock-up on project site incorporating required materials and workmanship, with minimum size of 6 feet long by 3 feet wide.
- C. Locate where directed by Architect.
- D. Mock-up may remain as part of the work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original packaging and clearly identified.
- B. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.
- C. Protect materials from harmful environmental elements, construction dust, direct sunlight, and other potentially detrimental conditions.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two year period after Date of Substantial Completion.
- C. Manufacturer's Warranty: Provide manufacturer's standard warranty of ten years from Date of Substantial Completion .

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Faced Panels:
 - 1. Trespa; Meteon; www.trespa.com..
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 FACED PANEL SYSTEM

- A. Description: Decorative high-pressure compact laminate panels.

2.3 PERFORMANCE REQUIREMENTS

- A. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of soffit.
- B. Design Pressure: In accordance with applicable codes.
- C. Surface Burning Characteristics: Flame spread index (FSI) of 0 to 25 - Class A, and smoke development index (SDI) of 450 or less in accordance with ASTM E84 and UL 723.
- D. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to 100 degrees F seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
- E. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.

2.4 COMPONENTS

- A. Structural Back-Up: As indicated on drawings.
- B. Sub-Construction Assembly: Adjustable, thermally efficient structural system consisting of brackets, rails, fasteners, and accessories for soffit panel system.
 - 1. Soffit Brackets:
 - a. Aluminum: 6063-T66 alloy and temper, 5-5/16 inches high and dimension of 1-9/16 inches for supporting rails.
 - 2. Vertical Rails: 6063-T66 or 6005A-T5 alloy and temper, 1/8 inch thick to support carrier board and to stiffen outside corners.
 - a. T-Profile: Bearing surface 3-9/16 inches wide, and insertion leg 2 inches long, nominal.
 - b. L-Profile: Legs are 1-9/16 by 2 inches long, nominal.
 - 3. Horizontal Rails: 6063-T66 or 6005A-T5 alloy and temper, attached to vertical rails providing supports for glass-faced panel assembly.

4. Screws: Self-drilling, hex head stainless steel screw used for attachment of rails to brackets.

C. Corners: Provide faced panel manufacturer's applicable components for inside and outside corner applications in accordance with project requirements.

D. Ventilation Gaps: Provide faced panel manufacturer's applicable components for ventilation gaps and other necessary openings in accordance with project requirements.

2.5 ACCESSORIES

A. Clips and Anchors: Provide in accordance with faced panel manufacturer; conceal unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.

B. Do not begin until unacceptable conditions have been corrected.

C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

A. Install faced panel assembly, supporting components and accessories in accordance with manufacturer's written instructions.

3.3 CLEANING

A. Clean faced panels in accordance with manufacturer's maintenance instructions, using cleaning materials and methods acceptable to manufacturer.

3.4 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Repair damage to adjacent substrates and surfaces.

C. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 074646
FIBER-CEMENT SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiber-cement siding.

1.2 RELATED REQUIREMENTS

- A. Section 033000 - Cast In Place Concrete: Siding substrate.
- B. Section 071326 - Sheet Waterproofing Membrane: Water-resistive barrier under siding.
- C. Section 072100 - Thermal Insulation: Siding substrate

1.3 REFERENCE STANDARDS

- A. ASTM C1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards -08.
- B. ASTM C1186 - Standard Specification for Flat Fiber Cement Sheets 2008 (Reapproved 2016).
- C. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials 2012 (Reapproved 2020).

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Manufacturer's requirements for related materials to be installed by others.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods and instructions, including nail patterns.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.
- D. Installer's Qualification Statement.
- E. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products under waterproof cover and elevated above grade, on a flat surface.

PART 2 PRODUCTS

2.1 FIBER-CEMENT SIDING

- A. Panel Siding: Panels made of cement and cellulose fiber formed under high pressure with integral surface texture, complying with ASTM C1185; with machined edges, for nail attachment.
 - 1. Texture: Smooth.
 - 2. Length (Height): 48 inches, nominal, or as needed to extend from bottom of EIFS finish to minimum 12 inches below adjacent grade.
 - 3. Width: 48 inches.
 - 4. Thickness: 1/4 inch, nominal.
 - 5. Water absorption: less than 30% in accordance with ASTM C1185.
 - 6. Impact resistance: passed in accordance with ASTM D1037
 - 7. Moisture movement: normal to saturation: 1.7mm/m in accordance with ASTM D1037.
 - 8. Finish: Factory applied topcoat.
 - 9. Color: As selected by Architect from manufacturers full range of available colors.
 - 10. Warranty: 50 year limited; transferable.
 - 11. Products:
 - a. Foundry Service and Supplies, Inc.; Finex: www.foundryservice.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.2 ACCESSORIES

- A. Trim: Same material and texture as siding.
- B. Fasteners: Galvanized or corrosion resistant; length as required to penetrate, 1-1/4 inch, minimum.

END OF SECTION

SECTION 075423
THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Self-Adhered TPO membrane roofing system.
- B. Cover board.
- C. Roof insulation, flat and tapered.
- D. Flashings and edge metal components.
- E. Roof assembly Vapor Barrier
- F. Accessories

1.2 RELATED SECTIONS

- A. Division 05 Section "Steel Decking" for steel roof deck.
- B. Division 06 Section "Miscellaneous Rough Carpentry" for wood nailers, cants, curbs, and blocking and for wood-based, structural-use roof deck panels.
- C. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.
- D. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.3 REFERENCES

- A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms in this Section:
 - 1. ASTM D 1079 "Standard Terminology Relating to Roofing and Waterproofing."
 - 2. Glossary of NRCA's "The NRCA Roofing and Waterproofing Manual."
 - 3. Roof Consultants Institute "Glossary of Building Envelope Terms."
- B. Sheet Metal Terminology and Techniques: SMACNA "Architectural Sheet Metal Manual."
- C. All references indicated shall be the most current edition of the standard, unless otherwise indicated.
- D. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
- E. ASTM D5147 - Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material.
- F. ASTM D5602 - Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens.
- G. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives
- H. ASTM D903 - Standard Test Method of Peel or Stripping Strength of Adhesive Bonds.

- I. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials
- J. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials.
- K. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen.

1.4 DESIGN CRITERIA

- A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.
- C. Installer shall comply with current code requirements based on authority having jurisdiction.
- D. Wind Uplift Performance: Roofing system shall meet the intent to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.
- E. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
 - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's data sheets for each product to be provided.
- B. Detail Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:
 - 1. Base flashings and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Crickets, saddles, and tapered edge strips, including slopes.
 - 4. Insulation fastening and adhesive patterns.
 - 5. Installation instructions for each component of the roofing system to be installed.
- C. Verification Samples: Provide for each product specified.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.
- E. Maintenance Data: Refer to Johns Manville's latest published documents on www.JM.com.
- F. Guarantees: Provide manufacturer's current guarantee specimen.
- G. Prior to roofing system installation, roofing sub-contractor shall provide a copy of the Guarantee Application Confirmation document issued by Johns Manville Roofing Systems indicating that the project has been reviewed for eligibility to receive the specified guarantee and registered.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive the specified manufacturer's guarantee.
- B. Manufacturer Qualifications: Qualified domestic U.S. owned and based manufacturer that has UL listing for roofing system identical to that used for this Project.
- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 329.
- D. Test Reports:
 - 1. Roof drain and leader test or submit plumber's verification.
- E. Source Limitations: Obtain all components from the single source roofing manufacturer guaranteeing the roofing system. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.9 GUARANTEE

- A. Provide manufacturer's system guarantee equal to Johns Manville's Peak Advantage No Dollar Limit Roofing System Guarantee.
 - 1. Single-source special guarantee includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover board, walkway products, manufacturer's expansion joints, manufacturer's edge metal products, and other single-source components of roofing system marketed by the manufacturer.
 - 2. Guarantee Period: 20 years from date of Substantial Completion.
 - 3. Contractor is required to list "Lothrop Associates Architects" as the Specifier/Consultant of record in the appropriate fields ("Specifier Account") when applying for the manufacturer's warranty.
- B. Installer's Guarantee: Submit roofing Installer's guarantee, including all components of roofing system for the following guarantee period:

1. Guarantee Period: Two years from date of Substantial Completion.
- C. Existing Guarantees: Guarantees on existing building elements should not be affected by scope of work.
 1. Installer is responsible for coordinating with building owner's representative to verify compliance.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC POLYOLEFIN ROOFING MEMBRANE - TPO

- A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, uniform, flexible sheet formed from a thermoplastic polyolefin, internally fabric or scrim reinforced. Basis of design: JM TPO SA 60
 1. Self-Adhered Membrane Thickness: 60 mils (1.52 mm), nominal
 - a. Exposed Face Color: White
 - b. Serviceable Installation Temperature: 20°F (-7°C) and above.

2.2 AUXILIARY ROOFING MATERIALS – SINGLE PLY

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing (Self-Adhered): 60 mil (1.5 mm) thick, manufacturer's internally reinforced or scrim reinforced with weldable selvage edges on each side of roll, one encapsulated edge and self-adhering capabilities in a wide installation temperature range. Basis of design: JM TPO SA – Flashing Membrane
 1. Serviceable Installation Substrate Temperature: 20°F (-7°C) and rising.
- C. Self-Adhered Primer: One-part penetrating primer solution to enhance the adhesion of self-adhering membranes. Basis of design: SA Primer Low VOC
- D. Liquid Applied Flashing: Manufacturer's single ply liquid and fabric reinforced flashing system created with a fleece polyester scrim and a two-component polyurethane based liquid applied flashing material, consisting of a liquid resin and a curing agent. Basis of design: JM SP Liquid Flashing Resin and JM SP Liquid Flashing Scrim
- E. Liquid Applied Flashing Primer: Manufacturer's single ply liquid flashing primer. Basis of design: JM SP Liquid Flashing TPO and PVC Primer, JM SP Liquid Flashing Concrete Primer, or JM SP Liquid Flashing Metal and Wood Primer
- F. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors. Basis of design: JM Termination Systems
- G. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer. Basis of design: High Load Fasteners and Plates
- H. Miscellaneous Accessories: Provide pourable sealers, primers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, cover strips, and other accessories required for full installation. Basis of design: JM TPO Pourable Sealer A & B, JM TPO Pipe Boots, JM TPO Universal Corners, JM TPO Edge Sealant, JM TPO T-Joint Patch, JM TPO Membrane Cleaner, JM TPO Membrane Primer, JM TPO Membrane Primer (Low VOC), JM TPO Sealing Mastic, JM TPO Cover Tape, JM

TPO Detail Membrane, JM TPO Peel & Stick 10" RPS, JM TPO Peel & Stick 6" RTS, JM TPO-Coated Metal, JM TPO Curb Flashing and JM Single Ply Caulk

2.3 ELECTRONIC LEAK DETECTION ACCESSORIES

- A. Conductive primer for Electronic Leak Detection (ELD): Enables ELD of conventional roofing assemblies by providing required conductive substrate directly below roofing membrane.
 - 1. Apply primer directly under roofing membrane on nonconductive surface in accordance with manufacturer's requirements.
 - 2. Manufacturers:
 - a. Detec Systems; TruGround Conductive Primer; www.detecsystems.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements

2.4 WALKWAYS

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads sourced from membrane roofing system manufacturer. Basis of design: JM TPO Walkpad

2.5 COVER BOARD and SUBSTRATE BOARD

- A. High-Density Polyisocyanurate: ASTM C 1289, Type II, Class 4, Grade 1, High-density Polyisocyanurate technology bonded in-line to inorganic coated glass facers with greater than 80 lbs of compressive strength. Basis of design: ProtectoR HD
 - 1. Thickness: 1/2 inch (13 mm)
 - 2. R-value: 2.5

2.6 ROOF INSULATION

- A. General: Preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), Basis of design: ENRGY 3
 - 1. Provide insulation package with minimum R Value: minimum required by applicable code.
 - 2. Provide insulation package in multiple layers.
 - 3. Minimum Long-Term Thermal Resistance (LTTR): 5.7 per inch.
 - a. Determined in accordance with CAN/ULC S770 at 75°F (24°C)

2.7 TAPERED INSULATION

- A. Tapered Insulation: ASTM C 1289, Type II, Class 1, Grade 2 (20 psi), provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches (1:48), unless otherwise indicated. Basis of design: Tapered ENRGY 3

2.8 INSULATION ACCESSORIES

- A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Provide factory preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. Basis of design:

Diamondback Pre-Cut Cricket, Diamondback Pre-Cut Miter, or Tapered Fesco Edge Strip

- C. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and furnished by roofing system manufacturer. Basis of design: UltraFast Fasteners and Plates
- D. Urethane Adhesive: Manufacturer's two component polyurethane adhesive formulated to adhere insulation to substrate. Basis of design: JM Two-Part Urethane Insulation Adhesive (UIA)
- E. Wood Nailer Strips: Comply with requirements in Division 06 Section "Miscellaneous Rough Carpentry."

2.9 EDGE METAL COMPONENTS

- A. Expansion Joints: Provide factory fabricated weatherproof, exterior covers for expansion joint openings consisting of flexible rubber membrane, supported by a closed cell foam to form flexible bellows, with two metal flanges, adhesively and mechanically combined to the bellows by a bifurcation process. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Expand-O-Flash
- B. Coping System: Manufacturer's factory fabricated coping consisting of a base piece and a snap-on cap. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Presto-Lock Coping, 0.040" aluminum with Kynar 500 finish as selected by Architect from manufacturer's full range of color selection.
- C. Fascia System: Manufacturer's factory fabricated fascia consisting of a base piece and a snap-on cover. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Presto-Tite Fascia, 0.040" aluminum with Kynar 500 finish as selected by Architect from manufacturer's full range of color selections.
- D. Metal Edge System: Manufacturer's factory fabricated metal edge system used to terminate the roof at the perimeter of the structure. Provide product from single-source roofing system supplier that is included in the No Dollar Limit guarantee. Basis of design: Presto-Weld Drip Edge, 0.040" aluminum with Kynar 500 finish as selected by Architect from manufacturer's full range of color selections.

2.10 ROOF ASSEMBLY VAPOR BARRIER

- A. Self-adhering, self-sealing, SBS rubber and asphalt blend with tri-laminate woven polyethylene, non-slip, UV-protected top surface.
- B. Tear Resistance: 95 lbf machine direction and 103 lbf cross-machine direction, in accordance with ASTM D1970/D1970M.
- C. Tensile Strength: 54 lbf/in. machine direction and 74 lbf/in. cross-machine direction in accordance with ASTM D5147/D5147M.
- D. Static Puncture: 90 lbf in accordance with ASTM D5602/D5602M.
- E. Low Temperature Flexibility: -58 degrees F in accordance with ASTM D5147/D5147M.
- F. Thickness: 31.5 mil in accordance with ASTM D5147/D5147M.
- G. Lap Adhesion: 68 lbf/ft in accordance with ASTM D1876.

- H. Elongation at Peak Load at 0 degrees F: 52% machine direction and 24% cross-machine direction in accordance with ASTM D5147/D5147M.
- I. Water Absorption: 0.1% max. in accordance with ASTM D5147/D5147M.
- J. Peel Resistance: 5.4 lbf/in. in accordance with ASTM D903.
- K. Water Vapor Permeance: 0.03 perm in accordance with ASTM E96/E96M.
- L. Air Permeability: <0.001 L/s/m² and <0.002 L/s/m² in accordance with ASTM E2178 and ASTM E283/E283M, respectively.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.
 - 1. General:
 - a. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
 - b. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
 - 2. Steel Decks:
 - a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
 - 3. Ensure general rigidity and proper slope for drainage.
 - 4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units more than 1/16 inch (1.6 mm) out of plane relative to adjoining deck.
- B. Unacceptable panels should be brought to the attention of the General Contractor and Project Owner's Representative and shall be corrected prior to installation of roofing system.

3.2 PREPARATION

- A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
- C. If applicable, prime surface of deck with asphalt primer at a rate recommended by roofing manufacturer and allow primer to dry.
- D. Proceed with each step of installation only after unsatisfactory conditions have been corrected.

3.3 SUBSTRATE BOARD INSTALLATION

- A. Coordinate installing membrane roofing system components so substrate board is not exposed to precipitation or left exposed at the end of the workday.

- B. Comply with membrane roofing system manufacturer's written instructions for installing roof substrate board.
- C. Install substrate board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with substrate board.
 - 1. Cut and fit substrate board within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- D. Mechanically Fasten Substrate Board: Fasten substrate board to metal deck as follows:
 - 1. Secure substrate board to deck using mechanical fasteners designed and sized for fastening specified board-type to deck type.
 - 2. Install manufacturer approved fasteners according to roofing system manufacturer's instruction, including spacing and placement of fasteners along the board perimeter and within the board field.
 - 3. Install to resist uplift pressure at corners, perimeter, and field of roof.

3.4 ROOF ASSEMBLY VAPOR BARRIER INSTALLATION

- A. Install vapor barrier in strict accordance with manufacturer's written instructions.
- B. All substrates must be primed prior to installation.
- C. Adhere vapor barrier to substrate board. Provide 3 inch side laps and 6 inch end laps in accordance with manufacturer's instructions.

3.5 INSULATION INSTALLATION

- A. Coordinate installation of roof system components so insulation and cover board are not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install insulation boards with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with like material.
- E. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
- F. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- G. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- H. Adhered Insulation: Adhere insulation to vapor barrier-covered substrate board using adhesive for fastening specified board-type to substrate type.
 - 1. Install insulation layers in a two-part urethane adhesive according to roofing system manufacturer's instruction.
 - 2. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.

3.6 COVER BOARD INSTALLATION

- A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.
- C. Install cover board with long joints in a continuous straight line. Joints should be staggered between rows, abutting edges and ends per manufacturer's written instructions. Fill gaps exceeding 1/4 inch (6 mm) with cover board.
 - 1. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.
- D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.
 - 1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.
- E. Adhered Cover Board: Adhere cover board to substrate as follows:
 - 1. Install in a two-part urethane adhesive according to roofing system manufacturer's instruction.
 - 2. Install to resist uplift pressure at corners, perimeter, and field of roof.

3.7 LEAK DETECTION PRIMER APPLICATION

- A. Apply leak detection primer in accordance with manufacturer's requirements to cover boards prior to installation of roofing membrane.
- B. Allow primer to dry in accordance with manufacturer's written instructions.

3.8 ROOFING MEMBRANE INSTALLATION, GENERAL

- A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.
- B. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.
- C. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.
 - 1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation.
 - 2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
 - 3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.9 SELF-ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing in accordance with membrane roofing system manufacturer's written instructions.
 - 1. Unroll roofing membrane and allow to relax before installing (minimum 15-30 minutes, colder temperatures might require longer relaxation times).
 - 2. Install sheet in accordance with roofing system manufacturer's written instructions.

- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer.
- C. Align sheet end laps of consecutive membranes. The end laps will be stripped in with minimum 8-inch JM TPO Reinforced Cover Strip per manufacturer's written instructions.
- D. Self-Adhere membrane to approved substrate per manufacturer's written instructions.
 - 1. Keep all flammable materials away while peeling the release liner.
 - 2. Adjust speed and tension on membrane to avoid wrinkles in the material.
 - 3. Broom membrane in once both sides are down to promote adhesion and assist in removing air pockets.
 - 4. Roll-in adhered membrane with 100lb split roller completely.
- E. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- F. Apply roofing membrane with side laps shingled with roof slope, where possible.
- G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
 - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.
 - 2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
 - a. Remove and repair any unsatisfactory sections before proceeding with installation.
 - 3. End laps are seamed by stripping with 8-inch reinforced cover strip following standard practices.
 - 4. Repair tears, voids, and incorrectly lapped seams in roofing membrane that do not meet requirements.
- H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.
- I. Install roofing membrane and auxiliary materials to tie into existing roofing.

3.10 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates per membrane roofing system manufacturer's written instructions.
- B. Self-Adhere membrane to smooth approved substrates, when substrate temperatures are 40°F (4.5°C) and rising.
 - 1. The use of SA Primer or SA LVOC Primer is required for flashing applications on curbs and parapet walls for temperatures between 40°F (4.5°C) and 20°F (-7°C).
 - 2. The use of SA Primer or SA LVOC Primer is required for flashing applications over approved substrates with a porous or rough surface, including: Dens Deck Prime, Dens Deck, DEXcell, concrete and smooth faces CMU.
- C. Apply single ply liquid applied flashing system per manufacturer's written instructions.
- D. Flash penetrations and field-formed inside and outside corners per manufacturer's installation instructions.
- E. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

- F. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.11 WALKWAY INSTALLATION

- A. Flexible Walkways: Install walkway products in locations indicated. Heat weld and adhere walkway products to substrate according to roofing system manufacturer's written instructions.

3.12 FIELD QUALITY CONTROL

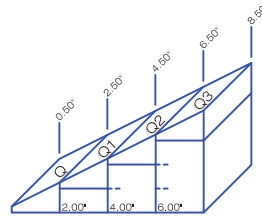
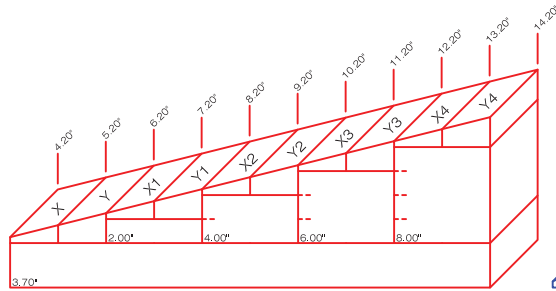
- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical representative to inspect roofing installation on completion and submit report to Architect.
 - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- B. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Provide leak detection testing in accordance with Section 070151.
 - 1. Test roofing areas for leaks using ELD method that locates discontinuities in membrane roofing in accordance with ASTM D7877 or ASTM D8231.
 - a. Testing agency to submit Daily Field Report (DFR) in accordance with ASTM D8231 indicating daily details of work performed.
 - b. Testing agency to submit training certification to ensure that technician performing ELD testing is currently certified in accordance with relevant training program.
 - c. Manufacturers:
 - 1) Detec Systems: Electronic Leak Detection Quality Control Testing - IntegriScan: www.detecsystems.com or approved equal.
 - 2) Substitutions: See Section 016000 - Product Requirements

3.13 PROTECTION AND CLEANING

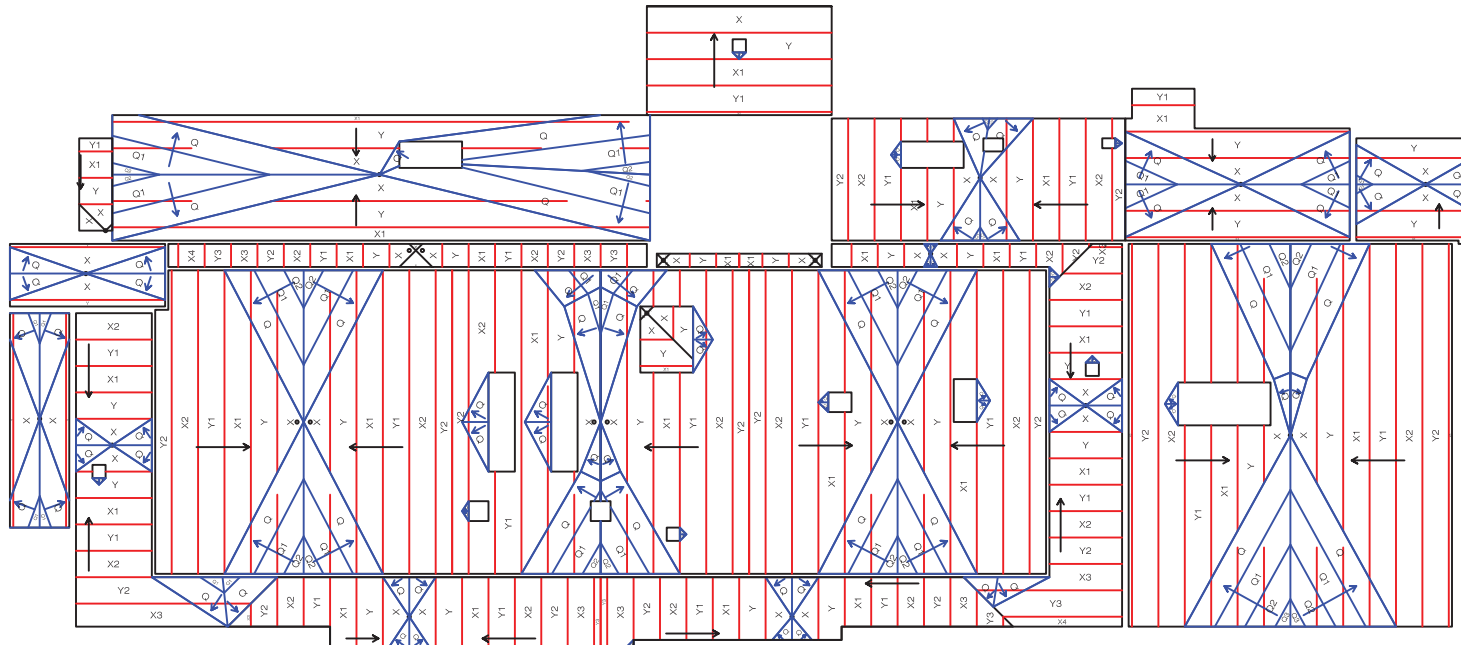
- A. Protect roofing system from damage and wear during remainder of construction period.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

NOTE: This drawing is for conceptual design puposes ONLY
 Not intended for Final Submittal or Installation
 — Not to Scale —



Y2
X2
Y1
X1
Y
X
X
Y
X1
Y1
X2
Y2



Notes:

The tapered system is 1/4" slope,
 1/2" crickets & 3.7" base. No flat field
 stock included for the sloped decks.
 No overlay or drain sumps included.

I have reviewed & approved the Conceptual Design Layout per JM quote shown here

Signature Required: _____

Company: _____

☐ Check to request full size drawings / Send via: ☐ Mail ☐ E-mail ☐ Fax

Orangeton Town Hall

Location: Orangeburg, NY

Date: 11-June-21

JM Project Number: NY21-344691-A1

Estimator: PDO

JM Johns Manville
 Tapered Systems Group
 10100 W. Ute Avenue / Littleton, CO 80127
 800-341-8032

October 19, 2021

The following roof system has been reviewed and approved as a warrantable system under the Johns Manville Peak Advantage Guarantee Program. A guarantee will be issued to the contractor in accordance with all procedures and requirements of the Johns Manville Peak Advantage Guarantee Program.

PROJECT INFORMATION

Project Number:	8056738 <i>**Reference number when corresponding with Johns Manville**</i>
Project Name:	Orangetown Town Hall
Guarantee Term:	20 Year No Dollar Limit
Project Location:	Orangetown Town Hall 26 W Orangeburg Road Orangeburg, NY 10962 United States

ROOF ASSEMBLY AS PROPOSED TO JOHNS MANVILLE

Roof Area Name: Town Hall Addition
System & Spec: TPO – ST8RA

Deck Information

Deck Type & Thickness:	Steel Deck; 18 gauge
Deck Slope (inch / foot):	0
Materials Left in Place:	

Substrate Board

Cover Board:	ProtectoR HD, 0.5 inch (4x8 boards)	
Attachment:	Fastened	UltraFast Fasteners & UltraFast Plates
Attachment Pattern:	Field (Zone 1): 8 Perimeter (Zone 2): 8 Corner (Zone 3): 8	Fasteners & Plates per board

Air/Vapor Barrier

Air/Vapor Barrier:	JM Vapor Barrier SA and SA Primer
Attachment:	Self Adhered

Insulation Layer 1

Insulation:	ENRGY 3, 3.7 inch (4x4 boards)	
Attachment:	Ribbon Adhered	JM Two-Part Urethane Insulation Adhesive (UIA)

Attachment Pattern:	Field (Zone 1): 12 in oc Perimeter (Zone 2): 12 in oc Corner (Zone 3): 12 in oc	Bead Spacing using 3/4 inch bead
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Insulation Layer 2

Insulation:	Tapered ENRGY 3 (4x4 boards) 1/4 in per ft slope	
Attachment:	Ribbon Adhered	JM Two-Part Urethane Insulation Adhesive (UIA)

Attachment Pattern:	Field (Zone 1): 12 in oc Perimeter (Zone 2): 12 in oc Corner (Zone 3): 12 in oc	Bead Spacing using 3/4 inch bead
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Cover Board

Cover Board:	ProtectoR HD, 0.5 inch (4x4 boards)	
Attachment:	Ribbon Adhered	JM Two-Part Urethane Insulation Adhesive (UIA)

Attachment Pattern:	Field (Zone 1): 12 in oc Perimeter (Zone 2): 12 in oc Corner (Zone 3): 12 in oc	Bead Spacing using 3/4 inch bead
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Membrane

Membrane:	JM TPO SA 60	
Attachment:	Adhered	Self Adhered

Flashings

Flashing Materials:	JM TPO SA 60	
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DESIGN CRITERIA & INFORMATION

Perimeter and Corner Dimensions

Perimeter and corner dimensions for buildings less than 60 ft. in height:

Equal to the smaller of:

- 0.1 times the building lesser plan dimension (overall length or width)
- 0.4 times the eave height

but will never measure less than 0.04 times the building lesser plan dimension and never less than 3 ft.

Perimeter and corner dimensions for buildings greater than 60 ft. in height:

Equal to 0.1 times the building lesser plan dimension (overall length or width), but never less than 3 ft.

Corners are "L" shaped with legs twice the width of the perimeter.

Buildings with continuous parapets 36" or greater may treat corners as perimeters.

Ensure any whole or partial insulation board that falls within the calculated perimeter or corner has the increased securement applied over the entire board. This must also be true for any roof cover/base sheet width when the roll is parallel to the building edge.

Installation Notes

- For additional installation guidelines and considerations, please visit <https://www.jm.com/en/commercial-roofing/specs-and-details/>

Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy. This complimentary assistance is not to be used or relied upon by anyone as a substitute for professional engineering design or documentation required by building code, contract or applicable law. By accepting these comments you agree they do not constitute any representations, endorsements of, or an assumption by Johns Manville of any liability for either the adequacy of the design of this building or of any material not supplied by Johns Manville. These comments are for Johns Manville Guarantee purposes only. Additional requirements may be necessary as determined by contract documents, building code and regulations, or governing entity.

- Listed below are recommendations for installation of products **only if included** in the proposed roof assembly

Attachment Method or Product	Recommendation
Materials Left In Place	<ul style="list-style-type: none"> Moisture scan is required All wet/damaged materials material must be completely removed and replaced. All flashing must be removed, all drains cut out, and new sumps installed.
Asphalt	Installed in full coverage hot asphalt
MBR Cold Application Adhesive	Wait 28 days to allow adhesive to cure
Roofing Systems Urethane Adhesive (RSUA)	Install with ¾ inch bead
JM 2 Part Urethane Insulation Adhesive (UIA)	Install with ¾ inch bead
JM All Season Sprayable Adhesive	Fan Pattern shall use 50% overlap
JM 2 Part Urethane Insulation Adhesive (UIA) Canister	Spatter Pattern shall use 80% coverage
UltraFast Fastener Plates – Square Flat	<ul style="list-style-type: none"> May be used with all Insulation and Cover Boards Recommended installation with high compressive strength boards (>80 PSI) Use with Structural Concrete Deck Fasteners
UltraFast Fastener Plates – Recessed Round	Installation of insulation boards or cover boards with lower compressive strength
Polymer Auger Fastener Plates – Cover Boards	Install with 3-inch plates
Polymer Auger Fastener Plate – Membrane	Install with 2-inch plates
Overburden	Owner responsible for removal and reinstallation of any/all overburn products should a roof leak occur and require repair.

The system(s) shall be eligible for a Johns Manville Peak Advantage Roofing System Guarantee when installed by a certified Johns Manville contractor and inspected and approved by a Johns Manville Technical Representative. All materials supplied or marketed by Johns Manville will be covered under the terms and conditions of this agreement.

Thank you for your interest in our roofing products and services. Please contact Johns Manville if any information is incomplete or incorrect so that appropriate modifications can be made.

Johns Manville Technical Services
Roofing Systems Group
10100 W Ute Ave
Littleton, CO 80127
800-922-5922 Option 3

Johns Manville is a manufacturer of commercial roofing products and offers this general conceptual information to you as a courtesy. This complimentary assistance is not to be used or relied upon by anyone as a substitute for professional engineering design or documentation required by building code, contract or applicable law. By accepting these comments you agree they do not constitute any representations, endorsements of, or an assumption by Johns Manville of any liability for either the adequacy of the design of this building or of any material not supplied by Johns Manville. These comments are for Johns Manville Guarantee purposes only. Additional requirements may be necessary as determined by contract documents, building code and regulations, or governing entity.

SECTION 076200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and other items indicated in Schedule.
- B. Sealants for joints within sheet metal fabrications.
- C. Downspout boots.
- D. Precast concrete splash pads.

1.2 RELATED REQUIREMENTS

- A. Section 061053 - Miscellaneous Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 077200 - Roof Accessories: Manufactured metal roof curbs.
- C. Section 079200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.
- D. Section 086300 - Metal-Framed Skylights: Integral metal curbs.

1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- F. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).
- G. CDA A4050 - Copper in Architecture - Handbook current edition.
- H. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.

- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details and instructions.
- C. Samples: Submit two samples 12 by 12 inch in size illustrating metal finish color.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 10 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 18 gauge, 0.040 inch thick; plain finish shop pre-coated with fluoropolymercoating.
 - 1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected by Architect from manufacturer's standard colors.
- B. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 20 gauge, 0.0375 inch thick; smooth No. 4 - Brushed finish.

2.2 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.3 GUTTER AND DOWNSPOUT FABRICATION

- A. Gutters: SMACNA (ASMM) Rectangular profile.
- B. Downspouts: Rectangular profile.

- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
- D. Accessories: Profiled to suit gutters and downspouts.
 - 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 - 2. Gutter Supports: Brackets.
 - 3. Downspout Supports: Brackets.
- E. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3000 psi at 28 days, with minimum 5 percent air entrainment.
- F. Downspout Boots: Cast iron.
- G. Downspout Extenders: Same material and finish as downspouts.
- H. Seal metal joints.

2.4 ACCESSORIES

- A. Fasteners: Stainless steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 INSTALLATION

- A. Secure flashings in place using concealed fasteners.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.
- E. Secure gutters and downspouts in place with concealed fasteners.
- F. Slope gutters 1/4 inch per 10 feet, minimum.
- G. Connect downspouts to downspout boots, and grout connection watertight.
- H. Set splash pads under downspouts.

3.3 SCHEDULE

- A. Gutters and Downspouts: where indicated on drawings.
- B. Counterflashings at Roofing Terminations (over roofing base flashings):
- C. Counterflashings at Curb-Mounted Roof Items, including skylights.
- D. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports:

END OF SECTION

SECTION 078400
FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems.

1.2 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems 2015 (Reapproved 2019).
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems 2020a.
- E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers 2020a.
- F. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies 2013 (Reapproved 2017).
- G. ITS (DIR) - Directory of Listed Products current edition.
- H. FM 4991 - Approval Standard for Firestop Contractors 2013.
- I. FM (AG) - FM Approval Guide current edition.
- J. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).
- K. UL 1479 - Standard for Fire Tests of Penetration Firestops Current Edition, Including All Revisions.
- L. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.
- M. UL (FRD) - Fire Resistance Directory Current Edition.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations. Include installation instructions for all products intended to be installed.

- D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- E. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Certificate from authority having jurisdiction indicating approval of materials used.
- H. Manufacturer's qualification statement.
- I. Installer's qualification statement.

1.4 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Trained by manufacturer.
 - 2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
 - 3. Verification of minimum three years documented experience installing work of this type.
 - 4. Verification of at least five satisfactorily completed projects of comparable size and type.
 - 5. Licensed by local authorities having jurisdiction (AHJ).

1.5 MOCK-UP

- A. Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall constructions, install one assembly for each different combination.
 - 2. Where firestopping is intended to fill a linear opening, install minimum of 1 linear ft.
- B. Obtain approval of authorities having jurisdiction (AHJ) before proceeding.
- C. If accepted, mock-up will represent minimum standard for this work.
- D. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.6 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall (HW) Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of wall assembly.
- B. Floor-to-Floor (FF), Floor-to-Wall (FW), Head-of-Wall (HW), and Wall-to-Wall (WW) Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- C. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.3 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

2.4 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.

3.4 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, will examine penetration firestopping in accordance with ASTM E2174 and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.5 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 079100
PREFORMED JOINT SEALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Precompressed foam seals.

1.2 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Emissions restrictions for joint seal adhesives and primers.

1.3 REFERENCE STANDARDS

- A. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's technical data sheets for each product, including chemical composition, movement capability, color availability, limitations on application, and installation instructions.
- C. Color Cards: For color selection.
- D. Samples for Color Selection: 4 inch long pieces of each color available; at least 2 samples of each color.
- E. Volatile Organic Content (VOC) Documentation: For adhesives and primers, submit VOC content and emissions documentation as specified in Section 016116.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section with at least three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Precompressed Foam Seals:
 - 1. EMSEAL Joint Systems, Ltd; Emshield WFR1 and Seismic Colorseal:
www.emseal.com

2. Willseal LLC; Willseal 150 and Willseal FR-V: www.willseal.com/#sle.
3. An approved equal.
4. Substitutions: See Section 016000 - Product Requirements.

2.2 PRECOMPRESSED FOAM SEALS

- A. Type 3A - Precompressed Foam Seal: Comprised of urethane or open-cell polyurethane foam impregnated with water-repellent, and with self-adhesive faces protected prior to installation by release paper.
 1. Color: As selected by Architect.
 2. Size as required to provide water-tight seal when installed.
 3. Calculate size according to manufacturer's recommendations.
 4. Measure size of existing joints before selecting seal width.
 5. Applications:
 - a. Exterior wall expansion joints.
- B. Type 3B - Precompressed Foam Seal, Fire-Retardant Impregnated: Comprised of waterproof silicone faces on each side of fire-retardant impregnated foam sealant.
 1. Color: As selected by Architect.
 2. Size as required to provide water-tight seal when installed.
 3. Calculate size according to manufacturer's recommendations.
 4. Measure size of existing joints before selecting seal width.
 5. Fire-Rating: As indicated on drawings, comply with UL 2079.
 6. Applications:
 - a. Exterior wall expansion joints.
 - b. As indicated on construction documents.

2.3 ACCESSORIES

- A. Adhesive: As recommended by seal manufacturer.
- B. Substrate Cleaner: Non-corrosive, non-staining type recommended by seal manufacturer; compatible with joint forming materials.
- C. Primer: Type recommended by seal manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive this work.
- B. Measure joint dimensions and verify that seal products are of the correct size to properly seal the joints.

3.2 PREPARATION

- A. Properly prepare construction components adjacent to the work of this section to prevent damage and disfigurement due to this work.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Precompressed Foam Seals:

1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.
2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
3. Remove loose materials and foreign matter that could impair adhesion of sealant.
4. Do not stretch precompressed seal; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

3.5 PROTECTION

- A. Protect joints from damage until adhesives have properly cured.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.

1.3 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- C. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.
- D. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).
- E. SCAQMD 1168 - Adhesive and Sealant Applications 1989 (Amended 2017).

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Substrates for which use of primer is required.
 - 6. Substrates for which laboratory adhesion and/or compatibility testing is required.
 - 7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 8. Certification by manufacturer indicating that product complies with specification requirements.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

- E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- F. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation as specified in Section 016116.
- G. Installation Plan: Submit at least four weeks prior to start of installation.
- H. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- I. Installation Log: Submit filled out log for each length or instance of sealant installed.
- J. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.
- K. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- C. Installation Plan: Include schedule of sealed joints, including the following.
 - 1. Installation Log Form: Include the following data fields, with known information filled out.
 - a. Date of installation.
 - b. Name of installer.
 - c. Actual joint width; provide space to indicate maximum and minimum width.
 - d. Actual joint depth to face of backing material at centerline of joint.
 - e. Air temperature.
- D. Field Quality Control Plan:
 - 1. Visual inspection of entire length of sealant joints.
 - 2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - 3. Field testing agency's qualifications.
 - 4. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- E. Field Adhesion Test Procedures:
 - 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 - 2. Have a copy of the test method document available during tests.
 - 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 - 4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- F. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.

1. Record results on Field Quality Control Log.
2. Repair failed portions of joints.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 1. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.

2.2 JOINT SEALANT APPLICATIONS

- A. Scope:
 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. Other joints indicated below.
 3. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
- C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
- D. Interior Wet Areas: Bathrooms and restrooms; fixtures in wet areas include plumbing fixtures, countertops, cabinets, and other similar items.

2.3 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
- B. Colors: As selected.

2.4 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. Color: Match adjacent finished surfaces.
- B. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
 2. Color: To be selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.4 FIELD QUALITY CONTROL

- A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 079513
EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion joint cover assemblies for floor, wall, ceiling, and soffit surfaces.

1.2 RELATED REQUIREMENTS

- A. Section 077100 - Roof Specialties: Roof expansion and control joint covers.
- B. Section 079100 - Preformed Joint Seals: Sealing expansion and control joints using preformed joint seals. (Joints Type 3A and 3B)
- C. Section 092116 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.
- D. Section 095100 - Acoustical Ceilings: Expansion joint assemblies in suspended ceiling grids.

1.3 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles 2020.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction and anchorage locations.
- D. Samples: Submit two samples 24 inch long, illustrating profile, dimension, color, and finish selected.
- E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 for additional provisions.
 - 2. Extra Resilient Joint Filler: 50 ft length and any special tools required for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Expansion Joint Cover Assemblies:
 - 1. Construction Specialties, Inc: www.c-sgroup.com.
 - 2. Inpro: www.inprocorp.com.
 - 3. MM Systems Corp: www.mmsystemscorp.com.
 - 4. Nystrom, Inc: www.nystrom.com.
 - 5. An approved equal.
 - 6. Substitutions: See Section 016000 - Product Requirements.

2.2 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Type 5: Interior Floor Joints Subject to Seismic Movement:
 - 1. Manufacturers:
 - a. Construction Specialties, Inc; Allway Seismic Metal Floor Covers: www.c-sgroup.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Types 1A and 2A: Interior Non-Fire-Rated Wall/Ceiling Joints Subject to Seismic Movement:
 - 1. Manufacturers:
 - a. Construction Specialties, Inc; Flush Thinline-Twinline Wall and Ceiling Covers: www.c-sgroup.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Types 1B and 2B: Interior Fire-Rated Wall/Ceiling/Floor Joints Subject to Thermal Movement:
 - 1. Manufacturers:
 - a. Construction Specialties, Inc; Fire Barriers: www.c-sgroup.com or approved equal.
 - b. Owens Corning Thermafiber; Safing Insulation: www.thermafiber.com or approved equal..
 - c. Substitutions: See Section 016000 - Product Requirements.
- D. Type 4: Exterior Roof Bellows with Metal Flange Expansion Joint Covers:
 - 1. Manufacturers:
 - a. Nystrom; EEJW; www.nystrom.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.3 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Joint Cover Styles: As indicated on drawings.
 - 4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 - 5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

- B. Floor Joint Covers: Coordinate with indicated floor coverings.
 - 1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
 - 2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.
- C. Resilient Seal Type Covers: Having flat exposed surface without crevices that could collect dirt; designed to withstand expected movement without extrusion of seal from joint assembly; for floors, provide style that is flush with top of floor covering; for exterior joints, weathertight.
- D. Covers In Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
- E. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.

2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
 - 1. Exposed Finish at Floors: Mill finish or natural anodized.
 - 2. Exposed Finish at Walls and Ceilings: Natural anodized.
- B. Resilient Seals:
 - 1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.
 - 2. Color: As selected by Architect from manufacturer's full color range.
- C. Anchors and Fasteners: As recommended by cover manufacturer.
- D. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
- E. Threaded Fasteners: Aluminum.
- F. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.2 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

END OF SECTION

SECTION 081116
ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 Work Included

- A. Furnish and install aluminum entrance, entrance door frames complete with hardware, and related components as shown on the drawings and specified in this section.
- B. All doors shall be EFCO® Series D300 Medium Stile Entrance Door. Other manufacturers requesting approval to bid their product as an equal must submit the following information fifteen days prior to close of bidding.
 - 1. A sample door (size and configuration) as per requirements of architect.
 - 2. Test reports documenting compliance with requirements of Section 1.5.
- C. Glass and Glazing
 - 1. All units shall be factory glazed.
- D. Single Source Requirement
 - 1. All aluminum doors and frames, storefront and aluminum window products listed in Section 1.2 shall be by the same manufacturer.

1.2 Related Work

- A. Section 084313 – Aluminum-Framed Storefronts
- B. Section 085113 – Aluminum Windows
- C. Section 08116.01 - Fire Rated Aluminum Full-Vision Doors and Frames
- D. Section 087100 - Door Hardware
- E. Section 088000 - Glazing

1.3 Items Installed but Not Furnished

- A. Structural support of the framing, wood framing, structural steel, and final cleaning.

1.4 Laboratory Testing and Performance Requirements

- A. Test Units
 - 1. Air test unit shall be minimum size of 36" (914 mm) x 84" (2134 mm).
- B. Test Procedures and Performances
 - 1. Entrance doors shall conform to all requirements for the door type referenced in 1.01.B. In addition, the following specific performance requirements shall be met.
 - 2. Air Infiltration Test
 - a. With door sash closed and locked, test unit in accordance with ASTM E 283 at a static air pressure difference of 1.57 psf (75 Pa).
 - b. Air infiltration shall not exceed .50 cfm/SF (2.54 l/s•m²) of unit, for single doors.
- C. Project Wind Loads

1. The system shall be designed to withstand the following loads normal to the plane of the wall:
 - a. Positive pressure of 25 psf (1197.01 Pa) at non-corner zones.
 - b. Negative pressure of 25 psf (1197.01 Pa) at non-corner zones.
 - c. Negative pressure of 25 psf (1197.01 Pa) at corner zones.

1.5 Quality Assurance

- A. Provide test reports from AAMA accredited laboratories certifying the performance as specified in 1.05.
- B. Test reports shall be accompanied by the entrance door manufacturer's letter of certification stating that the tested door meets or exceeds the referenced performance standard for the appropriate door type.

1.6 Submittals

- A. Contractor shall submit shop drawings, finish samples, test reports, installation methods and instructions, and warranties.
 1. Samples of materials as may be requested without cost to owner, i.e., metal, glass, fasteners, anchors, frame sections, mullion section, corner section, etc.

1.7 Warranties

- A. Total Entrance Door Installation
 1. The responsible contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total door installation which includes that of the manufacturer supplied doors, hardware, glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc., as it relates to air, and structural adequacy as called for in the specifications and approved shop drawings.
 2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at their expense during the warranty period.
- B. Window Material and Workmanship
 1. Provide written guarantee against defects in material and workmanship for 5 years from the date of final shipment.
- C. Glass
 1. Provide written warranty for insulated glass units that they will be free from obstruction of vision as a result of dust or film formation on the internal glass surfaces caused by failure of the hermetic seal due to defects in material and workmanship.
 2. Warranty period shall be for 10 (ten) years.
- D. Finish
 1. Warranty period shall be for 15 years from the date of final shipment.
 2. Provide organic finish warranty based on AAMA standard 2605.

PART 2 PRODUCTS

2.1 Material

- A. Aluminum
 1. Extruded aluminum shall be 6063-T6 alloy and temper.
- B. Hardware

1. Hardware for aluminum entrance doors is specified under "Hardware Section" of the specifications and shall be sent to the door manufacturer for application. The finish hardware supplier shall be responsible for furnishing physical hardware and templates of all hardware to the entrance door manufacturer prior to fabrication, and for coordinating hardware delivery requirements with the hardware manufacturer, the general contractor and the entrance door manufacturer to ensure the building project is not delayed.
- C. Glass
 1. Insulated glass (Tinted) shall be 1" thick with a center of glass U-Factor of 0.24 constructed as follows:
 - a. Exterior lite – 1/4 inch thick, Solarbronze tinted, float glass (annealed, H.S. Temp), uncoated.
 - b. Space of 1/2 inch, argon filled.
 - c. Interior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), with low-E Solarban 70 coating on the number 3 surface.
 2. Insulated glass (Untinted) shall be 1" thick with a center of glass U-Factor of 0.24 constructed as follows:
 - a. Exterior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), with a low-E Solarban 70 coating on the number 2 surface.
 - b. Space of 1/2 inch, argon filled.
 - c. Interior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), uncoated.
- 2.2 Fabrication
 - A. General
 1. Major portions of the door sections shall have .125" (3 mm) wall thickness. Glazing stop sections shall have .050" (1.2 mm) wall thickness.
 - B. Entrance Doors
 1. Door stiles shall be no less than 3-1/2" wide (not including glass stops).
 2. Door bottom rails shall be no less than 10" high (not including glass stops).
 3. Door stiles and rails shall have hairline joints at corners. Heavy concealed reinforcement brackets shall be secured with screws and shall be of deep penetration and fillet welded.
 4. Weather stripping shall be wool pile and shall be installed in one stile of pairs of doors and in jamb stiles of center pivoted doors.
 - C. Glazing
 1. All units shall be dry glazed with extruded pressure fitting aluminum glazing stops, and EPDM gaskets.
- 2.3 Finishes
 - A. Organic
 1. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2605-20: Minimum 70 percent PVDF resin by weight, in color coat and clear topcoat, if required. Color as selected from one of the following:
 - a. Sherwin-Williams Coil Coatings Fluoropon Color Card – Fluoropon
 - b. Sherwin-Williams Coil Coatings Metal Trends Color Card - Sherwin-Williams Coil Coatings Fluoropon Color Card – Fluoropon

PART 3 EXECUTION

3.1 Inspection

A. Job Conditions

1. Verify that openings are dimensionally within allowable tolerances, plumb, level, clean, provide a solid anchoring surface and are in accordance with approved shop drawings.
2. Provide for manufacturer representation to conduct pre-installation site meeting.

3.2 Installation

- A. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.
- B. Plumb and align entrance door faces in a single plane for each wall plane and erect doors and materials square and true. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.
- C. Adjust doors for proper operation after installation.
- D. Furnish and apply sealants to provide a weather tight installation at all joints and intersections and at opening perimeters. Wipe off excess material and leave all exposed surfaces and joints clean and smooth.

3.3 Anchorage

- A. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

3.4 Protection and Cleaning

- A. After completion of entrance installation, entrance doors shall be inspected, adjusted, put into working order and left clean, free of labels, dirt, etc. Protection from this point shall be the responsibility of the general contractor.
- B. A bi-annual sweetwater rinse is recommended to prohibit dirt, dust, and debris from accumulation on the surface of the coating and to help maintain the aesthetic of the coating.

END OF SECTION

SECTION 081116.01
FIRE-RATED ALUMINUM FULL VISION DOORS AND FRAMES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire-rated aluminum full vision Aluflam door system including pre-finished door, frame, glazing, and hardware.
- B. Refer to Hardware section 087100 - Door Hardware for additional hardware to be provided and installed under that section.

1.2 RELATED SECTIONS

- A. Section 087100 - Door Hardware
- B. Section 081116 - Aluminum Doors and Frame
- C. Section 084313 - Aluminum-Framed Storefronts
- D. Section 088000 - Glazing

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM E119: Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 2. ASTM E2074: Standard Test Method for Fire Tests of Door Assemblies; Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies.
- B. National Fire Protection Association (NFPA)
 - 1. NFPA 80: Standard for Fire Doors and Fire Windows.
 - 2. NFPA 251: Standard Methods of Tests of Fire Endurance of Building Construction and Materials.
 - 3. NFPA 252: Standard Methods of Fire Tests of Door Assemblies.
- C. Uniform Building Code (UBC)
 - 1. UBC 7-2: Methods for Fire Tests of Door Assemblies.
- D. Underwriters Laboratories, Inc. (UL):
 - 1. UL 10C: Positive Pressure Fire Tests of Door Assemblies
- E. Standard Council of Canada:
 - 1. ULC Standard CAN4-S104: Fire Tests of Door Assemblies.
- F. American National Standards Institute (ANSI)
 - 1. ANSI Z97.1: Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.
- G. Consumer Product Safety Commission (CPSC):
 - 1. CPSC 16 CFR 1201 Categories I and II: Safety Standard for Glazing Materials.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements
 - 1. Fire Rating: 60 minutes
 - 2. Certification: Doors and frames shall be tested with ASTM E2074, NFPA 252, UBC 7-2, UL 10C, CAN4-S104.
 - 3. Testing Laboratory: Fire tests shall be conducted by an approved independent testing laboratory, similar to Underwriter's Laboratories, Inc.

1.5 SUBMITTALS

- A. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedure Section.
 - 1. Shop Drawings: Submit shop drawings showing layouts, profiles, and product components.
 - 2. Samples: Submit samples for finishes, colors and textures.
 - 3. Technical Information: Submit latest edition of manufacturer's product data providing product description, technical data and installation instructions.

1.6 QUALITY ASSURANCE

- A. Listings and Labels
 - 1. Fire rated framing and glazing shall be under current follow-up services by an approved, independent agency and maintain a current listing or certification. Assemblies shall be labeled in accordance with limits of listings.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- B. Delivery: Deliver materials to specified destination in manufacturer's packaging undamaged, complete with installation instructions.
- C. Storage and Protection: Store off ground, under cover, protected from weather, direct sunlight, construction activities and at temperature conditions recommended by manufacturer, +10o F to +110o F.
- D. Handling: Protect materials and finish during handling and installation to prevent damage.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 – PRODUCTS

2.1 FIRE-RATED ALUMINUM FULL VISION DOORS AND FRAMES

- A. Manufacturer: Aluflam North America
 - 1. Contact: 16604 Edwards Road, Cerritos, CA 90703; Telephone: 562-926-9520; Fax: 562-404-1394. Email: info@aluflam-usa.com. Website: www.aluflam-usa.com, or

local representative 9www.aluflam-usa.com/contact/representatives.php).

2.2 MATERIALS – ALUMINUM FRAMING

- A. Frame Construction: Integral structure and glazing stops from extruded and thermally broken profiles. Filled internally with cement composite material.
- B. Dimensions:
 - 1. Door framing face dimension: 2-1/2" inch
 - 2. Depth of door framing: 3-7/16 inch
 - 3. Door stile face dimension: 3-9/16 inch
 - 4. Door cross rail (if applicable): 3-9/16 inch
- C. Assembly: Frame corners assembled by means of crimped and bonded miter joints.
- D. Sealing: Framing system shall insulate against effects of fire, smoke, and heat transfer either side. Perimeter of the framing system to the rough opening shall be firmly packed with mineral wool insulation.

2.3 MATERIALS – FIRE RESISTANT GLAZING

- A. Assemblies shall be glazed with glazing type GL-3A (60 minute, fire-resistance rated, 1 inch thick insulating glazing unit) consisting of:
 - 1. Outboard Lite: FireLite glass ceramic, 3/16 inch thick, minimum.
 - a. Tint: Clear
 - 2. Metal edge spacer, space between lights filled with air
 - 3. Inboard Lite: fully tempered float glass, 1/4 inch minimum,
 - a. Tint: Clear
 - 4. Total thickness: 1 inch nominal.
- B. Individual lites shall be permanently identified with a listing mark.
- C. Glazing material installed in "hazardous locations" (subject to human impact) shall be certified to meet the applicable requirements for fire rated assemblies referenced in ASNI Z97.1 Standard for Safety Glazing Materials Used in Buildings and/or CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.
- D. Visible daylight transmission shall be a minimum of 81%. Glazing material shall be optically clear, colorless and free from unusual distortion.

2.4 MATERIALS – GLAZING AND ASSEMBLY ACCESSORIES

- A. Fasteners: All fasteners, setting pads, and glazing clips, shall be stainless or zinc-plated steel.
- B. Glazing Accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame-retardant intumescent glazing tape. Ceramic setting blocks shall be placed between the metal setting pads and the glazing material. Setting pads and blocks provided by the manufacturer.

2.5 FABRICATION

- A. Door frames and door leaves shall be furnished pre-assembled. Door assemblies shall be field glazed.
- B. Door assemblies shall be factory prepared for field mounting of hardware.

- C. Fabrication Dimensions: Fabricate to approved dimensions. The General Contractor shall guarantee dimensions within required tolerance (+/- 1/8 inch). Obtain approved shop drawings prior to fabrication.

2.6 FINISHES

- A. Framing shall be chemically cleaned and pretreated, then finished on all exposed areas with Fluoropolymer Paint – Kynar/Duramax UC. Color as selected by Architect from manufacturer's full color range.
- B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering prior to shipping.
- C. Slight variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

2.7 DOOR HARDWARE

- A. Hardware shall be supplied from door manufacturer's standard recommended hardware groups as specified.
- B. Operating hardware for active/active pairs of doors. Each to have the following:

Quantity	Description	Manufacturer/Model	Finish
2	Surface applied door closers	Dorma TS93 series	Aluminum
6	Surface-applied hinges	Dr Hahn A901/951 series	Aluminum
2	Vertical rod exit devices top rod only for 60 min and lower rated	Dorma 9800 series	Stainless
2	10" bottom kickplate	Aluflam	Match door finish
2	Automatic floor seal	Planet MF	Aluminum

- C. Balance of hardware by others

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine area to receive doors. Openings shall be plumb, square and within allowable tolerances. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Door installation shall be by a specialty contractor with appropriate experience qualifications; and in strict accordance with the approved shop drawings.

3.3 CLEANING

- A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Glass and frame should be cleaned using soft clean cloth, chamois leathers, sponges or soft paper. Use clean, warm water with a mild detergent. Do not use detergent that contains either alkaline, acids, or fluoride. Abrasive cleaning methods can damage surfaces. Clean prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 081213
HOLLOW METAL FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated hollow metal frames for wood doors.
- B. Fire-rated hollow metal frames for wood and insulate fiberglass doors.
- C. Bullet-resistant hollow metal frames for bullet-resistant wood doors.
- D. Interior glazed borrowed lite frames.

1.2 RELATED REQUIREMENTS

- A. Section 04810 - Unit Masonry Assemblies : Embedding anchors for hollow metal work into masonry construction,
- B. Section 081416 - Flush Wood Doors: Wood doors for hollow metal frames.
- C. Section 081613 - Fiberglass Doors: Insulated Fiberglass doors for hollow metal frames.
- D. Section 087100 - Door Hardware: Hardware, silencers, and weatherstripping.
- E. Section 088000 - Glazing: Glazed borrowed lites.
- F. Section 099000 - Painting and Coating: Field painting.
- G. Division 28 Section "Access Control Hardware" for frame preparation requirements for access control wiring and devices.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2018.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2015.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2021.

- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.
- J. ASTM C476 - Standard Specification for Grout for Masonry 2020.
- K. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
- L. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames 2002.
- N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames 2011.
- O. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.
- P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.
- Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- R. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.
- S. UL (DIR) - Online Certifications Directory Current Edition.
- T. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Include the following:
 - 1. Elevations of each door and frame design
 - 2. Frame details for each frame type, including dimensioned profiles and metal thicknesses. Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any. Include elev
 - 3. Locations of reinforcement and preparations for hardware.
 - 4. Details of anchorages, joints, field splices, and connections.
 - 5. Details of accessories.
 - 6. Details of moldings, removable stops, and glazing.
 - 7. Details of conduit and preparations for power, signal, and control systems.
- D. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel frame supplier in order to prepare the frames to receive the finish hardware items.
- E. Samples: Submit one sample of frame metal, 2 by 2 inches, showing factory finishes, colors, and surface textures.

- F. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- G. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal frames complying with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames" from SDI Certified manufacturer: <https://steeldoor.org/sdi-certified>.
- B. Source Limitations: Obtain hollow metal frames through one source from a single manufacturer wherever possible.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 4" above sill).
- E. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.
- F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal frames to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
- B. Door and frames to be stacked in a vertical, upright position.
- C. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hollow Metal Frames:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
 - 3. Fleming Door Products, an Assa Abloy Group company: www.assaabloydss.com.
 - 4. An approved equal.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Refer to Door and Frame Schedule on drawings for frame sizes, fire ratings, sound ratings, finishing, door hardware to be installed, and other variations, if any.
- B. Door Frame Type: Provide hollow metal door frames with integral casings.
 - 1. Interior Doors: Use frames with integral casings.
- C. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
- D. Accessibility: Comply with ICC A117.1 and ADA Standards.
- E. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
- F. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- G. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115, NAAMM HMMA 830, NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- H. Zinc Coating for Units Subject to Corrosive Conditions: Components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise.
- I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry, to be grouted, OR as necessary for secure hardware operation.
- J. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
- K. Frames for Interior Glazing or Borrowed Lites: Construction and face dimensions to match door frames, and as indicated on drawings.
- L. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.

- M. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into head of frame, and flush with top.
- N. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.

2.3 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

- A. Type A , Exterior Door Frames: Knock-down type. Provide fire-rated door frame construction as indicated for door frame Type B , Fire-Rated Door Frames, and the following exterior door frame requirements.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 14 gauge, 0.067 inch, minimum.
 - d. Zinc Coating: Manufacturer's standard coating thickness; ASTM A653/A653M.
 - 2. Thermally broken frame.
 - 3. Frame Finish: Factory primed and field finished.
 - 4. Weatherstripping: See Section 087100.
- B. Type B , Interior Door Frames, Non-Fire Rated: Knock-down type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - 2. Frame Finish: Factory primed and field finished.
- C. Type C , Fire-Rated Door Frames: Knock-down type.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Frame Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - 2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C or NFPA 252 ("positive pressure fire tests").
 - 3. Temperature-Rise Rating (TRR) Across Framed Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - 4. Provide units listed and labeled by UL (DIR).
 - a. Attach fire rating label to each fire rated unit.
 - 5. Frame Finish: Factory primed and field finished.

2.4 FINISHES

- A. Primer: Rust-inhibiting, fast-curing, lead and chromate free, complying with ANSI/SDI A250.10, door manufacturer's standard, recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - 1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.5 ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- B. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
- C. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- D. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 FRAME ANCHORS

- A. Jamb Anchors
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inches thick.
 - 2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
- B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.
- C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.7 LIGHT OPENINGS AND GLAZING

- A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.
- B. Moldings for Glazed Lites in Door and Loose Stops for Glazed Lites in Frames: Maximum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.
- C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.
- D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048 inch thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.8 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld joints continuously through full throat width of frames, including rabbets, soffits, and stops; grind, fill, dress, and make smooth, flush, and invisible.
 - a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.
3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. Equal Rabbet Frames: Provide frames with equal rabbet dimensions unless glazing and removable stops required wider dimensions on glass side of frame.
5. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48 inches and wider with mortise butt type hinges at top hinge locations.
6. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
7. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
8. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
9. Electrical Thru-Wiring: Provide hollow metal frames receiving electrified hardware with loose wiring harness (not attached to open throat components or installed in closed mullion tubes) and standardized Molex plug connectors on one end to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electric through-wire transfer hardware or wiring harness specified in hardware sets in Division 08 Section "Door Hardware" and "Access Control Hardware".
10. Electrical Knock Out Boxes: Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; including, but not limited to, electric through wire transfer hardware, electrical raceways and wiring harnesses, door position switches, electric strikes, magnetic locks, and jamb mounted card readers as specified in Division 08 Sections "Door Hardware" and "Access Control Hardware".
 - a. Provide electrical knock out boxes with a dual 1/2-inch and 3/4-inch knockouts
 - b. Conduit to be coordinated and installed in the field (Division 26) from middle hinge box and strike box to door position box.
 - c. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 08 Section "Door Hardware".
 - d. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
11. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

12. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on center and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on center and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
 13. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware" or not.
 14. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.
- D. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware".
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
 2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparations of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Section.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- C. Verify that finished walls are in plane to ensure proper door alignment.
- D. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.
- C. Tolerance shall comply with SDI-117 "Manufacturing Tolerances for Standard Steel Doors and Frames".
- D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.
- E. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Install frames plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions. Comply with ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, secure with post-installed expansion anchors.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
 - 4. Grout requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.
- C. Install fire rated units in accordance with NFPA 80.
- D. Coordinate frame anchor placement with wall construction.
- E. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- F. Comply with glazing installation requirements of Section 088000.
- G. Install door hardware as specified in Section 087100.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6.
- H. Coordinate installation of electrical connections to electrical hardware items.

3.4 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat and Painted Finish touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.6 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 081416
FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire-rated, non-rated, and bullet resistant.

1.2 RELATED REQUIREMENTS

- A. Section 081213 - Hollow Metal Frames.
- B. Section 081613 - Fiberglass Doors
- C. Section 087100 - Door Hardware.
- D. Section 088000 - Glazing.
- E. Section 092116 - Gypsum Board Assemblies: Bullet-resistant sheathing and wallboard for bullet-resistant partitions and walls.

1.3 REFERENCE STANDARDS

- A. AWI (QCP) - Quality Certification Program Current Edition.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition 2014, with Errata (2016).
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.
- D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- E. UL 752 - Standard for Bullet-Resisting Equipment Current Edition, Including All Revisions.
- F. WDMA I.S. 1A - Interior Architectural Wood Flush Doors 2013.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics. Include manufacturer's written installation instructions and methods.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS).
 - 2. Include certification program label.
- D. Samples: Submit two samples of door construction, 6 by 6 inches in size cut from top corner of door.

- E. Samples: Submit two samples of door veneer, 12 by 12 inches in size illustrating wood grain, stain color, and sheen.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G. Test Reports: Show compliance with specified requirements for the following:
 - 1. Bullet resistant doors and frames.
- H. Manufacturer's Installation Instructions: Indicate special installation instructions.
- I. Manufacturer's Qualification Statement.
- J. Installer's Qualification Statement.
- K. Specimen warranty.
- L. Warranty, executed in Owner's name.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- C. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org.
 - 2. Provide labels or certificates indicating that installed work will comply with AWI/AWMAC/WI (AWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. VT Industries, Inc; Heritage Collection: www.vtindustries.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - 3. Bullet Resistant Doors: UL 752, Level 3.
 - 4. Wood veneer facing with factory transparent finish Match Architect's sample.

2.3 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Bullet Resistant Doors: Equivalent to type, with bonded structural composite lumber core (SCLC); rating; plies and faces as indicated above.

2.4 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: [____], veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.
 - 1. Vertical Edges: Same species as face veneer.
 - 2. "Running Match" each pair of doors and doors in close proximity to each other.
 - 3. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
- B. Facing Adhesive: Type I - waterproof.

2.5 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.

- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory prepare doors with raceway for internal wiring required by electrified hinge and lockset hardware.
- F. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- G. Provide edge clearances in accordance with the quality standard specified.

2.6 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
 - 1. Transparent:
 - a. System - TR-8, UV Cured Acrylated Polyester/Urethane.
 - b. Sheen: Flat.
- B. Factory finish doors in accordance with sample to be provided.

2.7 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 081213.
- B. Glazing: See Section 088000.
- C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- D. Astragals and Edges for Double Doors: Pairs of doors astragals, and door edge sealing and protection devices.
 - 1. UL listed products in compliance with requirements of authorities having jurisdiction.
 - 2. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
 - 3. Edge Type: Beveled edge
 - 4. Material: Aluminum.
 - 5. Metal Finish: Beige powder coating.
- E. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.

1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
 - C. Use machine tools to cut or drill for hardware.
 - D. Coordinate installation of doors with installation of frames and hardware.
 - E. Coordinate installation of glazing.
- 3.3 TOLERANCES
- A. Comply with specified quality standard for fit and clearance tolerances.
 - B. Comply with specified quality standard for telegraphing, warp, and squareness.
- 3.4 ADJUSTING
- A. Adjust doors for smooth and balanced door movement.
 - B. Adjust closers for full closure.
- 3.5 SCHEDULE
- A. See Door Schedule on drawings..

END OF SECTION

SECTION 081613
FIBERGLASS DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiberglass doors.

1.2 RELATED REQUIREMENTS

- A. Section 081213 - Hollow Metal Frames: Metal frames.
- B. Section 087100 - Door Hardware.

1.3 REFERENCE STANDARDS

- A. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).
- C. ASTM D570 - Standard Test Method for Water Absorption of Plastics 1998 (Reapproved 2018).
- D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position 2018.
- E. ASTM D638 - Standard Test Method for Tensile Properties of Plastics 2014.
- F. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials 2017.
- G. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor 2013a.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- J. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
- K. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).

- M. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights 2019c.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Obtain hardware templates from hardware manufacturer prior to starting fabrication.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard details, installation instructions, hardware and anchor recommendations.
- C. Shop Drawings: Indicate layout and profiles; include assembly methods.
 - 1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
 - 2. Indicate wall conditions, door and frame elevations, sections, materials, gauges, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on drawings to identify details and openings.
- D. Selection Samples: Submit two complete sets of color chips, illustrating manufacturer's available finishes, colors, and textures.
- E. Verification Samples: Submit door surface samples for each finish specified, 10 inches by 10 inches in size, illustrating finishes, colors, and textures.
- F. Door Corner Sample: Submit corner cross sections, 10 inches by 10 inches in size, illustrating construction, finish, color, and texture.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer; include detailed terms of warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Mark doors with location of installation, door type, color, and weight.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.
 - 1. Store at temperature and humidity conditions recommended by manufacturer.
 - 2. Do not use non-vented plastic or canvas shelters.

3. Immediately remove wet wrappers.
- D. Store in position recommended by manufacturer, elevated minimum 4 inches above grade, with minimum 1/4 inch space between doors.

1.8 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide lifetime manufacturer warranty covering materials and workmanship, including degradation or failure due to chemical contact.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Pultruded Fiberglass Reinforced Plastic (FRP) Doors:
 1. FRP Architectural Doors Inc.; www.frparch.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.

2.2 DOOR AND FRAME ASSEMBLIES

- A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
 1. Screw-Holding Capacity: Tested to 890 pounds, minimum.
 2. Surface Burning Characteristics: Flame spread index (FSI) of 0 to 25, Class A, and smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84.
 3. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
 4. Sizes: As indicated on drawings.
 5. Clearance Between Door and Frame: 1/8 inch, maximum.
 6. Clearance Between Bottom of Door and Finished Floor: 3/4 inch, maximum; not less than 1/4 inch clearance to threshold.

2.3 COMPONENTS

- A. Doors: Fiberglass construction with reinforced core.
 1. Thickness: 1-3/4 inch, nominal.
 2. Core Material: Manufacturer's standard core material for application indicated.
 3. Construction:
 - a. Fiberglass face sheets, 1/8 inch thick, laminated to core; factory pre-finished.
 4. Face Sheet Texture: Pebble grain.
 5. Door Panel: Flush door.
 6. Subframe and Reinforcements: Fiberglass pultrusions or polymer foam; no metal or wood.
 7. Waterproof Integrity: Provide factory fabricated edges, cut-outs, and hardware preparations of fiberglass reinforced plastic (FRP); provide cut-outs with joints sealed independently of glazing, louver inserts, or trim.
 8. Hardware Preparations: Factory reinforce, machine, and prepare for door hardware including field installed items; provide solid blocking for each item; field cutting, drilling or tapping is not permitted; obtain manufacturer's hardware templates for preparation as necessary.
- B. Hollow Metal Frames: See Section 081213.

2.4 PERFORMANCE REQUIREMENTS

- A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
- B. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 7.5 psf.
- C. Air Leakage: Maximum of 0.1 cfm per square foot at 6.27 psf differential pressure, when tested in accordance with ASTM E283.
- D. Structural Performance: Withstand positive and negative wind loads equal to 1.5 times design wind loads specified by local code without damage or permanent set, when tested in accordance with ASTM E330/E330M, using 10 second duration of maximum load.
- E. Thermal Transmittance, Exterior Doors: AAMA 1503, U-value of 0.35, maximum, measured on exterior door in size required for this project.
- F. Thermal Resistance, Exterior Doors: R-11 minimum.
- G. Acoustical Performance: Sound Transmission Class (STC) of 25, minimum, when tested in accordance with ASTM E90.
- H. Fiberglass Reinforced Plastic (FRP) Face Sheet Properties:
 - 1. Izod Impact Resistance: ASTM D256, 7 foot-pound force per inch of width, minimum, with notched izod.
 - 2. Tensile Strength at Break: ASTM D638, 13,250 psi, minimum.
 - 3. Water Absorption: ASTM D570, 0.16 percent, maximum, after 24 hours at 74 degrees F.
 - 4. Flexural Strength: ASTM D790, 27,000 psi, minimum.
 - 5. Barcol Hardness: ASTM D2583, minimum of 40 units.

2.5 FINISHES

- A. Gel Coating: Ultraviolet (UV) stabilized polyester finish.
 - 1. Thickness: Minimum 15 mils, 0.015 inch wet thickness, plus/minus 3 mils, 0.003 inch.
 - 2. Color: As selected by Architect from manufacturer's standard line of colors.

2.6 ACCESSORIES

- A. Door Hardware: See Section 087100.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.
- B. Do not begin installation until substrates have been properly prepared.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.

- B. Install exterior doors in accordance with ASTM E2112.
- C. Install door hardware as specified in Section 087100.
- D. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.
- E. Set thresholds in continuous bed of sealant.
- F. In stud walls, install frames prior to building walls; anchor frames to studs using concealed anchors.
- G. Separate aluminum and other metal surfaces from sources of corrosion of electrolytic action at points of contact with other materials.

3.3 ADJUSTING

- A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.
- B. Adjust hardware for smooth and quiet operation.
- C. Adjust doors to fit snugly and close without sticking or binding.

3.4 CLEANING

- A. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.

END OF SECTION

SECTION 083100
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling mounted access units.

1.2 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Openings in ceilings and walls.
- B. Section 099000 - Painting and Coating: Field paint finish.
- C. Division 22: Plumbing components requiring access.
- D. Division 23: Mechanical components requiring access.
- E. Division 26: Electrical components requiring access.

1.3 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products current edition.
- B. UL (FRD) - Fire Resistance Directory Current Edition.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Samples: Submit two access units, 12 by 12 inches in size indicating frame configuration.
- E. Manufacturer's Installation Instructions: Indicate installation requirements.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Project Record Documents: Record actual locations of each access unit.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units in Wet Areas:
 - 1. Location: as required.
 - 2. Panel Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
 - 3. Size: 12 by 12 inches.
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 5. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
- B. Fire-Rated Wall-Mounted Units:
 - 1. Location: as required.
 - 2. Wall Fire-Rating: As indicated on drawings.
 - 3. Panel Material: Steel.
 - 4. Size: 12 by 12 inches.
 - 5. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.

2.2 WALL AND CEILING MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
 - a. Multipurpose Access Panel: Activar/JL Industries TM.
 - 2. ACUDOR Products Inc: www.acudor.com.
 - a. Wall and Ceiling Mounted Units: ACUDOR DW-5058.
 - 3. Best Access Doors: www.bestaccessdoors.com.
 - a. Universal Access Panel Drywall: Best Access Doors; Series BA-UAP.
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Style: Exposed frame with door surface flush with frame surface.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - 2. Door Style: Single thickness with rolled or turned in edges.
 - 3. Heavy Duty Frames: 14 gauge, 0.0747 inch, minimum thickness.
 - 4. Heavy Duty Single Steel Sheet Door Panels: 14 gauge, 0.0747 inch, minimum thickness.
 - 5. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
 - 6. Steel Finish: Primed.
 - 7. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
 - 8. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Latch/Lock: Tamperproof tool-operated cam latch.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.3 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 084313
ALUMINUM – FRAMED STOREFRONTS

PART 1 GENERAL

1.1 Work Included

- A. Furnish and install aluminum architectural storefront and window system complete with hardware and related components as shown on drawings and specified in this section.
- B. All storefront and window systems shall be EFCO® System 403 Thermal Flush-Glazed Screw Spline Storefront. Other manufacturers requesting approval to bid their product as an equal must submit the following information fifteen days prior to close of bidding.
 - 1. A sample storefront system (size and configuration) as per requirements of architect.
 - 2. Test reports documenting compliance with requirements of Section 1.05.
- C. Glass
 - 1. Reference Section 088000 for Glass and Glazing.
- D. Single Source Requirement
 - 1. All aluminum doors and frames, storefront, and aluminum window products listed in Section 1.2 shall be by the same manufacturer.

1.2 Related Work

- A. Section 081116 – Aluminum Doors and Frames
- B. Section 081116.01 - Fire-Rated Aluminum Full-Vision Doors and Frames
- C. Section 085113 – Aluminum Windows
- D. Section 087100 - Door Hardware
- E. Section 088000 - Glazing

1.3 Laboratory Testing and Performance Requirements

- A. Test Units
 - 1. Air, water, and structural test unit size shall be a minimum of two lites high and three lites wide.
 - 2. Thermal test unit sizes shall be 80" (2032 mm) wide x 80" (2032 mm) high with one intermediate vertical mullion and two lites of glass.
- B. Test Procedures and Performance
 - 1. Air Infiltration Test
 - a. Test unit in accordance with ASTM E 283 at a static air pressure difference of 6.24 psf (299 Pa).
 - b. Air infiltration shall not exceed .06 cfm/SF (.30 l/s•m²) of unit.
 - 2. Water Resistance Test
 - a. Test unit in accordance with ASTM E 331.
 - b. There shall be no uncontrolled water leakage at a static test pressure of 12.0 psf (575 Pa).
 - 3. Uniform Load Deflection Test
 - a. Test in accordance with ASTM E 330.

- b. Deflection under design load shall not exceed $L/175$ of the clear span.
4. Uniform Load Structural Test
 - a. Test in accordance with ASTM E 330 at a pressure 1.5 times the design wind pressure in 1.05.B.3.b.
 - b. At conclusion of the test, there shall be no glass breakage, permanent damage to fasteners, storefront parts, or any other damage that would cause the storefront to be defective.
5. Condensation Resistance Test (CRF)
 - a. Test unit in accordance with AAMA 1503.1.
 - b. Condensation Resistance Factor (CRF) shall not be less than 57 (frame) when glazed with 0.24 center of glass U-Factor. (See chart at end of section).
6. Condensation Resistance (CR)
 - a. With ventilators closed and locked, test unit in accordance with NFRC 500-2010.
 - b. Condensation Resistance (CR) shall not be less than 37 when glazed with 0.24 center of glass U-Factor. (See chart at end of section).
7. Thermal Transmittance Test (Conductive U-Factor)
 - a. With ventilators closed and locked, test unit in accordance with NFRC 100-2010.
 - b. Conductive thermal transmittance (U-Factor) shall not be more than 0.37 BTU/hr•ft²•°F (2.10 W/m²•K) when glazed with 0.24 center of glass U-Factor. (See chart at end of section).

Glass Comparison Chart				
Glass	C.O.G. U-Factor	U-Factor	Frame CRF	CR
1" IG	0.48	0.57 BTU/hr•ft ² •°F (3.24 W/m ² •K)	57	*
1" IG	0.30	0.42 BTU/hr•ft ² •°F (2.38 W/m ² •K)	57	36
1" IG	0.24	0.37 BTU/hr•ft ² •°F (2.10 W/m ² •K)	57	37
1" IG	0.20	0.34 BTU/hr•ft ² •°F (1.93 W/m ² •K)	57	37

U-Factor and Condensation Resistance (CR) are based on a nominal size of 47.25" (1200 mm) x 59" (1500 mm) with two lites of glass using NFRC-100, and 500 - 2010.

Center of Glass (C.O.G.) U-Factor is based on Intercept® Spacer.

Frame CRF is based on AAMA 1503.1

C. Project Wind Loads

1. The system shall be designed to withstand the following loads normal to the plane of the wall:
 - a. Positive pressure of 25 psf (1197.01 Pa) at non-corner zones.
 - b. Negative pressure of 25 psf (1197.01 Pa) at non-corner zones.
 - c. Negative pressure of 25 psf (1197.01 Pa) at corner zones.

1.4 Quality Assurance

- A. Provide test reports from AAMA accredited laboratories certifying the performance as specified in 1.05.
- B. Test reports shall be accompanied by the storefront manufacturer's letter of certification stating that the tested storefront meets or exceeds the referenced criteria for the appropriate

storefront type.

1.5 Submittals

- A. Contractor shall submit shop drawings; finish samples, test reports, installation instructions, and warranties.
 - 1. Samples of materials as may be requested without cost to owner, i.e., metal, glass, fasteners, anchors, frame sections, mullion section, corner section, etc.
- B. An NFRC Component Modeling Approach (CMA) generated label certificate shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the manufacturer's framing combined with the specified glass, and the glass spacer used in the fabrication of the glass, at NFRC standard test size as defined in table 4-3 in NFRC 100-2010.

1.6 Warranties

- A. Total Storefront and Window Installation
 - 1. The responsible contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total storefront and window installation. This includes the glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc., as it relates to air, water and structural adequacy as called for in the specifications and approved shop drawings.
 - 2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at their expense during the warranty period.
- B. Window Material and Workmanship
 - 1. Provide written guarantee against defects in material and workmanship for 10 years from the date of final shipment.
- C. Glass
 - 1. Provide written warranty for insulated glass units that they will be free from obstruction of vision as a result of dust or film formation on the internal glass surfaces caused by failure of the hermetic seal due to defects in material and workmanship.
 - 2. Warranty period shall be for 10 (ten) years.
- D. Finish
 - 1. Warranty period shall be for 15 years from the date of final shipment.
 - 2. Provide organic finish warranty based on AAMA standard 2605.
 - 3. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2605-20: Minimum 70 percent PVDF resin by weight, in color coat, and clear topcoat, if required. Color as selected from one of the following:
 - a. Sherwin-Williams Coil Coatings Fluoropon Color Card – Fluoropon
 - b. Sherwin-Williams Coil Coatings Metal Trends Color Card - Sherwin-Williams Coil Coatings Fluoropon Color Card – Fluoropon

PART 2 PRODUCTS

2.1 Materials

- A. Aluminum
 - 1. Extruded aluminum shall be 6063-T6 alloy and temper.
- B. Glass

1. Ship open for 1" Insulated glass with a center of glass U-Factor of 0.24 constructed as follows:
2. Insulated glass (Tinted) shall be 1" thick with a center of glass U-Factor of 0.24 constructed as follows:
 - a. Exterior lite – 1/4 inch thick, Solarbronze tinted, float glass (annealed, H.S. Temp), uncoated.
 - b. Space of 1/2 inch, argon filled.
 - c. Interior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), with low-E Solarban 70 coating on the number 3 surface.
3. Insulated glass (Untinted) shall be 1" thick with a center of glass U-Factor of 0.24 constructed as follows:
 - a. Exterior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), with a low-E Solarban 70 coating on the number 2 surface.
 - b. Space of 1/2 inch, argon filled.
 - c. Interior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), uncoated.

C. Thermal Barrier

1. All exterior aluminum shall be separated from interior aluminum by a rigid, structural thermal barrier. For purposes of this specification, a structural thermal barrier is defined as a system that shall transfer shear during bending and, therefore, promote composite action between the exterior and interior extrusions.
2. Barrier material shall be poured-in-place, two-part polyurethane. A nonstructural thermal barrier is unacceptable.

2.2 Fabrication

A. General

1. All aluminum frame extrusions shall have a minimum wall thickness of .080" (2 mm).
2. All exposed work shall be carefully matched to produce continuity of line and design with all joints. System design shall be such that raw edges will not be visible at joints.

B. Frame

1. Depth of frame shall not be less than 4 1/2" (114 mm).
2. Face dimension shall not be less than 2" (50 mm).
3. Frame components shall be screw spline construction.

C. Glazing

1. All units shall be "dry glazed" with gaskets on both exterior and interior of the glass.

2.3 Finishes

A. Organic

- B. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2605-20: Minimum 70 percent PVDF resin by weight, in color coat, and clear topcoat, if required. Color as selected from one of the following:
 1. Sherwin-Williams Coil Coatings Fluoropon Color Card – Fluoropon
 2. Sherwin-Williams Coil Coatings Metal Trends Color Card - Sherwin-Williams Coil Coatings Fluoropon Color Card – Fluoropon

PART 3 EXECUTION

3.1 Inspection

A. Job Conditions

1. All openings shall be prepared by others to the proper size and shall be plumb, level and in the proper location and alignment as shown on the architect's drawings.
2. Provide for manufacturer representation to conduct pre-installation site meeting.

3.2 Installation

- A. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.
- B. Storefront system and windows shall be erected plumb and true, in proper alignment and relation to established lines and grades.
- C. Entrance doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Weather stripping contact and hardware movement shall be checked and final adjustments made for proper operation and performance of units.
- D. Furnish and apply sealing materials to provide a weather tight installation at all joints and intersections and at opening perimeters.
- E. Sealing materials specified shall be used in strict accordance with the manufacturer's printed instructions, and shall be applied only by mechanics specially trained or experienced in their use. All surfaces must be clean and free of foreign matter before applying sealing materials. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.

3.3 Anchorage

- A. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

3.4 Protection and Cleaning

- A. The general contractor shall protect the aluminum materials and finish against damage from construction activities and harmful substances. The general contractor shall remove any protective coatings as directed by the architect, and shall clean the aluminum surfaces as recommended for the type of finish applied.
- B. A bi-annual sweetwater rinse is recommended to prohibit dirt, dust, and debris from accumulation on the surface of the coating and to help maintain the aesthetic of the coating.

END OF SECTION

SECTION 085113
ALUMINUM WINDOWS

PART 1 GENERAL

1.1 Work Included

- A. Furnish and install aluminum architectural windows complete with hardware and related components as shown on drawings and specified in this section.
- B. All windows shall be EFCO® System 403 Thermal Flush-Glazed Screw Spline Storefront. Other manufacturers requesting approval to bid their product as an equal must submit the following information fifteen days prior to close of bidding.
 - 1. A sample window, 24" (610 mm) x 36" (914 mm) single unit, as per requirements of architect.
 - a. Test reports documenting compliance with requirements of Section 1.05.
- C. Glass and Glazing
 - 1. All units shall be factory glazed.
- D. Single Source Requirement
 - 1. All aluminum doors and frames, storefront, and aluminum window products listed in Section 1.2 shall be by the same manufacturer.

1.2 Related Work

- A. Section 081116 – Aluminum Doors and Frames
- B. Section 084313 - Aluminum-Framed Storefronts
- C. Section 088000 - Glazing
- D. Section 087100 - Door Hardware

1.3 Laboratory Testing and Performance Requirements

- A. Test Units
 - 1. Air, water, and structural test unit shall conform to requirements set forth in AAMA/WDMA/CSA 101/I.S.2/A440 – 17 and manufacturer's standard locking/operating hardware and insulated glazing configuration.
 - 2. Thermal test unit sizes shall be 47.75" x 59". Unit shall consist of a single typical fixed window.
- B. Test Procedures and Performances
 - 1. Windows shall conform to all AAMA/WDMA/CSA 101/I.S.2/A440 – 17 requirements for the window type referenced in 1.01.B. In addition, the following specific performance requirements shall be met.
 - a. Air Infiltration Test
 - b. Test unit in accordance with ASTM E 283 at a static air pressure difference of 6.27 psf (300 Pa).
 - c. Air infiltration shall not exceed .10 cfm/SF (0.5 l/s•m²) of unit.
 - 2. Water Resistance Test
 - a. Test unit in accordance with ASTM E 331/ASTM E 547 at a static air pressure difference of 15.0 psf (720 Pa).

- b. There shall be no uncontrolled water leakage.
3. Uniform Load Structural Test
 - a. Test unit in accordance with ASTM E 330 at a static air pressure difference of 225.56 psf (10800 Pa), both positive and negative.
 - b. At conclusion of test there shall be no glass breakage or permanent damage.
4. Forced Entry Resistance
 - a. Window shall be tested in accordance to ASTM F 588 or AAMA 1303.5 and meet the requirements of performance level 40.
5. Condensation Resistance Test (CRF)
 - a. Test unit in accordance with AAMA 1503.1.
 - b. Condensation Resistance Factor (CRF) shall not be less than 75 (frame) when glazed with 0.24 center of glass U-Factor. (See chart at end of section).
6. Condensation Resistance (CR)
 - a. With ventilators closed and locked, test unit in accordance with NFRC 500-2014.
 - b. Condensation Resistance (CR) shall not be less than 53 when glazed with 0.24 center of glass U-Factor. (See chart at end of section).
7. Thermal Transmittance Test (Conductive U-Factor)
 - a. With ventilators closed and locked, test unit in accordance with NFRC 100-2014.
 - b. Conductive thermal transmittance (U-Factor) shall not be more than 0.35 BTU/hr•ft²•°F (1.87 W/m²•K) when glazed with 0.24 center of glass U-Factor. (See chart at end of section).

Glass Comparison Chart				
Glass	C.O.G. U-Factor	U-Factor	Frame CRF	CR
1" IG	0.48	0.54 BTU/hr•ft ² •°F (3.01 W/m ² •K)	75	43
1" IG	0.29	0.40 BTU/hr•ft ² •°F (2.16 W/m ² •K)	75	52
1" IG	0.24	0.35 BTU/hr•ft ² •°F (1.87 W/m ² •K)	75	53
1" IG	0.20	0.32 BTU/hr•ft ² •°F (1.70 W/m ² •K)	75	55

U-Factor and Condensation Resistance (CR) are based on a nominal size of 47" (1200 mm) x 59" (1500 mm) using NFRC-100, and 500 - 2014.

Center of Glass (C.O.G.) based on Intercept® Spacer.

Frame CRF is based on AAMA 1503.1

C. Project Wind Loads

1. The system shall be designed to withstand the following loads normal to the plane of the wall:
 - a. Positive pressure of 25 psf (1197.01 Pa) at non-corner zones.
 - b. Negative pressure of 25 psf (1197.01 Pa) at non-corner zones.
 - c. Negative pressure of 25 psf (1197.01 Pa) at corner zones.

1.4 Quality Assurance

- A. Provide test reports from AAMA accredited laboratories certifying the performance as specified in 1.05.
- B. Test reports shall be accompanied by the window manufacturer's letter of certification, stating the tested window meets or exceeds the referenced criteria for the appropriate

window type.

1.5 Submittals

- A. Contractor shall submit shop drawings; finish samples, test reports, installation instructions, and warranties.
 - 1. Samples of materials as may be requested without cost to owner, i.e., metal, glass, fasteners, anchors, frame sections, mullion section, corner section, etc.
- B. An NFRC Component Modeling Approach (CMA) generated label certificate shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the manufacturer's framing combined with the specified glass, and the glass spacer used in the fabrication of the glass, at NFRC standard test size as defined in table 4-3 in NFRC 100-2014.

1.6 Warranties

- A. Total Window Installation
 - 1. The responsible contractor shall assume full responsibility and warrant for one year the satisfactory performance of the total window installation which includes that of the windows, hardware, glass (including insulated units), glazing, anchorage and setting system, sealing, flashing, etc., as it relates to air, water, and structural adequacy as called for in the specifications and approved shop drawings.
 - 2. Any deficiencies due to such elements not meeting the specifications shall be corrected by the responsible contractor at their expense during the warranty period.
- B. Window Material and Workmanship
 - 1. Provide written guarantee against defects in material and workmanship for 10 years from the date of final shipment.
- C. Glass
 - 1. Provide written warranty for insulated glass units that they will be free from obstruction of vision as a result of dust or film formation on the internal glass surfaces caused by failure of the hermetic seal due to defects in material and workmanship.
 - 2. Warranty period shall be for 10 (ten) years.
- D. Finish
 - 1. Warranty period shall be for 15 years from the date of final shipment.
 - 2. Provide organic finish warranty based on AAMA standard 2605.

PART 2 PRODUCTS

2.1 Materials

- A. Aluminum
 - 1. Extruded aluminum shall be 6063-T6 alloy and tempered.
- B. Glass
 - 1. Insulated glass (Tinted) shall be 1" thick with a center of glass U-Factor of 0.24 constructed as follows:
 - a. Exterior lite – 1/4 inch thick, Solarbronze tinted, float glass (annealed, H.S. Temp), uncoated.
 - b. Space of 1/2 inch, argon filled.
 - c. Interior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), with low-E Solarban 70 coating on the number 3 surface.

2. Insulated glass (Untinted) shall be 1" thick with a center of glass U-Factor of 0.24 constructed as follows:
 - a. Exterior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), with a low-E Solarban 70 coating on the number 2 surface.
 - b. Space of 1/2 inch, argon filled.
 - c. Interior lite – 1/4 inch thick, clear color, float glass (annealed, H.S. Temp), uncoated.
 - C. Thermal Barrier
 1. All exterior aluminum shall be separated from interior aluminum by a rigid, structural thermal barrier. For purposes of this specification, a structural thermal barrier is defined as a system that shall transfer shear during bending and, therefore, promote composite action between the exterior and interior extrusions.
 2. The thermal barrier shall be thermal struts, consisting of glass reinforced polyamide nylon, mechanically crimped in raceways extruded in the exterior and interior extrusions.
 3. Pour and debridge urethane thermal barriers shall not be permitted.
- 2.2 Fabrication
- A. General
 1. All aluminum frame extrusions shall have a minimum wall thickness of .125" (3 mm).
 2. Depth of frame shall not be less than 4 1/2" (114 mm).
 - B. Frame
 1. Frame components shall be mechanically fastened.
 2. Frame components shall be mechanically fastened with screw spline construction
 - C. Glazing
 1. All units shall be glazed with the manufacturer's standard sealant process provided the glass is held in place by a removable, extruded aluminum, glazing bead. The glazing bead must be isolated from the glazing material by a gasket.
 2. All units shall be glazed with a minimum of 1/2" glass bite.
 - D. Finishes
 1. Organic
 - a. Liquid Fluoropolymer Aluminum Extrusion Coatings, AAMA 2605-20: Minimum 70 percent PVDF resin by weight, in color coat, and clear topcoat, if required. Color as selected from one of the following:
 - 1) Sherwin-Williams Coil Coatings Fluropon Color Card – Fluropon
 - 2) Sherwin-Williams Coil Coatings Metal Trends Color Card - Sherwin-Williams Coil Coatings Fluropon Color Card – Fluropon

PART 3 EXECUTION

- 3.1 Inspection
- A. Job Conditions
 1. Verify that openings are dimensionally within allowable tolerances, plumb, level, clean, provide a solid anchoring surface, and are in accordance with approved shop drawings.
 2. Provide for manufacturer representation to conduct pre-installation site meeting.

3.2 Installation

- A. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.
- B. Plumb and align window faces in a single plane for each wall plane, and erect windows and materials square and true. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.
- C. Furnish and apply sealants to provide a weather tight installation at all joints and intersections and at opening perimeters. Wipe off excess material and leave all exposed surfaces and joints clean and smooth.

3.3 Anchorage

- A. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.

3.4 Protection and Cleaning

- A. After completion of window installation, windows shall be inspected, adjusted, put into working order and left clean, free of labels, dirt, etc. Protection from this point shall be the responsibility of the General Contractor.
- B. A bi-annual sweet water rinse is recommended to prohibit dirt, dust, and debris from accumulation on the surface of the coating and to help maintain the aesthetic of the coating.

END OF SECTION

SECTION 085653
SECURITY WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Security transaction windows, including glazing, with pass-through device.

1.2 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- B. Section 092116 - Gypsum Board Assemblies: Bullet-resistant sheathing and wallboard for bullet-resistant partitions and walls.

1.3 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
- D. SSPC-Paint 33 - Coal-Tar Mastic Coating, Cold Applied 2015.
- E. UL 752 - Standard for Bullet-Resisting Equipment Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data showing materials, construction details, dimensions of components, installation instructions, and finishes.
- C. Shop Drawings: Drawings prepared specifically for this project, showing plans, elevations, sections, details of construction, anchorage to other work, hardware, and glazing.
 - 1. For new work show required opening dimensions and allowance for field deviation.
 - 2. For field glazed windows, include detailed instructions for glazing installation.
- D. Test Reports: Test reports for specific window model and glazing to be furnished, showing compliance with specified requirements; window and glazing may be tested separately, provided window test sample adequately simulates the glazing to be used.
 - 1. Include testing agency qualifications.
 - 2. For structural, forced entry, and ballistic tests, provide details on method of anchorage to test frame.
- E. Samples of Color Anodized Finishes: Frame member sections showing range of color to be expected in finished work.
- F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Firm with at least 5 years experience in the manufacture of windows of the type specified and able to provide test reports showing that their standard manufactured products meet the specified requirements; custom designed products not acceptable.
- B. Testing Agency Qualifications: Independent testing agency able to show experience in conducting tests of the type specified and:
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Security Transaction Windows with Pass-Through Device:
 - 1. Insulguard Security Products; BulletBlock 44/450 Window System, or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Security Glazing:
 - 1. Insulguard Security Products; SP 1.25 Level 3 Acrylic, or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- C. Provide windows from a single manufacturer.

2.2 ASSEMBLIES

- A. Security and Detention Windows:
 - 1. Dimensions, profiles, features, and performance specified and indicated on drawings are required; do not deviate unless specifically approved by Architect under substitution procedures specified in Section 016000.
 - 2. Design to fit openings indicated on drawings; design to accommodate deviation of actual construction from dimensions indicated on drawings.
 - 3. Fabricate frames and sash with corners mitered or coped full depth with concealed welded joints.
 - 4. Design anchorages to provide performance equivalent to that required for window unit; provide anchorages at least equivalent to those by which the tested units were anchored to the test frame.
 - 5. Separate dissimilar metals to prevent corrosion by galvanic action by painting contact surfaces with primer or with sealant or tape recommended by manufacturer for the purpose.
 - 6. Weld components before finishing and in concealed locations, to greatest extent possible; minimize distortion and discoloration of finish; remove residue of welding; grind exposed welds smooth and finish to match.
 - 7. Label units to indicate which side is which, such as inside/outside or secure/non-secure; use labels that are removable after installation but durable enough not to be lost during delivery, storage, handling, and installation.

2.3 SECURITY TRANSACTION WINDOWS WITH PASS-THROUGH DEVICE

- A. Security Transaction Windows with Pass-Through Device:
 - 1. Location: Built within interior wall, as indicated on drawings.
 - 2. Ballistic Resistance: Tested to meet UL 752, Level 3.
 - 3. Window Type: Fixed.
 - a. Overall Window Frame Size: As indicated on drawings.
 - b. Frame Material: Aluminum.
 - 1) Finish: Natural anodized.
 - 4. Glazing: Laminated, Acrylic and Polycarbonate, clear, and ballistic resistant.
 - 5. Pass-Through Device: Deal tray with bullet trap, recessed-mounted in counter below window.
 - a. Size: 12 inches x 8 inches x 1-1/2 inches deep
 - b. Material: Stainless steel.
 - 6. Communication: Standard talk-through portal.

2.4 ASSEMBLY COMPONENTS

- A. Aluminum Framing: ASTM B221 (ASTM B221M) extrusions of alloy and temper selected by manufacturer for strength, corrosion resistance, and finish required; not less than 1/8 inch thick at any location of frame and sash members.
- B. Frame Anchors: Mild steel plates, shapes, or bars, concealed in completed construction; provide anchorage devices as necessary to securely fasten windows to adjacent construction; use security fasteners for exposed anchors.
 - 1. Provide minimum of two anchors per side of window plus one additional anchor for each 18 inches or fraction thereof more than 36 inches in height or width.
- C. Glazing Seals: Factory installed; molded EPDM or neoprene compressible gaskets and compression strips.
- D. Bituminous Paint: Cold-applied asbestos-free asphalt mastic, complying with SSPC-Paint 33; 30 mils, 0.030 inch minimum thickness per coat.

2.5 FINISHES

- A. Fluoropolymer Finish: Cleaned and pretreated; two coat thermosetting finish containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with AAMA 2604; 1.5 to 2 mils thick, applied in accordance with paint manufacturer's recommendations; medium gloss.
- B. Color: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions and drawing details.
- B. Install windows in correct orientation (inside/outside or secure/non-secure).
- C. Anchor windows securely in manner so as to achieve performance specified.
- D. Separate metal members from concrete and masonry using bituminous paint.

- E. Set sill members and sill flashing in continuous bead of sealant.

END OF SECTION

SECTION 086300
METAL-FRAMED SKYLIGHTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum skylight framing system.
- B. Skylight glazing.
- C. Fasteners, anchors, reinforcement, and flashings.

1.2 REFERENCE STANDARDS

- A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- G. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.
- H. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
- I. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2018.
- J. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free 2007 (Reapproved 2018).
- K. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.
- L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014 (Reapproved 2021).
- M. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).

- N. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's specifications, standard details, and installation requirements.
- C. Shop Drawings: Indicate framed opening requirements and tolerances, spacing of members, anticipated deflection under load, affected related work, expansion and contraction joint locations and details, and sizes and locations for field welding.
 - 1. Show field measurements on shop drawings.
- D. Selection Samples: Submit full range of aluminum finish samples for Architect's color selection.
- E. Samples: Submit two samples, not less than 12 by 12 inches in size illustrating appearance of prefinished aluminum and specified glazing system, including glazed edge and corner.
- F. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations.
- G. Designer's Qualification Statement.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.

1.4 QUALITY ASSURANCE

- A. Designer Qualifications: Design skylight system under direct supervision of a professional engineer experienced in design of system type specified and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not fewer than three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the type of work specified in this section with at least three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal-Framed Skylights Manufacturers:
 - 1. Wasco Skylights - Part of the VELUX Group; Wasco Pinnacle Skylight System: www.wascoskylights.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 METAL-FRAMED SKYLIGHTS

- A. Metal Framed Skylights: Factory-fabricated, and glazed.
 - 1. Frame: Extruded aluminum structural members with integral condensation collection and guttering system thermally separated from exterior pressure bar.

2. Glazing System: Pressure glazing bar system for sloped joints and two (2)-sided structural sealant glazing (SSG) for horizontal joints.
3. Glazing: Insulating glass.
4. Aluminum Finish: High performance organic coatings.
5. Fabricate to prevent vibration harmonics, thermal movement transmitted to other building elements, and loosening, weakening, or fracturing of attachments or components of system.

2.3 PERFORMANCE REQUIREMENTS

- A. Provide metal-framed skylights that comply with the following:
 1. Structural Design: Design and size components to withstand dead loads and specified live loads without damage or permanent set.
 2. Wind Loads: Test in accordance with ASTM E330/E330M, using loads 1.5 times the specified design pressures and 10 second duration of maximum load.
 3. Design Pressure (DP): In accordance with applicable codes.
 4. Snow Load: 50 psf.
 5. Glazing Support Member Deflection Under Wind Load: 1/180 of span, maximum.
 6. Thermal Movement: Design system to accommodate thermal expansion and contraction over ambient temperature range of 100 degrees F, dynamic loading and release of loads, creep of concrete structural members and deflection of structural support framing without damage to skylight system components or loss of weathertightness.
 7. Energy Code Compliance: Comply with ICC (IBC), ASHRAE Std 90.1 I-P, or the authorities having jurisdiction as required for metal-framed skylights.
 8. Air Leakage: 0.30 cfm/sq ft maximum leakage when tested at 1.57 psf pressure difference in accordance with ASTM E283/E283M.
 9. Water Penetration: None, when measured in accordance with ASTM E331 at a test pressure difference of 2.86 pounds per square foot.

2.4 MATERIALS

- A. Aluminum Extrusions: Alloy and temper 6063-T5, 6063-T6, or 6061-T6 members complying with ASTM B221 (ASTM B221M), with minimum thickness 1/8 inch for structural members and 1/16 inch for non-structural members.
- B. Formed Aluminum: Sheet material of alloy 5052, 5005, or 6061-T651 members complying with ASTM B209 (ASTM B209M), with minimum thickness 1/8 inch for structural members and 1/16 inch for non-structural members.
- C. Internal Reinforcement: ASTM A36/A36M Steel shapes as required for strength and mullion size limitations, hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
- D. Insulating Glass: Sealed insulated units, outer pane of clear transparent, tempered glass; inner pane of clear transparent, laminated glass; space of sealed air, metal edge frame.
 1. Exterior Lite: 1/4 inch Vitro Architectural Glass, Solarban 70 with Low-E coating on surface #2
 2. Air space: 1/2 inch hermetically sealed air gap
 3. Interior Lite: 5/16 inch laminated glazing, consisting of 2 layers of 1/8 inch clear glass with PVB interlayer.
- E. Glazing Accessories: As recommended by manufacturer of skylight system.
- F. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; compatible with glazing accessories.

- G. Touch-Up Primer for Galvanized Steel Surfaces: Zinc rich type.
- H. Protective Back Coating: Asphaltic mastic, ASTM D4479/D4479M Type I.
- I. Fasteners: Stainless steel.
- J. Flashing: Matching finish of skylight frame system components; secure using un-concealed fastening method, and seal with weather-tight sealant.
 - 1. Aluminum sheet, 20 gauge, 0.032 inch minimum thickness.

2.5 FABRICATION

- A. Rigidly fit and secure joints and corners with screw and spline; fabricate rigid joints with connections that are flush, hairline, and weatherproof.
- B. Fabricate components to allow for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly.
- C. Drain to exterior any water entering exterior joints, condensation occurring in glazing channels, or migrating moisture occurring within system.
- D. Prepare components to receive concealed anchorage devices, and ensure that fasteners will be concealed upon completion of installation.

2.6 FINISHES

- A. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system; both interior and exterior surfaces.
- B. Color: To be selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that structural curb is ready to receive skylight system. Coordinate installation of roofing and other adjacent work to ensure weathertight construction.

3.2 PREPARATION

- A. Apply single coat of protective coating to concealed aluminum and steel surfaces in contact with dissimilar materials.

3.3 INSTALLATION

- A. Install metal-framed skylights in accordance with manufacturer's instructions.
- B. Set skylight structure plumb, level, and true to line, without warp or rack of frames or glazing panels. Anchor securely in place in accordance with approved shop drawings.
- C. Maintain assembly dimensional tolerances, aligning with adjacent work.
- D. Install base flashings in accordance with Section 076200.
- E. Pack fibrous insulation in shim spaces at perimeter of assembly to ensure continuity of thermal barrier.

- F. Touch up damaged finishes so repair is imperceptible from 6 feet distance, and remove and replace components that cannot be acceptably touched up.

3.4 TOLERANCES

- A. Maximum Variation from Plumb, Level, or Line: 1/8 inch per 10 feet, or 3/8 inch total in overall dimension.
- B. Alignment of Two Adjoining Members Abutting in Plane: Within 1/16 inches.

3.5 FIELD QUALITY CONTROL

- A. Provide services of metal-framed skylight manufacturer's field representative to observe for proper installation of system and submit report.

3.6 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed surfaces; wipe surfaces clean.

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes commercial door hardware for the following:
1. Swinging doors.
 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
1. Mechanical door hardware.
 2. Electromechanical door hardware.
 3. Automatic operators.
 4. Cylinders specified for doors in other sections.
 5. Controllers, actuators and safety devices.
- C. Related Sections:
1. Division 08 Section "Hollow Metal Doors and Frames".
 2. Division 08 Section "Flush Wood Doors".
 3. Division 08 Section "Aluminum-Framed Storefronts".
 4. Division 08 Section "Fire-Rated Aluminum Full-Vision Doors and Frames"
 5. Division 08 Section "Aluminum Doors and Frames"
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. ICC/IBC - International Building Code.
 3. NFPA 70 - National Electrical Code.
 4. NFPA 80 - Fire Doors and Windows.
 5. NFPA 101 - Life Safety Code.
 6. NFPA 105 - Installation of Smoke Door Assemblies.
 7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
 8. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
1. ANSI/BHMA Certified Product Standards - A156 Series.
 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
 3. ANSI/UL 294 - Access Control System Units.
 4. UL 305 - Panic Hardware.

1.3 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
 - 3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 - h. Warranty information for each product.
 - 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
 - 1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 - c. Wiring instructions for each electronic component scheduled herein.
 - 2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
 - 1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a

qualified independent testing agency.

- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

- I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.

- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
 - 1. Ten years for mortise locks and latches.
 - 2. Five years for exit hardware.
 - 3. Twenty five years for manual overhead door closer bodies.
 - 4. Five years for motorized electric latch retraction exit devices.
 - 5. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
 - 1. Quantity: Provide the following hinge quantity:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
 - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
 - b. Sizes from 3'1" to 4'0": 5" heavy weight.
 - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.

- b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
 - 4. Hinge Options: Comply with the following:
 - a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging, lockable doors.
 - 5. Manufacturers:
 - a. Bommer Industries (BO).
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
- B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs. Coordinate with aluminium door manufacturer and provide custom screw pattern where required.
 - 1. Manufacturers:
 - a. Bommer Industries (BO).
 - b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
- C. Pin and Barrel Continuous Hinges: ANSI/BHMA A156.26 Grade 1-600 certified pin and barrel continuous hinges with minimum 14 gauge Type 304 stainless steel hinge leaves, concealed stainless pin, and twin self-lubricated nylon bearings at each knuckle separation. Factory trim hinges to suit door height and prepare for electrical cut-outs.
 - 1. Manufacturers:
 - a. Markar Products; ASSA ABLOY Architectural Door Accessories (MR).
 - b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
 - 1. Manufacturers:
 - a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) - EL-CEPT Series.
 - b. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
 - 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
 - b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.
 - 2. Manufacturers:
 - a. Hager Companies (HA) - Quick Connect.

- b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.
 - 1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
 - 2. Furnish dust proof strikes for bottom bolts.
 - 3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
 - 4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 - 5. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).
- B. Coordinators: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
 - 1. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 - 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
 - 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 - 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 - 4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 - 5. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).

2.5 CYLINDERS AND KEYING

- A. Construction Keying: Provide construction master keyed cylinders.
- B. Key Registration List (Bitting List):
 - 1. Furnish a list of opening numbers with locking devices, showing cylinder types and quantities required when cylinders or cores are to be owner furnished.

2.6 KEY CONTROL

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Manufacturers:
 - a. Lund Equipment (LU).

- b. MMF Industries (MM).
- c. Telkee (TK).

2.7 MECHANICAL LOCKS AND LATCHING DEVICES

- A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
 - 1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ML2000 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.

2.8 ELECTROMECHANICAL LOCKING DEVICES

- A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below and in the hardware sets.
 - 1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.
 - 2. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ML20900 Series.
 - b. Sargent Manufacturing (SA) - 8200 Series.

2.9 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
 - 4. Short-lipped strikes: For locks at double doors with astragals.
- B. Standards: Comply with the following:
 - 1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
 - 4. Dustproof Strikes: BHMA A156.16.

2.10 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
 - 1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
3. Except on fire rated doors, provide exit devices with key cylinder dogging device to hold the pushbar and latch in a retracted position.
4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
5. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Extended cycle test: Devices to have been cycle tested to 9 million cycles.
11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.

2.11 ELECTROMECHANICAL EXIT DEVICES

- A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.
1. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.
 2. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.
 3. Manufacturers:
 - a. Corbin Russwin Hardware (RU) - ED5000 Series.
 - b. Sargent Manufacturing (SA) - 80 Series.

2.12 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
 2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 3. Cycle Testing: Provide closers which have surpassed 15 million cycles.
 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
 7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
1. Manufacturers:
 - a. Norton Door Controls (NO) - 7500 Series.
 - b. Sargent Manufacturing (SA) - 351 Series.

2.13 ELECTROHYDRAULIC DOOR OPERATORS

- A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Standard: Certified ANSI/BHMA A156.19.
- C. Performance Requirements:
1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
 2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.
- D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.
- E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

- F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Norton Door Controls (NO) - 6000 Series.

2.14 ARCHITECTURAL TRIM

- A. Door Protective Trim
 - 1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
 - 2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
 - 3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
 - 4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
 - a. Stainless Steel: 300 grade, 050-inch thick.
 - 5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
 - 6. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).

2.15 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Manufacturers:
 - a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
 - b. Trimco (TC).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed

design with mounting brackets as required for proper operation and function. Coordinate with aluminium door manufacturer and provide low-profile stop where required.

1. Manufacturers:
 - a. Rixson Door Controls (RF).
 - b. Sargent Manufacturing (SA).

2.16 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
 1. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
 2. Reese Enterprises, Inc. (RE).

2.17 ELECTRONIC ACCESSORIES

- A. Switching Power Supplies: Provide power supplies with either single or dual voltage configurations at 12 or 24VDC. Power supplies shall have battery backup function with an integrated battery charging circuit and shall provide capability for power distribution, direct lock control and Fire Alarm Interface (FAI) through add on modules. Power supplies shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs.
 1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 2. Manufacturers:
 - a. Securitron (SU) - AQD Series.

2.18 CONTROLLERS, ACTUATORS, AND SAFETIES

- A. Push Plate Actuator:
 1. Standard wall mounted, surface mounted, momentary contact type; satin stainless steel plate; 4 inch x 4 inch square, labeled PUSH.
 2. Stancion mounted, recessed mounted, momentary contact type; satin stainless steel plate; 4 inch x 4 inch square, labeled PUSH.

a. Stancion Manufacturers:

- 1) WIKK Industries, Inc.; 6169A Industrial Court; Greendale, WI 53129; 877-421-9490; www.wikk.com.
- 2) Basis of Design: Bollard RD4
 - a) 6 inches diameter x 0.125 inches wall thickness; 316 Stainless Steel; US32D Satin Polished finish
 - b) 48 inches high with welded angled top (45 deg) towards front
 - c) Prep front for recessed mounted actuator and intercom where indicated on drawings.
 - d) Surface mounted with concealed mounting base

2.19 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.20 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
 - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
 - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
 - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
 - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.5 CLEANING AND PROTECTION

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.6 DEMONSTRATION

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.7 DOOR HARDWARE SETS

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for

proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. MR - Markar
4. RO - Rockwood
5. RU - Corbin Russwin
6. RF - Rixson
7. NO - Norton
8. HD - HID
9. SU - Securitron

HARDWARE SETS

SET: 1.0 :

DOORS 152B, 156B

DESCRIPTION: EXTERIOR ALUM PAIR

2	CONTINUOUS HINGE	DFM-HD1 EL-CEPTX10B SERIES		PE
1	EXIT DEVICE (CVR,NL,EL,RX,CD)	ED4800 O859ET M92 MELR M52	612	RU
1	EXIT DEVICE (CVR,RX,CD)	ED4800 EO M92 M52	612	RU
3	PERMANENT CYLINDER	BY OWNER		
2	PULL	P12	612	RU
2	CONC OVERHEAD STOP	1-X36	612	RF
2	SURFACE CLOSER	R/PR/J 7500	691	NO
1	THRESHOLD (COORD W/ DETAILS)	274X292DFGPK FHSL14SS PEMKOTE		PE
2	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
2	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
2	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		
1	WEATHER / PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY		

Notes: Operation: Doors are closed and unlocked during normal business hours. Monitoring by door position switches. Free egress at all times. Depressing pushrail will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 2.0

DOORS 152A, 156A

DESCRIPTION: EXTERIOR ALUM PAIR - CARD ACCESS; AUTO

2	CONTINUOUS HINGE	DFM-HD1 EL-CEPTX10B SERIES	PE
1	EXIT DEVICE (CVR,NL,EL,RX,LX,CD)	ED4800 O859ET M91 M92 MELR M52	612 RU
1	EXIT DEVICE (CVR,RX,CD)	ED4800 EO M92 M52	612 RU
3	PERMANENT CYLINDER	BY OWNER	
2	PULL	P12	612 RU
2	CONC OVERHEAD STOP	1-X36	612 RF
1	SURFACE CLOSER	R/PR/J 7500	691 NO
1	AUTOMATIC OPENER	6061; 6071 D (DARK BRONZE)	690 NO
1	THRESHOLD (COORD W/ DETAILS)	274X292DFGPK FHSL14SS PEMKOTE	PE
2	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)	MK
2	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)	MK
1	WIRING DIAGRAM	BY SECURITY VENDOR	
2	DOOR SWITCH	501	NO
1	CARD READER	BY SECURITY VENDOR	HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)	SU
2	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR	
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY	

Notes: Operation: Doors are closed and unlocked during normal business hours. After hours, valid card at reader retracts latch for momentary or extended access, then enables outside actuator. Inside actuator retracts latch, then auto opens door. Monitoring by door position switch. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection/suppression systems are activated. Depressing pushrail will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 2.1

DOORS: 170

DESCRIPTION: EXTERIOR ALUM PAIR - AUTO

2	CONTINUOUS HINGE	DFM-HD1 SERIES		PE
1	EXIT DEVICE (CVR, CD)	ED4800 EO M52	612	RU
1	EXIT DEVICE (CVR,NL,CD)	ED4800 O859ET M52	612	RU
4	PERMANENT CYLINDER	BY OWNER		
1	CYLINDER	TO SUIT DEVICE	612	
2	PULL	P12	612	RU
2	CONC OVERHEAD STOP	1-X36	612	RF
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	AUTOMATIC OPENER	6061; 6071 D (DARK BRONZE)	690	NO
1	THRESHOLD (COORD W/ DETAILS)	274X292DFGPK FHSL14SS PEMKOTE		PE
1	WIRING DIAGRAM	BY SECURITY VENDOR		
2	DOOR SWITCH	501		NO
1	KEYSWITCH	MKA		SU
2	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY		

Notes: Exit devices must be dogged manually for auto operator to function. Key switch turns operator on/off.

SET: 3.0

DOORS 157B

DESCRIPTION: EXTERIOR ALUM PAIR - EXIT ONLY

2	CONTINUOUS HINGE	DFM-HD1 SERIES		PE
2	EXIT DEVICE (CVR,LD)	ED4800 EO M51	612	RU
2	CONC OVERHEAD STOP	1-X36	612	RF
2	SURFACE CLOSER	R/PR/J 7500	691	NO
1	THRESHOLD (COORD W/ DETAILS)	274X292DFGPK FHSL14SS PEMKOTE		PE
2	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY		

SET: 3.1

DOORS 171C

DESCRIPTION: EXTERIOR ALUM - EXIT ONLY

1	CONTINUOUS HINGE	DFM-HD1 SERIES		PE
1	EXIT DEVICE (RIM, LD)	ED4200 EO M51	612	RU
1	CONC OVERHEAD STOP	1-X36 612 RF		
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	THRESHOLD (COORD W/ DETAILS)	274X292DFGPK FHSL14SS PEMKOTE		PE
1	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY		

SET: 4.0

DOORS: 100B, 100D

DESCRIPTION: INTERIOR ALUM PAIR - CARD ACCESS

2	CONTINUOUS HINGE	DFM-HD1 EL-CEPTX10B SERIES	PE
1	EXIT DEVICE (CVR,NL,EL,RX,CD)	ED4800 O859ET M92 MELR M52	612 RU
1	EXIT DEVICE (CVR,RX,CD)	ED4800 EO M92 M52	612 RU
3	PERMANENT CYLINDER	BY OWNER	
2	PULL	P12	612 RU
2	CONC OVERHEAD STOP	1-X36	612 RF
2	SURFACE CLOSER	R/PR/J 7500	691 NO
1	THRESHOLD (COORD W/ DETAILS)	272D FHSL14SS PEMKOTE	PE
2	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)	MK
2	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)	MK
1	WIRING DIAGRAM	BY SECURITY VENDOR	
1	CARD READER	BY SECURITY VENDOR	HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)	SU
2	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR	
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY	

Notes: Operation: Doors are closed and unlocked during normal business hours. After hours, valid card at reader retracts latches for momentary or extended access. Monitoring by door position switches. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection / suppression systems are activated. Depressing pushrail will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 5.0

DOORS: 100A, 100C

DESCRIPTION: INTERIOR ALUM PAIR - CARD ACCESS; AUTO

2	CONTINUOUS HINGE	DFM-HD1 EL-CEPTX10B SERIES	PE
1	EXIT DEVICE (CVR,NL,EL,RX,LX,CD)	ED4800 O859ET M91 M92 MELR M52	612 RU
1	EXIT DEVICE (CVR,RX,CD)	ED4800 EO M92 M52	612 RU
3	PERMANENT CYLINDER	BY OWNER	
2	PULL	P12	612 RU
2	CONC OVERHEAD STOP	1-X36	612 RF
1	SURFACE CLOSER	R/PR/J 7500	691 NO
1	AUTOMATIC OPENER	6061; 6071 D (DARK BRONZE)	690 NO
1	THRESHOLD (COORD W/ DETAILS)	272D FHSL14SS PEMKOTE	PE
2	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)	MK
2	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)	MK
1	WIRING DIAGRAM	BY SECURITY VENDOR	
2	DOOR SWITCH	501	NO
1	CARD READER	BY SECURITY VENDOR	HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)	SU
2	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR	
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY	

Notes: Operation: Doors are closed and unlocked during normal business hours. After hours, valid card at reader retracts latch for momentary or extended access, then enables outside actuator. Inside actuator retracts latch, then auto opens door. Monitoring by door position switch. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection/suppression systems are activated. Depressing pushrail will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 5.1

DOORS: 184A, 185A

DESCRIPTION: ALUMINUM PAIR - PUSH-PULL; AUTO

2	CONTINUOUS HINGE	DFM-HD1 SERIES		PE
2	FIXED PUSHBAR	ED5000DB EO	612	RU
2	PULL	P12	612	RU
2	CONC OVERHEAD STOP	1-X36	612	RF
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	AUTOMATIC OPENER	6061; 6071 D (DARK BRONZE)	690	NO
1	THRESHOLD (COORD W/DETAILS)	272D FHSL14SS PEMKOTE		PE
2	DOOR SWITCH	501		NO
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY		

SET: 5.2

DOORS: 184B, 185B

DESCRIPTION: ALUMINUM PAIR - PUSH-PULL

2	CONTINUOUS HINGE	DFM-HD1 SERIES		PE
2	FIXED PUSHBAR	ED5000DB EO	612	RU
2	PULL	P12	612	RU
2	CONC OVERHEAD STOP	1-X36	612	RF
2	SURFACE CLOSER	R/PR/J 7500	691	NO
1	THRESHOLD (COORD W/DETAILS)	272D FHSL14SS PEMKOTE		PE
1	WEATHER/PERIMETER SEALS	SUPPLIED WITH DOOR/FRAME ASSEMBLY		

SET: 6.0

DOORS: 001C, 003A

DESCRIPTION: EXTERIOR STAIR - CARD ACCESS

1	CONTINUOUS HINGE	FM300 EL-CEPTX10B	PC	MR
1	EXIT DEVICE (RIM, FAIL SECURE, RX)	ED5200A 1259905ET M92	612	RU
1	PERMANENT CYLINDER	BY OWNER		
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	THRESHOLD (COORD W/ DETAILS)	274X292DFGPK FHSL14SS PEMKOTE		PE
1	HEAD & JAMB GASKETING	2891DPK		PE
1	SWEEP	315DN		PE
1	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
1	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
1	WIRING DIAGRAM	BY SECURITY VENDOR		
1	CARD READER	BY SECURITY VENDOR		HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)		SU
1	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		

Notes: Operation: Door is normally closed and locked. Valid card at reader unlocks outside lever for momentary access. Monitoring by door position switch. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection/suppression systems are activated. Depressing pushrail will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 7.0

DOORS: 304, 219, R001

DESCRIPTION: EXTERIOR ROOF - CARD ACCESS (BOTH DIRECTIONS)

1	CONTINUOUS HINGE	DFM-HD1 EL-CEPTX10B SERIES		PE
1	FAIL SAFE LOCK (BOTH DIRECTIONS)	ML20932-SAF 125X M91	612	RU
2	PERMANENT CYLINDER	BY OWNER		
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	THRESHOLD (COORD W/ DETAILS)	274X292DFGPK FHSL14SS PEMKOTE		PE
1	HEAD & JAMB GASKETING	2891DPK		PE
1	SWEEP	315DN		PE
1	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
1	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
1	WIRING DIAGRAM	BY SECURITY VENDOR		
2	CARD READER	BY SECURITY VENDOR		HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)		SU
1	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		

Notes: Function should be reviewed with code official. Operation: Door is normally closed and locked. Valid card at reader from both directions unlocks lever for momentary access. Monitoring by door position switch. During a loss of power the door will unlock. Free egress at all times. Lock status will change to unlocked when the fire detection/suppression systems are activated. Key override from both directions.

SET: 8.0 NOT USED

SET: 9.0

DOORS: 001B, 002B, 003, 151

DESCRIPTION: STAIR; CORRIDOR - PASSAGE

3	HINGE, FULL MORTISE, HVY WT	T4A3786	US10	MK
1	EXIT DEVICE (RIM, PASSAGE)	ED5200A 125910ET	612	RU
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	HEAD & JAMB GASKETING	S88BL		PE

SET: 10.0

DOORS: 153

DESCRIPTION: FIRE RATED ALUM DOOR ASSEMBLY - AUTO

2	PERMANENT CYLINDER	BY OWNER		
1	AUTOMATIC OPENER	6061; 6071 D (DARK BRONZE)	690	NO
2	DOOR SWITCH	501		NO
1	HARDWARE	SUPPLIED WITH DOOR ASSEMBLY		

Notes: Fire door assembly hardware unlatches when auto operator is used. Doors must close and latch upon signal from fire alarm.

SET: 11.0

DOORS: 157C, 157D

DESCRIPTION: BOARDROOM PAIR - CARD ACCESS

6	HINGE, FULL MORTISE, HVY WT	T4A3786	US10	MK
2	EXIT DEVICE (CVR,LBR,NL,EL,RX)	ED5860B 125959ET M55 M92 MELR	612	RU
2	PERMANENT CYLINDER	BY OWNER		
2	SURFACE CLOSER	R/PR/J 7500	691	NO
2	KICK PLATE	K1050 10" CSK BEV	US10	RO
2	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	HEAD & JAMB GASKETING	S88BL		PE
1	MEETING STILE	S772BL		PE
2	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
2	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
1	WIRING DIAGRAM	BY SECURITY VENDOR		
1	CARD READER	BY SECURITY VENDOR		HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)		SU
2	ELECTRIC POWER TRANSFER	EL-CEPT	10B	SU
2	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		

Notes: Opening will require HM transom bar as part of frame. Operation: Doors are normally closed and locked. Valid card at reader retracts latch for momentary or extended access. Monitoring by door position switches. During a loss of power the door will default to secure. Free egress at all times. Lock status will change to latched and locked when the fire detection / suppression systems are activated. Depressing pushrail will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 12.0

DOORS: 166, 167, 172, 179C, 182, 206A

DESCRIPTION: BULLET RESISTANT - CARD ACCESS

1	CONTINUOUS HINGE	FM3500 EL-CEPTX10B SECURITY STUDS	PC	MR
1	FAIL SECURE LOCK	ML20906-SEC 125X M92	612	RU
1	PERMANENT CYLINDER	BY OWNER		
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	THRESHOLD (COORD W/ DOOR MFR)	2716D PEMKOTE FHSL14SS		PE
1	HEAD & JAMB GASKETING	S88BL		PE
1	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
1	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
1	WIRING DIAGRAM	BY SECURITY VENDOR		
1	CARD READER	BY SECURITY VENDOR		HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)		SU
1	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		

Notes: Coordinate hardware with door mfr. Provide remote release switch (by Security) for doors 167 and 182. Operation: Door is normally closed and locked. Valid card at reader (or signal from remote release where required) unlocks outside lever for momentary access. Monitoring by door position switch. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection/suppression systems are activated. Rotating inside lever will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 13.0

DOORS: 001A, 002A, 171A

DESCRIPTION: ASSEMBLY; STAIR DISCHARGE - CARD ACCESS

1	HINGE, FULL MORTISE, HVY WT	T4A3786	US10	MK
1	EXIT DEVICE (RIM, FAIL SECURE, RX)	ED5200A 1259905ET M92	612	RU
1	PERMANENT CYLINDER	BY OWNER		
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	HEAD & JAMB GASKETING	S88BL		PE
1	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
1	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
1	WIRING DIAGRAM	BY SECURITY VENDOR		
1	CARD READER	BY SECURITY VENDOR		HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)		SU
1	ELECTRIC POWER TRANSFER	EL-CEPT	10B	SU
1	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		

Notes: Operation: Door is normally closed and locked. Valid card at reader unlocks outside lever for momentary access. Monitoring by door position switch. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection/suppression systems are activated. Depressing pushrail will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 14.0

DOORS: 200, 303, 306, 307A, 309

DESCRIPTION: DOUBLE - CARD ACCESS

6	HINGE, FULL MORTISE, HVY WT	T4A3786	US10	MK
2	SELF-LATCHING FLUSH BOLT	2945	US10	RO
2	DUST PROOF STRIKE	570	US10	RO
1	FAIL SECURE LOCK	ML20906-SEC 125X M92	612	RU
2	PERMANENT CYLINDER	BY OWNER		
1	COORDINATOR	1700	BLACK	RO
2	SURFACE CLOSER	R/PR/J 7500	691	NO
2	KICK PLATE	K1050 10" CSK BEV	US10	RO
2	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	THRESHOLD (COORD W/ DETAILS)	272D FHSL14SS PEMKOTE		PE
1	HEAD & JAMB GASKETING	S88BL		PE
1	ASTRAGAL	357D		PE
1	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
1	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
1	WIRING DIAGRAM	BY SECURITY VENDOR		
1	CARD READER	BY SECURITY VENDOR		HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)		SU
2	ELECTRIC POWER TRANSFER	EL-CEPT	10B	SU
1	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		

Notes: Operation: Door is normally closed and locked. Valid card at reader unlocks outside lever for momentary access. Monitoring by door position switch. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection/suppression systems are activated. Rotating inside lever will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 15.0

DOORS: 149, 160, 161A, 161B, 171B, 172A, 183, 202A, 205A, 206C, 214, 223, 225, 305, 307B, 308

DESCRIPTION: SINGLE - CARD ACCESS

3	HINGE, FULL MORTISE, HVY WT	T4A3786	US10	MK
1	FAIL SECURE LOCK	ML20906-SEC 125X M92	612	RU
1	PERMANENT CYLINDER	BY OWNER		
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	HEAD & JAMB GASKETING	S88BL		PE
1	FRAME WIRE HARNESS	QC-CXXXP (JAMB TO J-BOX)		MK
1	DOOR WIRE HARNESS	QC-CXXX (JAMB TO DEVICE)		MK
1	WIRING DIAGRAM	BY SECURITY VENDOR		
1	CARD READER	BY SECURITY VENDOR		HD
1	POWER SUPPLY	AQD SERIES (RELAYS AS REQUIRED)		SU
1	ELECTRIC POWER TRANSFER	EL-CEPT	10B	SU
1	DOOR CONTACT (CONCEALED)	BY SECURITY VENDOR		

Notes: Operation: Door is normally closed and locked. Valid card at reader unlocks outside lever for momentary access. Monitoring by door position switch. During a loss of power the door will default to secure. Free egress at all times. Lock status will not change when the fire detection/suppression systems are activated. Rotating inside lever will activate request to exit switch for appropriate monitor by EAC systems. Outside key override.

SET: 16.0

DOORS: 164, 173, 176, 177A, 207, 208, 209, 210, 211, 212, 213, 215, 216, 217, 218B, 222, 229

DESCRIPTION: OFFICE

3	HINGE, FULL MORTISE	TA2714	US10	MK
1	ENTRANCE LOCK	ML2053 125X	612	RU
1	PERMANENT CYLINDER	BY OWNER		
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
3	SILENCER	608-RKW		RO

SET: 17.0

DOORS: 004A, 004B, 161C, 202B, 205B, 301, 302

DESCRIPTION: CONVENIENCE STAIR; HALL; CONFERENCE; BREAK - PASSAGE

3	HINGE, FULL MORTISE, HVY WT T4A3786	US10	MK
1	PASSAGE LATCH ML2010 125X	612	RU
1	SURFACE CLOSER R/PR/J 7500	691	NO
1	KICK PLATE K1050 10" CSK BEV	US10	RO
1	DOOR STOP 401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	HEAD & JAMB GASKETING S88BL		PE

SET: 18.0

DOORS: 004C, 148, 157A, 157E, 162, 168, 169, 224, 226

DESCRIPTION: STORAGE; FILES; JAN CLOSET; ELEC; IT

3	HINGE, FULL MORTISE, HVY WT T4A3786	US10	MK
1	STOREROOM LOCK ML2057 125X	612	RU
1	SURFACE CLOSER R/PR/J 7500	691	NO
1	KICK PLATE K1050 10" CSK BEV	US10	RO
1	DOOR STOP 401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	HEAD & JAMB GASKETING S88BL		PE

SET: 18.1

DOORS: 019A, 179A, 179B

DESCRIPTION: IT; ELEC CLOSET PAIR

6	HINGE, FULL MORTISE, HVY WT.	T4A3786	US10	MK
1	DUST PROOF STRIKE	570	US10	RO
2	FLUSH BOLT	555	US10	RO
1	STOREROOM LOCK	ML2057 125X	612	RU
1	SURFACE CLOSER	R/PR/J 7500	691	NO
2	KICK PLATE	K1050 10" CSK BEV	US10	RO
2	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
1	HEAD & JAMB GASKETING	S88BL		PE
1	ASTRAGAL	357D		PE
1	MEETING STILE	S772BL		PE

SET: 19.0

DOORS: 206B, 218A

DESCRIPTION: CLOSET PAIR - PASSAGE

6	HINGE, FULL MORTISE	TA2714	US10	MK
2	DUST PROOF STRIKE	570	US10	RO
2	FLUSH BOLT	555	US10	RO
1	PASSAGE LATCH	ML2010 125X	612	RU
2	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
2	SILENCER	608-RKW		RO

SET: 20.0

DOORS: 145A, 166A

DESCRIPTION: CLOSET

3	HINGE, FULL MORTISE	TA2714	US10	MK
1	STOREROOM LOCK	ML2057 125X	612	RU
1	PERMANENT CYLINDER	BY OWNER		
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
3	SILENCER	608-RKW		RO

SET: 21.0

DOORS: 154, 155, 180, 181, 203, 204

DESCRIPTION: RESTROOM

3	HINGE, FULL MORTISE, HVY WT	T4A3786	US10	MK
1	PULL PLATE	111X70C	US10	RO
1	PUSH PLATE	70F	US10	RO
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
3	SILENCER	608-RKW		RO

SET: 22.0

DOORS: 163, 201, 221, 311, 312

DESCRIPTION: PRIVATE RESTROOM

3	HINGE, FULL MORTISE, HVY WT	T4A3786	US10	MK
1	PRIVACY LOCK	ML2060 125X M19VN	612	RU
1	SURFACE CLOSER	R/PR/J 7500	691	NO
1	KICK PLATE	K1050 10" CSK BEV	US10	RO
1	DOOR STOP	401; 404; 441CU; OVERHEAD AS REQ'D	US10	RO
3	SILENCER	608-RKW		RO
1	COAT HOOK	RM802	US10B	RO

END OF SECTION

SECTION 088000
GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Plastic sheet glazing units.
- D. Glass coatings.

1.2 RELATED REQUIREMENTS

- A. Section 081116 - Aluminum Doors and Frames: Glazing furnished as part of entrance assembly
- B. Section 081116.01 - FireRated Aluminum Full-Vision Doors and Frames: Glazing furnished as part of entrance assembly
- C. Section 081213 - Hollow Metal Frames: Glazed borrowed lites.
- D. Section 081416 - Flush Wood Doors: Glazed lites in doors.
- E. Section 084313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.
- F. Section 085113 - Aluminum Windows: Glazing furnished by window manufacturer.
- G. Section 085653 - Security Windows: Bullet-resistant glazing furnished by window manufacturer.
- H. Section 086300 - Metal-Framed Skylights: Glazing furnished as part of skylight assembly.
- I. Section 088723 - Safety and Security Films.
- J. Section 102800 - Toilet, Bath, and Laundry Accessories: Mirrors.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- C. ASTM C1036 - Standard Specification for Flat Glass 2021.
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass 2019.
- F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021.

- G. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
 - H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
 - I. ASTM E413 - Classification for Rating Sound Insulation 2016.
 - J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
 - K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.
 - L. GANA (GM) - GANA Glazing Manual 2008.
 - M. GANA (SM) - GANA Sealant Manual 2008.
 - N. GANA (LGRM) - Laminated Glazing Reference Manual 2009.
 - O. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - P. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2016).
 - Q. ITS (DIR) - Directory of Listed Products current edition.
 - R. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
 - S. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2017.
 - T. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014, with Errata (2017).
 - U. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2017.
 - V. UL (DIR) - Online Certifications Directory Current Edition.
 - W. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.
 - X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
 - Y. UL 263 - Standard for Fire Tests of Building Construction and Materials Current Edition, Including All Revisions.
 - Z. UL 752 - Standard for Bullet-Resisting Equipment Current Edition, Including All Revisions.
- 1.4 SUBMITTALS
- A. See Section 013000 - Administrative Requirements, for submittal procedures.
 - B. Product Data on Insulating Glass Unit, Glazing Unit, and Plastic Sheet Glazing Unit
Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
 - C. Samples: Submit two samples 12 by 12 inch in size of glass units.

- D. Certificate: Certify that products of this section meet or exceed specified requirements.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.
- D. Polycarbonate Sheet Glazing: Provide a five (5) year manufacturer warranty to include coverage for breakage, coating failure, abrasion resistance, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Laminated Glass Manufacturers:
 - 1. Cardinal Glass Industries: www.cardinalcorp.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- C. Fire-Resistance-Rated Glass: Provide products as required to achieve indicated fire-rating period.
 - 1. Manufacturers:
 - a. Technical Glass Products; FireLite Plus and FireLite IGU: www.fireglass.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- D. Mirrored Glass Manufacturers:

1. Pilkington North America Inc; Pilkington Mirropane Transparent Mirror:
www.pilkington.com/na or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.
- E. Plastic Sheet Glazing Manufacturers:
1. SABIC Innovative Plastics US LLC; Lexan: www.sabic.com/sfs or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 3. Glass thicknesses listed are minimum.
- B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
1. In conjunction with vapor retarder and joint sealer materials described in other sections.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
 5. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
 2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.

2.4 INSULATING GLASS UNITS

- A. Manufacturers:
1. Vitro Architectural Glass (formerly PPG Glass); Solarban 70:
www.vitroglazings.com or approved equal.

2. Substitutions: See Section 016000 - Product Requirements.
- B. Insulating Glass Units: Types as indicated.
 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 3. Nonmetal Edge Spacers: Polypropylene warm-edge technology design.
 - a. Spacer Width: As required for specified insulating glass unit.
 - b. Spacer Height: Manufacturer's standard.
 4. Spacer Color: Black.
 5. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 - b. Color: Black.
 6. Purge interpane space with dry air, hermetically sealed.
- C. Type GL-1 - Insulating Glass Units: Vision glass, double glazed.
 1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (solar control type), on #2 surface.
 4. Nonmetal edge spacer.
 5. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 6. Total Thickness: 1 inch.
 7. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.24, nominal.
 8. Visible Light Transmittance (VLT): 64 percent, nominal.
 9. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.
- D. Type GL-3A - Insulating Glass Units: Vision glass, double glazed, Fire and Impact Safety-Rated
 1. Application: Interior glazing as indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: FireLite glass ceramic, 3/16 inch thick, minimum.
 - a. Tint: Clear
 4. Metal edge spacer
 5. Inboard Lite: Fully tempered float glass, 1/4 inch minimum.
 - a. Tint: Clear
 6. Total Thickness: 1 inch, nominal
- E. Type GL-6 - Insulating Glass Units: Vision glass, double glazed, tinted.
 1. Applications: Exterior glazing as indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Solarbronze
 4. Non-metal edge spacer
 5. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear
 - b. Coating: Low-E (solar control type), on #3 surface
 6. Total Thickness: 1 inch.
 7. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.24, nominal.

8. Visible Light Transmittance (VLT): 39 percent, nominal.
9. Solar Heat Gain Coefficient (SHGC): 0.20, nominal.

F. Type GL-6A - Insulating Glass Units: Safety Glazing, tinted.

1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
2. Glass Type: Same as Type GL-6 except use fully tempered float glass for both outboard and inboard lites.

G. Type GL-1A - Insulating Glass Units: Safety glazing.

1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
2. Glass Type: Same as Type GL-1 except use fully tempered float glass for both outboard and inboard lites.

2.5 GLAZING UNITS

A. Type GL-3 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45 minutes.

1. Applications:
 - a. Glazing in fire-rated door assembly.
 - b. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
2. Glass Type: Fire-Rated and Safety-Rated Glass Ceramic.
3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
4. Safety Glazing Certification: 16 CFR 1201 Categories I and II, and ANSI Z97.1.
5. Glazing Method: As required for fire rating.
6. Fire-Rating Period: As indicated on drawings.
7. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
 - a. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
 - b. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
 - d. "T" - meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
 - e. "XXX" - placeholder that represents fire-rating period, in minutes.

B. Type GL-7 - Monolithic Safety Glazing: Non-fire-rated.

1. Applications:
 - a. Glazed lites in doors, except fire doors.
 - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.

2. Glass Type: Fully tempered safety glass as specified.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
- C. Type GL-4 - Bullet-Resistant Security Glazing: Laminated acrylic and polycarbonate, 3-Ply.
1. Applications: Locations as indicated on drawings.
 2. Tint: Clear.
 3. Thickness: 1-1/4 inch.
 4. Outer Lite: 1/8 inch polycarbonate sheet.
 5. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
 6. Middle Lite: 1 inch acrylic sheet.
 7. Interlayer, Inboard Side : Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
 8. Inside Lite: 1/8 inch polycarbonate sheet.
 9. Performance Criteria:
 - a. Bullet Resistance: Pass UL 752 tests in compliance with ballistic criteria level and weapon description indicated; Level 3 - .44 magnum lead semi-wadcutter gas checked.
 10. Visible Light Transmittance (VLT): 85 percent, nominal.
 11. Glazing Method: As required to meet performance criteria.
 12. Manufacturers:
 - a. Insulguard Security Products, SP 1.25 Bullet Block Window or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- D. Type GL-2 - Sound Control Glazing: Laminated double insulating glass.
1. Applications: Locations as indicated on drawings.
 2. Tint: Clear.
 3. Sound Transmission Class (STC) Rating: Provide at least STC 34 rating, complying with ASTM E90 and ASTM E413.
 4. Overall Thickness: As required to meet STC rating as indicated.
 5. Laminated Double Insulating Glass:
 - a. Outer Layer, Outboard Side: Annealed glass.
 - 1) Thickness: 3/16 inch.
 - b. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
 - c. Outer Layer, Inboard Side: Annealed glass.
 - 1) Thickness: 3/16 inch.
 - d. Air Space: 1/2 inch, filled with air.
 - e. Inner Layer, Outboard Side: Annealed glass.
 - 1) Thickness: 1/4 inch.
 - f. Interlayer: Polyvinyl butyral (PVB), thickness as required to meet performance criteria.
 - g. Inner Layer, Inboard Side: Annealed glass.
 - 1) Thickness: 1/4 inch.
- E. Type GL-5 - Transparent One-Way Mirror: Mirror quality float glass with pyrolytic (hard coat) type coating located on high light level surface of glass; ASTM C1376.
1. Applications: Locations as indicated on drawings.
 2. Thickness: 1/4 inch.
 3. Glass Tint: Grey.

4. Glass Type: Annealed.

END OF SECTION

SECTION 088723
SAFETY AND SECURITY FILMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glazing film applied to existing glazing assemblies.
- B. Glazing assemblies to receive film are indicated on drawings.

1.2 REFERENCE STANDARDS

- A. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting 2018.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Record of product certification for safety requirements.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation instructions and methods.
- C. Samples: For each film product to be used, minimum size 4 inches by 6 inches, representing actual product, color, and patterns.
- D. Test Reports: Detailed reports of full-scale chamber tests to specified criteria, using assemblies identical to those required for this project.
- E. Specimen Warranty.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Glazing film manufacturer specializing in manufacture of safety glazing films with minimum 10 years successful experience.
- B. Installer Qualifications: Certified by glazing film manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under

environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 10 year manufacturer's replacement warranty to cover film against peeling, cracking, discoloration, and deterioration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. 3M Window Film; Frosted CRYSTAL Glass Finishes: www.solutions.3m.com or approved equal.
- B. Substitutions: See Section 016000 - Product Requirements.

2.2 SAFETY AND SECURITY GLAZING FILM

- A. Privacy Glazing: Retrofit existing glazing assemblies to provide privacy between existing Police Department spaces and new Lobby and Vestibule spaces.
 - 1. Surface applied film.

2.3 MATERIALS

- A. Glazing Film: Translucent vinyl film for permanent bonding to glass.
 - 1. Thickness: 3.2 mils, minimum.
 - 2. Color: Frosted Crystal White.
 - 3. Adhesive Type: Pressure sensitive acrylic.
 - 4. Tensile Strength: 3.5 psi minimum when tested in accordance with ASTM D882.
 - 5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84 (Class A).
- B. Accessory Materials: As recommended or required by film manufacturer.
- C. Glass Cleaner: As recommended by glazing film manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Field -Applied Film: Verify that existing conditions are adequate for proper application and performance of film.
- B. Examine glass and frames. Verify that existing conditions are adequate for proper application and performance of film.
- C. Verify glass is not cracked, chipped, broken, or damaged.
- D. Verify that frames are securely anchored and free of defects.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean glass of dust, dirt, paint, oil, grease, mildew, mold, and other contaminants that would inhibit adhesion.
- B. Immediately prior to applying film, thoroughly wash glass with neutral cleaning solution.
- C. Protect adjacent surfaces.
- D. Do not begin installation until substrates have been properly prepared.

3.3 INSTALLATION

- A. Do not apply glazing film when surface temperature is less than 40 degrees F or if precipitation is imminent.
- B. Install in accordance with manufacturer's instructions, without air bubbles, wrinkles, streaks, bands, thin spots, pinholes, or gaps, as required to achieve specified performance.
- C. Accurately cut film with straight edges to required sizes allowing 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required by anchorage method.
- D. Seams: Seam film only as required to accommodate material sizes; form seams vertically without overlaps and gaps; do not install with horizontal seams.
- E. Clean glass and anchoring accessories following installation. Remove excess sealants and other glazing materials from adjacent finished surfaces.
- F. Remove labels and protective covers.

END OF SECTION

SECTION 089100
LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Louvers, frames, and accessories.

1.2 RELATED REQUIREMENTS

- A. Division 07 - Weather and Air/Vapor Barriers: Sealing frames to weather barrier installed on adjacent construction.
- B. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 233100 - HVAC Ducts and Casings: Ductwork attachment to louvers.

1.3 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2015.
- C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials, installation instructions, and finishes.
- C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
- D. Samples: Submit two samples 2 by 2 inches in size illustrating finish and color of exterior and interior surfaces.
- E. Test Reports: Independent agency reports showing compliance with specified performance criteria.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
 - 1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Louvers:
 - 1. Airline Louvers; 8" Deep Chevron Drainable Blade Wind Driven Rain Resistant Louver: www.airlinelouvers.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 LOUVERS

- A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
 - 1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
 - 2. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
 - 3. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
- B. Stationary Louvers: Chevron blade, extruded aluminum construction, with intermediate mullions matching frame.
 - 1. Free Area: 50 percent, minimum.
 - 2. Pressure Drop: 0.5 inches of water gauge maximum per square foot of free area at velocity of 888 fpm, when tested in accordance with AMCA 500-L, test unit size 48 inch by 48 inch.
 - 3. Blades: V-shaped, sight-proof.
 - 4. Frame: 8 inches deep, channel profile; corner joints mitered and , with continuous recessed caulking channel each side.
 - 5. Aluminum Thickness: Frame 12 gauge, 0.0808 inch minimum; blades 12 gauge, 0.0808 inch minimum.
 - 6. Aluminum Finish: Superior performing organic coatings; finish welded units after fabrication.

2.3 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T52/T6 temper.

2.4 FINISHES

- A. Superior Performing Organic Coatings System: Manufacturer's standard multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- B. Color: As selected from manufacturer's standard colors.

2.5 ACCESSORIES

- A. Screens: Frame of same material as louver, with reinforced corners; removable, screw attached; installed on inside face of louver frame.
- B. Insect Screen: 18/16 size aluminum mesh.
- C. Flashings: Of same material as louver frame, formed to required shape, single length in one piece per location.
- D. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared openings are ready to receive this work and opening dimensions are as indicated on shop drawings.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louver frames in openings with concealed fasteners.
- E. Coordinate with installation of mechanical ductwork.

3.3 CLEANING

- A. Strip protective finish coverings.
- B. Clean surfaces and components.

END OF SECTION

SECTION 089200
LOUVERED EQUIPMENT ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Louvered aluminum screens for concealing rooftop equipment.

1.2 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Superstructure support and bracing of rooftop screens and grilles.
- B. Section 075423 - Thermoplastic Polyolefin (TPO) Membrane Roofing: Treating penetrations for support of rooftop screens.

1.3 REFERENCE STANDARDS

- A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2020.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
- C. Shop Drawings: Include plans, sections, and details of connections and bracing.
 - 1. Include structural calculations indicating compliance with wind loading requirements.
- D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available finishes, colors, and textures.
- E. Verification Samples: For each product specified, two samples, minimum size 8 inches square, representing actual product configuration, color, and texture.
- F. Manufacturer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than ten years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Comply with manufacturer's instructions for handling of grille and screen products.

1.7 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Submit manufacturer's standard ten-year finish warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Louvered Equipment Enclosures:
 - 1. Ametco; www.ametco.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Wind Resistance: Design grilles and screens, including superstructure support system, to withstand positive and negative wind loading in accordance with applicable building code.

2.3 EXTRUDED HORIZONTAL LOUVERS

- A. Construction: Individual extruded aluminum louvers in inverted overlapping configuration, with blade supports attached to and supported by customized support structure.
- B. Louver Blades: Alloy 6063-T5 or T6 temper, or equivalent in accordance with ASTM B221 (ASTM B221M), 0.5 inch thick, 4 inch deep, spaced at 2.83 inch on center, and configured to totally block sightlines from grade. Equal to Phoenix Design screen as manufactured by Ametco.
- C. Aluminum Finish: Low gloss polyester enamel paint, roller coated over pretreated aluminum and baked at 400 degrees F.
 - 1. Color: As selected from manufacturer's standard colors.
- D. Overall Screen Configuration: Dimensions, details, and layout as indicated on drawings.

2.4 ACCESSORIES

- A. Miscellaneous Trim: Aluminum sheet, alloy 3005-H25 temper, or equivalent in accordance with ASTM B209 (ASTM B209M), formed to shapes indicated and finished to match other components.
- B. Support Structure: As specified in Section 055000.
- C. Fasteners: Self-tapping stainless steel screws, as approved by manufacturer of rooftop equipment screens.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install rooftop equipment screens in accordance with manufacturer's printed instructions and as indicated on shop drawings.
- B. Form tight joints and fit exposed connections accurately.
- C. Provide necessary fastenings and anchors required for a complete installation, and install units plumb, level, and in proper alignment with adjacent work.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Protect metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry or dissimilar metals.
- C. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 090561
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile and stone tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.

1.2 RELATED REQUIREMENTS

- A. Section 017419 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.

1.3 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens) 2021.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete 2020.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2021.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride 2016a.
- E. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings 2011.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.5 SUBMITTALS

- A. Visual Observation Report: For existing floor coverings to be removed.
- B. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
 - 3. Manufacturer's installation instructions for each component or material to be installed or applied for this work.
- C. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
 - 3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 4. Manufacturer's installation instructions.
 - 5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- D. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Recommendations for remediation of unsatisfactory surfaces.
 - 6. Product data for recommended remedial coating.
 - 7. Submit report to Architect.
 - 8. Submit report not more than two business days after conclusion of testing.
- E. Adhesive Bond and Compatibility Test Report.
- F. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.
- G. Copy of RFCI (RWP).

1.6 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.

2. Confirm date of start of testing at least 10 days prior to actual start.
3. Allow at least 4 business days on site for testing agency activities.
4. Achieve and maintain specified ambient conditions.
5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

D. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.

E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Use product recommended by testing agency.

PART 3 EXECUTION

3.1 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 - 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
 - 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not attempt to remove coating or penetrating material.
 - b. Do not abrade surface.
 - 3. Preliminary cleaning.
 - 4. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 - 5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 7. Specified remediation, if required.
 - 8. Patching, smoothing, and leveling, as required.
 - 9. Other preparation specified.
 - 10. Adhesive bond and compatibility test.
 - 11. Protection.
- C. Remediations:
 - 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 - 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 - 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.2 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.3 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive

laitance, mold, mildew, and other materials that might prevent adhesive bond.

- B. Do not use solvents or other chemicals for cleaning.

3.4 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.5 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
 - 3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.6 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

3.7 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.8 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.9 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 092116
GYPSUM BOARD ASSEMBLIES - USG

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal grid or channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.
- G. Bullet-resistant sheathing and wallboard.

1.2 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- C. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members 2015.
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- I. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.
- J. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

- L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- M. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- N. ASTM E413 - Classification for Rating Sound Insulation 2016.
- O. GA-216 - Application and Finishing of Gypsum Panel Products 2018.
- P. GA-600 - Fire Resistance and Sound Control Design Manual, 22nd edition 2018.
- Q. UL (FRD) - Fire Resistance Directory Current Edition.
- R. UL 752 - Standard for Bullet-Resisting Equipment Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- D. Test Reports: For stud framing products that do not comply with ASTM C645 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.
- E. Test Reports: Bullet resistant sheathing and wallboard.
- F. Installer's qualification statement.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum 5 years of documented experience.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
 - 1. See PART 3 for finishing requirements.
- B. Interior Partitions: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:

1. Fire-Resistance-Rated Partitions: UL listed assembly No. U 419; one and two hour rating.
2. Fire-Resistance-Rated Ceilings and Soffits: One (1) hour fire rating.
3. Fire-Resistance-Rated Shaft Walls: UL listed assembly No. U 415; one hour rating.
4. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.2 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 1. Marino Ware, www.marinoware.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.
- B. Non-structural Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 1. Studs: "C" shaped with knurled or embossed faces.
 2. Paired Studs for Sound-Rated Assemblies: Engineered single-piece assemblies comprised of paired studs coupled by sound isolators, designed to replace conventional side-by-side, parallel, double-wall partition framing.
 - a. Widths: As indicated on drawings.
 - b. Products:
 - 1) Sound Guard.
 3. Runners: U shaped, sized to match studs.
 4. Furring Members: Hat-shaped sections, minimum depth of 1 1/2 inch.
- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- D. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and screwed to secondary deflection channel set inside but unattached to top track.
- E. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.
- F. Non-structural Framing Accessories:
 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
 - b. Height: 47-3/4 inches.
 - c. Products:
 - 1) Clark Dietrich; Pony Wall, www.clarkdietrich.com or approved equal.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

2.3 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 1. USG Corporation: www.usg.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.

- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
 - 3. Paper-Faced Products:
 - a. USG Corporation; USG Sheetrock Brand EcoSmart Panels Firecode X: www.usg.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - C. Backing Board For Wet Areas:
 - 1. Application: Surfaces behind tile in wet areas including tub and shower surrounds and shower ceilings.
 - 2. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Fire-Resistance-Rated Type: Type X core, thickness 5/8 inch.
 - D. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
 - 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 - 2. Type X Thickness: 5/8 inch.
 - 3. Edges: Tapered.
 - E. Bullet Resistant Sheathing and Wallboard: Woven roving, multi-ply, ballistic grade fiberglass cloth with thermoset polyester resin; comply with UL 752 Level 3.
 - 1. Products:
 - a. Armorcore Bullet Resistant Fiberglass Panels as manufactured by Armorcore; www.armorcore.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - F. Exterior Soffit Board: Exterior gypsum soffit board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings and soffits in protected exterior areas, unless otherwise indicated.
 - 2. Type X Thickness: 5/8 inch.
 - 3. Edges: Tapered.
 - G. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, beveled long edges, ends square cut.
 - 1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
- 2.4 Gypsum Wallboard ACCESSORIES
- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3 inch minimum.
 - B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
 - 1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 2. Tape Thickness: 1/4 inch.

- C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- D. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Products:
 - a. Same manufacturer as framing materials.
 - b. Substitutions: See Section 016000 - Product Requirements.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
- F. Drywall Ceiling Installation Accessories: Products recommended by gypsum board manufacturer.
- G. Fasteners and Adhesives: Products recommended by gypsum board manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.2 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.
- C. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs with continuous bridging.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 - 1. Orientation: Horizontal.
 - 2. Spacing: At 16 inches on center.
- F. Furring for Fire-Resistance Ratings: Install as required for fire-resistance ratings indicated and to GA-600 requirements.
- G. Blocking: Install wood blocking for support of:
 - 1. Wall-mounted cabinets.
 - 2. Plumbing fixtures.
 - 3. Toilet partitions.

4. Toilet accessories.
5. Wall-mounted door hardware.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 1. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Exterior Soffits: Install exterior soffit board perpendicular to framing, with staggered end joints over framing members or other solid backing.
 1. Seal joints, cut edges, and holes with water-resistant sealant.
- E. Installation on Metal Framing: Use screws for attachment of gypsum board.
- F. Bullet Resistant Sheathing and Wallboard:
 1. Install bullet-resistant sheathing according to manufacturer's written recommendations and with manufacturer-approved fasteners.
 2. Cover all joints between boards with a 4 inch strip of the same thickness material as the boards, centered on the joint.

3.5 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 1. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.6 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
- B. Corner Beads: Install at external corners, using longest practical lengths.

3.7 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 3. Level 3: Walls to receive textured wall finish.
 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 5. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- 3.8 TOLERANCES
- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 093000
TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Coated glass mat backer board as tile substrate.
- E. Stone thresholds.
- F. Non-ceramic trim.

1.2 RELATED REQUIREMENTS

- A. Section 035400 - Cast Underlayment.
- B. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium) 2019.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
- D. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 1999 (Reaffirmed 2021).
- E. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.
- F. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive 2019.
- G. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 2020.
- H. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy 1999 (Reaffirmed 2019).
- I. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2019).

- J. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2019).
- K. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.
- L. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2018.
- M. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2019).
- N. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2021).
- O. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar 2020.
- P. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation 2010 (Reaffirmed 2016).
- Q. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation 2014.
- R. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar 2012.
- S. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2021.
- T. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products 2018.
- U. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.
- V. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives. Include manufacture's installation instructions for each component to be installed or applied.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.

- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- E. Installer's Qualification Statement:
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.

1.6 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
 - a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.1 TILE

- A. Manufacturers:
 - 1. Genrose Stone and Tile, or approved equal.
 - 2. Creative Materials Corporation, or approved equal.
 - 3. Substitutions: See Section 016000 - Product Requirements.
- B. Porcelain Tile: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: As indicated on drawings
 - 3. Surface Finish: As indicated on drawings
 - 4. Color(s): As indicated on drawings.
 - 5. Products:
 - a. Genrose; Jewelstone.
 - b. Creative Materials Corporation; Montserrat and Omni.

2.2 TRIM AND ACCESSORIES

- A. Pre-Formed Accessories To Be Covered with Tile: High density expanded polystyrene with ANSI A118.10 waterproofing finish or membrane.
 - 1. Products:

- a. LATICRETE International, Inc; LATICRETE HYDRO BAN Pre-Sloped Shower Pan: www.laticrete.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Non-Ceramic Trim: Satin brass anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall tile.
 - b. Open edges of floor tile.
 - c. Transition between floor finishes of different heights.
 - d. Borders and other trim as indicated on drawings.
 - e. Balcony and terrace edge trim and fascia.
 - 2. Manufacturers:
 - a. Schluter-Systems; RONDEC: www.schluter.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Thresholds: 3 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
 - 1. Thickness: 1/2 inch.
 - 2. Material: Marble, honed finish.
 - 3. Applications:
 - a. At doorways where tile terminates.

2.3 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. LATICRETE International, Inc: www.laticrete.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- C. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
 - 1. Applications: Use this type of bond coat where indicated, and where no other type of bond coat is indicated.
 - 2. Products:
 - a. LATICRETE International, Inc; MULTIMAX LITE: www.laticrete.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.4 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Standard Grout: ANSI A118.6 standard cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As selected by Architect from manufacturer's full line.
 - 4. Products:
 - a. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.5 Maintenance Materials

- A. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
 - 2. Products:
 - a. Laticrete; Stonetech Heavy Duty Grout Sealer or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.6 ACCESSORY MATERIALS

- A. Waterproofing Membrane at floors and showers: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Thickness: 25 mils, minimum, dry film thickness.
 - c. Products:
 - 1) LATICRETE International, Inc; LATICRETE HYDRO BAN:
www.laticrete.com or approved equal.
 - 2) Substitutions: See Section 016000 - Product Requirements.
- B. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
- C. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 090561.
 - 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.

- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.3 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Install thresholds where indicated.
- H. Sound tile after setting. Replace hollow sounding units.
- I. Keep control and expansion joints free of mortar, grout, and adhesive.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.4 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
- B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.5 INSTALLATION - SHOWERS AND BATHTUB WALLS

- A. At tiled shower receptors install in accordance with TCNA (HB) Method B420, mortar bed floor, and W245, thin-set over coated glass mat backer board walls.
- B. Grout with standard grout as specified above.

3.6 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.

3.7 CLEANING

- A. Clean tile and grout surfaces.

3.8 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 095100
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 RELATED REQUIREMENTS

- A. Section 053100 - Steel Decking: Placement of special anchors or inserts for suspension system.
- B. Section 211300 - Fire-Suppression Sprinkler Systems: Sprinkler heads in ceiling system.
- C. Section 233700 - Air Outlets and Inlets: Air diffusion devices in ceiling.
- D. Section 265100 - Interior Lighting: Light fixtures in ceiling system.
- E. Section 284600 - Fire Detection and Alarm: Fire alarm components in ceiling system.

1.3 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- B. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2013.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2020.
- E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.
- F. CHPS (HPPD) - High Performance Products Database Current Edition at www.chps.net/.
- G. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.

- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Samples: Submit two samples 12 by 12 inch in size illustrating material and finish of acoustical units.
- E. Samples: Submit two samples each, 6 inches long, of suspension system main runner, cross runner, and perimeter molding.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Manufacturer's Qualification Statement.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.6 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc: www.armstrongceilings.com or approved equal.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Suspension Systems:
 - 1. Same as for acoustical units.
 - 2. Substitutions: See Section 016000 - Product Requirements.

2.2 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
 - 1. VOC Content: Certified as Low Emission by one of the following:
 - a. Product listing in UL (GGG).
 - b. Product listing in CHPS (HPPD).
- B. Acoustical Panels Fire-resistant: Painted mineral fiber, with the following characteristics:
 - 1. Application(s): Fire-rated assemblies.
 - 2. Classification: ASTM E1264 Type III.
 - 3. Size: 24 by 48 inch.
 - 4. Thickness: 1 inches.

5. Light Reflectance: 85 percent, determined in accordance with ASTM E1264.
 6. NRC Range: 0.85 to 0.90, determined in accordance with ASTM E1264.
 7. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 8. Panel Edge: Square.
 9. Color: White.
 10. Suspension System: Exposed grid.
 11. Products:
 - a. Armstrong World Industries, Inc. www.armstrongceilings.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Acoustical Panels non fire-resistant: Mineral fiber with membrane-faced overlay, with the following characteristics:
1. Application(s): All locations, except for fire-resistant assemblies.
 2. Classification: ASTM E1264 Type IV.
 3. Size: 24 by 48 inch.
 4. Thickness: 1 inches.
 5. Light Reflectance: 85 percent, determined in accordance with ASTM E1264.
 6. NRC: 0.85, determined in accordance with ASTM E1264.
 7. Articulation Class (AC): 170, determined in accordance with ASTM E1264.
 8. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 9. Panel Edge: Square, tegular.
 10. Color: White.
 11. Suspension System: Exposed grid.
 12. Products:
 - a. Armstrong World Industries, Inc; Calla #2823: www.armstrongceilings.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.3 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, stabilizer bars, clips, and splices as required.
1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Exposed Suspension System, Type non fire-resistant: Hot-dipped galvanized steel grid and cap.
1. Application(s): All locations not part of a fire-resistant ceiling assembly.
 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 3. Profile: Tee; 9/16 inch face width.
 4. Finish: Baked enamel.
 5. Color: White.
 6. Products:
 - a. Armstrong Suprafine 9/16 inch Acoustical Suspension System. or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Exposed Suspension System, Type fire-resistant: Hot-dipped galvanized steel grid and cap.
1. Application(s): Fire-rated assemblies.
 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 3. Profile: Tee; 15/16 inch face width.

4. Finish: Baked enamel.
5. Products:
 - a. Armstrong World Industries, Inc.: Prelude XL Fire Guard:
www.armstrongceilings.com.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.4 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Perimeter Moldings: Same metal and finish as grid.
 1. Angle Molding: L-shaped, for mounting at same elevation as face of grid.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 Preparation

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 1. Use longest practical lengths.
- E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- F. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- G. Install hold-down clips on panels within 20 ft of an exterior door.

END OF SECTION

SECTION 096500
RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Static control resilient tile flooring.
- C. Resilient base.
- D. Resilient stair accessories.

1.2 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- C. Section 033000 - Cast-in-Place Concrete: Items furnished under this Section to be coordinated and installed during concrete installation.
- D. Section 090561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- E. Section 090561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- F. Section 260526 - Grounding and Bonding for Electrical Systems: Grounding and bonding of static control flooring to building grounding system.

1.3 REFERENCE STANDARDS

- A. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- C. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- D. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials 2021a, with Editorial Revision.
- E. ASTM F925 - Standard Test Method for Resistance to Chemicals of Resilient Flooring 2013 (Reapproved 2020).
- F. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile 2020.
- G. ASTM F1861 - Standard Specification for Resilient Wall Base 2021.
- H. ASTM F2169 - Standard Specification for Resilient Stair Treads 2015 (Reapproved 2020).

- I. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate floor patterns.
- D. Verification Samples: Submit two samples, full tile or plank in size, illustrating color and pattern for each resilient flooring product specified.
- E. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
- F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 100 square feet of each type and color.
 - 3. Extra Wall Base: 500 linear feet of each type and color.
 - 4. Extra Stair Materials: Quantity equivalent to 5 percent of each type and color.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Do not double stack pallets.

1.7 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.1 TILE FLOORING

- A. Luxury Vinyl Tile: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
 - 1. Manufacturers:
 - a. Masland Contract; www.maslandcontract.com or approved equal.
 - b. Mohawk Group; www.mohawkgroup.com or approved equal.
 - c. Mannington Commercial; www.manningtoncommercial.com or approved equal.
 - d. Substitutions: See Section 016000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1700, Class III.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648.
 - 4. VOC Content Limits: As specified in Section 016116.
 - 5. Wear Layer Thickness: 0.5 mm minimum..
 - 6. Pattern: As indicated on drawings.
 - 7. Color: As indicated on drawings.
 - 8. Refer to Finish Legends and Schedule on drawings.
- B. Static Control Tile: Homogeneous; color and pattern throughout thickness.
 - 1. Manufacturers:
 - a. Statguard Flooring; 8400 Series Vinyl Floor Tile; www.statguardflooring.com or an approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 2. Minimum Requirements: Solid vinyl tile complying with ASTM F1700, Class 1, Type A.
 - 3. Electrical Resistance:
 - a. Dissipative Tile: Resistance between 1.0 megohms and 1000 megohms as tested in accordance with ASTM F150.
 - 4. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 - 5. Tile Size: 12 by 12 inch.
 - 6. Total Thickness: 0.125 inch.
 - 7. Color: To be selected by Architect from manufacturer's full range.

2.2 STAIR COVERING

- A. Stair Treads and Nosings for Exterior Concrete Stair: Extruded aluminum with rubber inserts; full width of stair tread in one piece.
 - 1. Manufacturers:
 - a. Nystrom; Ecotread; www.nystrom.com, or an approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
 - 2. Nominal Thickness: 0.250 inch.
 - 3. Nominal Depth: 4 inches.
 - 4. Nosing: Short - 1/2 inch.

5. Texture: Ribbed.
 6. Installation: Cast-in place anchor
 7. Color: To be selected by Architect from manufacturer's full range.
- B. Stair Treads with Integral Risers: Rubber; full height of riser, full width and depth of tread in one piece; tapered thickness.
1. Manufacturers:
 - a. Johnsonite, a Tarkett Company; Angle Fit Stair Treads with Integrated Riser: www.johnsonite.com or approved equal..
 - b. Substitutions: See Section 016000 - Product Requirements.
 2. Minimum Requirements: Comply with ASTM F2169, Type TS, rubber, vulcanized thermoset.
 3. Commercial Warranty: 5 years
 4. Slip Resistance: SCOF > or = to 0.8 in accordance with ASTM D2047.
 5. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 6. Smoke Density: < 450 in accordance with ASTM E662.
 7. Nosing: Square.
 8. Tread Texture: Hammered.
 9. Color: As indicated on drawings. Refer to Finish Legends and Finish Plans.

2.3 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; style as scheduled.
1. Manufacturers:
 - a. Tarkett Company; Baseworks Thermoset Rubber Type TS: www.commercial.tarkett.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
 3. Chemical Resistance: Good, in accordance with ASTM F925.
 4. Flame Spread/Smoke Density: Class B and < 450 smoke in accordance with ASTM E84.
 5. Height: 4-1/2 inch.
 6. Thickness: 0.125 inch.
 7. Finish: Satin.
 8. Length: Roll.
 9. Color: As indicated on drawings. Refer to Finish

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 090561.
 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.

3.3 Installation - General

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.
 - 2. Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring manufacturer's instructions. Refer to Section 260526 for grounding and bonding to building grounding system.
 - 3. Fit joints and butt seams tightly.
 - 4. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Resilient Strips: Attach to substrate using adhesive.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 Installation - Tile Flooring

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- C. Install square tile to ashlar pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

3.5 Installation - Resilient Base

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Scribe and fit to door frames and other interruptions.

3.6 Installation - Stair Coverings

- A. Install stair coverings in one piece for full width and depth of tread for interior stair installations.
- B. Adhere over entire surface. Fit accurately and securely.

3.7 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.8 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

3.9 SCHEDULE - Refer to Finish Schedule on drawings.

END OF SECTION

SECTION 096813
TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.
- B. Custom-fabricated Town Seal floor medallion.
- C. Removal of existing carpet tile.

1.2 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 017419 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap.
- C. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
- D. Section 090561 - Common Work Results for Flooring Preparation: Removal of existing floor coverings, cleaning, and preparation.
- E. Section 090561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- F. Section 221006 - Plumbing Piping Specialties: Plumbing floor cover plate with recess for carpet.

1.3 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials 2016 (Reapproved 2021).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- C. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials 2021a, with Editorial Revision.
- D. CRI (GLP) - Green Label Plus Testing Program - Certified Products Current Edition.
- E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.
- F. NSF/ANSI 140 - Sustainability Assessment for Carpet 2019.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

- C. Shop Drawings for custom-fabricated Town Seal floor medallion: Provide information sufficient to completely define the Town Seal floor medallion for fabrication and installation, including medallion size, fonts, and colors.
 - 1. Request artwork for Town Seal floor medallion from Owner, through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 2. Submit for approval by Owner, through Architect, prior to fabrication.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Sustainable Design Submittal: Submit VOC content documentation for adhesives.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.6 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Mohawk Group; Uncharted Collection: www.mohawkgroup.com or approved equal.
 - 2. Masland Contract; www.maslandcontract.com or approved equal.
 - 3. J & J Flooring; www.jjflooringgroup.com or approved equal.
 - 4. Patcraft; www.patcraft.com or approved equal.
 - 5. Shaw Contract; www.shawcontract.com or approved equal.
 - 6. Substitutions: See Section 016000 - Product Requirements.

2.2 MATERIALS

- A. Tile Carpeting, Type CPT1: Tip Sheared Loop Pattern, manufactured in one color dye lot.
1. Product: Cha Cha manufactured by Masland Contract.
 2. Tile Size: 24 by 24 inch, nominal.
 3. Thickness: 0.343 inch.
 4. Color and pattern as indicated on drawings. Refer to Finish Legend, Finish Schedule and Finish Plans.
 5. Fiber Content: 100% Universal Fibers Type 6,6 with permanent stain resistance (nylon synthetic solution-dyed fibers).
 6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 8. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 9. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity.
 10. Gauge: 1/12 inch.
 11. Pile Weight: 28 oz/sq yd.
 12. Light Fastness: Yes.
 13. Primary Backing Material: Synthetic.
 14. Secondary Backing Material: Vinyl.
 15. Total Weight: 138 oz/sq yd.
- B. Tile Carpeting, Type CPT2: Tip Sheared Loop Pattern, manufactured in one color dye lot.
1. Product: Twill Weave manufactured by J & J Flooring.
 2. Tile Size: 24 by 24 inch, nominal.
 3. Color and pattern as indicated on drawings. Refer to Finish Legend, Finish Schedule and Finish Plans.
 4. Fiber Type: Encore BCF with recycled content, Solution/Yarn dyed fibers.
 5. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 6. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 7. Smoke Density: less than 450 in accordance with ASTM E662.
 8. Sustainability: Gold Certified in accordance with NSF/ANSI 140 .
 9. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 10. Maximum Electrostatic Charge: 3 Kv. at 20 percent relative humidity.
 11. Gauge: 1/12 inch.
 12. Stitches: 11 per inch.
 13. Light Fastness: Yes.
 14. Primary Backing Material: Synthetic.
- C. Tile Carpeting, Type CPT3: Tufted, manufactured in one color dye lot.
1. Product: Uncharted Collection manufactured by Mohawk Group.
 2. Tile Size: 24 by 24 inch, nominal.
 3. Color and pattern as indicated on drawings. Refer to Finish Legend, Finish Schedule and Finish Plans.
 4. Fiber Type: Colorstrand Nylon (nylon, solution/yarn dyed)
 5. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 6. Smoke Density: less than 450 in accordance with ASTM E662.
 7. Sustainability: Gold Certified in accordance with NSF/ANSI 140 .
 8. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.

9. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity.
 10. Gauge: 1/12 inch.
 11. Stitches: 10.4 per inch.
 12. Pile Weight: 16 oz/sq yd.
 13. Primary Backing Material: Synthetic.
- D. Tile Carpeting, Type CPT4: Tip Sheared Loop Pattern, manufactured in one color dye lot.
1. Product: Top Notch manufactured by Masland Contract.
 2. Tile Size: 24 by 24 inch, nominal.
 3. Thickness: 0.375 inch.
 4. Color and pattern as indicated on drawings. Refer to Finish Legend, Finish Schedule and Finish Plans.
 5. Fiber Content: 100% Universal Fibers Type 6,6 with permanent stain resistance (nylon synthetic solution-dyed fibers).
 6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 8. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 9. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity.
 10. Gauge: 1/12 inch.
 11. Pile Weight: 22 oz/sq yd.
 12. Primary Backing Material: Synthetic.
- E. Tile Carpeting, Type CPT5: Multi-Level Pattern Cut/Loop, manufactured in one color dye lot.
1. Product: Shadowgraph manufactured by Patcraft.
 2. Tile Size: 9 by 36 inch, nominal.
 3. Thickness: 0.268 inch.
 4. Color and pattern as indicated on drawings. Refer to Finish Legend, Finish Schedule and Finish Plans.
 5. Fiber Type: Eco Solution Q Nylon (nylon, 100% solution dyed)
 6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 8. Smoke Density: less than 450 in accordance with ASTM E662.
 9. Sustainability: Gold Certified in accordance with NSF/ANSI 140 .
 10. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
 11. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity.
 12. Gauge: 1/12 inch.
 13. Stitches: 11 per inch.
 14. Pile Weight: 25 oz/sq yd.
 15. Primary Backing Material: Synthetic.
- F. Tile Carpeting, Type EM1: Tufted, manufactured in one color dye lot.
1. Product: Welcome II Tile, Stepping Out Collection manufactured by Shaw Contract.
 2. Tile Size: 24 by 24 inch, nominal.
 3. Thickness: 0.362 inch.
 4. Color and pattern as indicated on drawings. Refer to Finish Legend, Finish Schedule and Finish Plans.
 5. Fiber Type: Pet Polyester, 100% solution dyed.
 6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").

8. Smoke Density: less than 450 in accordance with ASTM E662.
9. Sustainability: Gold Certified in accordance with NSF/ANSI 140 .
10. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.
11. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity.
12. Primary Backing Material: Synthetic.

G. Custom-Fabricated Town Seal Medallion

1. Manufacturer: Masland Contract; www.maslandcontract.com, or approved equal
2. Design Number: MOZ19-23098, size as indicated on drawings, 3-color carpet medallion
3. Contact: Jeremy Wright

2.3 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, clear anodized color.
- C. Adhesives:
 1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 090561.
 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.

- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines, unless otherwise indicated on plans.
- F. Locate change of color or pattern between rooms under door centerline, unless otherwise indicated on drawings.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
- I. Complete installation of edge strips, concealing exposed edges.
- J. Install custom-fabricated Town Seal medallion in accordance with manufacturer's written instructions.

3.4 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 096900
ACCESS FLOORING

PART 1 - GENERAL

1.1 Section Includes

- A. Work of this section includes, but is not limited to: access floor panels, floor coverings, understructure and various electrical, data and communication accessories.

1.2 Related Sections

- A. Concrete sealer shall be compatible with pedestal adhesive, see Division 3.
- B. See Division 26 Section "Grounding and Bonding for Electrical Systems" for connection to ground of access flooring understructure. Note: The electrical engineer or contractor shall determine requirements for grounding and the electrical contractor shall provide the necessary labor and materials to electrically connect the access flooring to the building ground if it is required.

1.3 Environmental Conditions for Storage and Installation

- A. Area to receive and store access floor materials shall be enclosed and maintained at ambient temperatures between 35° to 95° F and relative humidity levels between 20% to 80%. All floor panels shall be stored at ambient temperature between 50° to 90° F for at least 24 hours before installation begins. All areas of installation shall be enclosed and maintained at ambient temperature between 50° to 90° F and at relative humidity levels between 20% to 80% and shall remain within these environmental limits throughout occupancy.

1.4 References

- A. CISCA (Ceilings & Interior Systems Construction Association) - "Recommended Test Procedures for Access Floors" shall be used as a guideline when presenting load performance product information.

1.5 Performance Certification

- A. Product tests shall be witnessed and certified by independent engineering and testing laboratory based in the U.S. with a minimum of five years experience testing access floor components in accordance CISCA "Recommended Test Procedures for Access Floors".

1.6 Country-of-Origin and Product Marking

- A. Access floor materials shall comply with the provisions outlined in FAR Subpart 25.2 – Buy American Act – Construction Materials.
- B. Floor panels shall be permanently marked with manufacturer's name, product identification, manufacturing date and country-of-origin. Removable Product ID stickers are not acceptable.

1.7 Performance Requirements

- A. Design Load: Panel supported on actual understructure system shall be capable of supporting a point load of 1000 lbs. applied on a one square inch area at any location on the panel without experiencing permanent set in excess of 0.010 inches as defined by CISCA. The loading method used to determine design (allowable) load shall be in conformance with CISCA Concentrated Load test method but with panel tested on actual understructure instead of steel blocks.
- B. Safety Factor: Panel supported on actual understructure system shall withstand a point load of no less than (2) two times its design load rating on a one square inch area anywhere on the panel without failure when tested in accordance with CISCA A/F, Section 2, "Ultimate Loading". Failure is defined as the point at which the system will no longer accept the load.
- C. Ultimate Load: Panel supported on actual understructure system shall be capable of supporting a point load of at least 2000 lbs. applied through a load indenter on a one square inch area at any location on the panel without failure (i.e. minimum safety factor of 2) when tested in accordance with CISCA A/F, Section 2, "Ultimate Loading".
- D. Rolling Load: Panel supported on actual understructure system shall be able to withstand the following rolling loads at any location on the panel without developing a local and overall surface deformation greater than 0.040 inches when tested in accordance with CISCA A/F Section 3, "Rolling Loads". Note: wheel 1 and wheel 2 tests shall be performed on two separate panels.
 - 1. Size: 3" dia x 1 13/16" wide Load: 800 lbs. Passes: 10
 - 2. Size: (A) 6" dia x 2" wide Load: 600 lbs. Passes: 10,000
- E. Impact Load: Panel and supporting understructure (the system) shall be capable of supporting an impact load of 150 lbs. dropped from a height of 36 inches onto a one square inch area (using a round or square indenter) at any location on the panel when tested in accordance with CISCA A/F, Section 8, "Drop Impact Load Test".
- F. Panel Drop Test: Panel shall be capable of being dropped face up onto to a concrete slab from a height of 36", after which it shall continue to meet all load performance requirements as previously defined.
- G. Panel Cutout: Panel with an 8" diameter interior cutout supported on actual understructure shall be capable of maintaining its design load strength with a minimum safety factor of 2 anywhere on the panel without the use of additional supports.
- H. Flammability: System shall meet Class A Flame spread requirements for flame spread and smoke development. Tests shall be performed in accordance with ASTM-E84-1998, Standard Test Method for Surface Burning Characteristics for Building Materials.
- I. Combustibility: All components of the access floor system shall qualify as non-combustible by demonstrating compliance with requirements of ASTM E 136, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 deg C.
- J. Recycled Content: Panel and understructure system shall be required to have a minimum post-consumer recycled content of 18% and a minimum total recycled content of 49%.
- K. Axial Load: Pedestal support assembly shall provide a 6000 lb. axial load without permanent deformation when tested in accordance with CISCA A/F, Section 5, "Pedestal Axial Load Test".
- L. Overturning Moment: Pedestal support assembly shall provide an average overturning moment of 1000 in-lbs. when glued to a clean, sound, uncoated concrete surface when tested in accordance with CISCA A/F, Section 6, "Pedestal Overturning Moment Test".

- M. Stringer Concentrated Load: Stringer shall be capable of withstanding a concentrated load of 450 lbs. placed in its midspan on a one square inch area using a round or square indenter without exceeding a permanent set of 0.010" after the load is removed when tested in accordance with CISCA A/F, Section 4, "Stringer Load Testing".

1.8 Design Requirements:

- A. Access floor system, where indicated on the design documents, shall consist of modular and removable fully encased cementitious filled welded steel panels supported on all four edges by structural steel members which are designed to bolt onto adjustable height pedestal assemblies forming a modular grid pattern.
- B. Panel shall be easily removed by one person with a suction cup lifting device and shall be interchangeable except where cut for special conditions.
- C. Quantities, finished floor heights (FFH) and location of accessories shall be as specified on the contract drawings.

1.9 Submittals for Review

- A. Detail sheets, for each proposed product type, which provide the necessary information to describe the product and its performance.
- B. Floor finish samples for verification of selected floor finish to be factory applied.
- C. Test reports, certified by an independent testing laboratory with a minimum of five years experience testing access floor components in accordance with CISCA Recommended Test Procedures, certifying that component parts perform as specified.

1.10 Submittals for Information

- A. Manufacturer's installation instructions and guidelines.
- B. Manufacturer's Owner Manual outlining recommended care and maintenance procedures.

PART 2 - PRODUCTS

2.1 Manufacturers

- A. Access floor system shall be as manufactured by Tate Access Floors, Inc. and shall consist of ConCore[®] CCN 1000 access floor panel supported by a bolted stringer understructure system.
- B. Alternative products shall meet or exceed all requirements as indicated herein and must receive prior written approval by the architect or designer.
- C. Access floor manufacture shall be ISO9001: 2000 certified demonstrating it has a robust and well documented quality management system with continuous improvement goals and strategies.
- D. Access floor manufacturer's facilities shall be ISO14001:2004 certified demonstrating that they maintain an environmental management system.
- E. Access floor manufacturer's facilities shall be OHSAS 18001:2007 certified demonstrating that they maintain an Occupational Health and Safety Management system.

2.2 Support Components

A. Pedestals:

1. Pedestal assemblies shall be corrosive resistant, all steel welded construction, and shall provide an adjustment range of +/- 1" for finished floor heights 6" or greater. Zinc electroplating shall be prohibited on all pedestal components, including head plate, threaded rod, adjustment nut, pedestal tube, base plate, and all fasteners.
2. Pedestal assemblies shall provide a means of leveling and locking the assembly at a selected height, which requires deliberate action to change height setting and prevents vibration displacement.
3. Hot dip galvanized steel pedestal head shall be welded to a threaded rod which includes a specially designed adjusting nut. The nut shall provide location lugs to engage the pedestal base assembly, such that deliberate action is required to change the height setting.
4. Threaded rod shall provide a specially designed anti-rotation device, such that when the head assembly is engaged in the base assembly, the head cannot freely rotate (for FFH of 7" or greater and Types 1A, 2B and 3B square tube bases only). Note: This prevents the assembly from inadvertently losing its leveling adjustment when panels are removed from the installation during use.
5. Hot dip galvanized pedestal base assembly shall consist of a formed steel plate with no less than 16 inches of bearing area, welded to a 7/8" square steel tube and shall be designed to engage the head assembly.

B. Stringers:

1. Stringers shall support each edge of panel.
2. Steel stringer shall have conductive galvanized coating. Zinc electroplating shall be prohibited on stringers and stringer fasteners.
3. Stringers shall be individually and rigidly fastened to the pedestal with one machine screw for each foot of stringer length. Bolts shall provide positive electrical contact between the stringers and pedestals. Connections depending on gravity or spring action are unacceptable.
4. Stringer grid shall be 2 foot x 2 foot grid configuration ensuring maximum lateral stability in all directions.

2.3 Panel Components

A. Floor Panels:

1. Panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally with a lightweight cementitious material. Mechanical or adhesive methods for attachment of the steel top and bottom sheets are unacceptable.
2. Floor panels shall be protected from corrosion by electro-deposited epoxy paint. The use of zinc electroplating shall be prohibited.
3. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions.

2.4 Accessories

A. Air sealing grommet shall be installed in the interior or on the edge of a factory placed cutout located in one of the two following positions in the panel.

1. OPTION A (Interior Cutout)
 - a. 4.075" from the left edge of the panel
 - b. 7.375" from the top and bottom edge of the panel
 - 1) The cutout in the panel shall measure 6.75"x 9.25" and shall be a punched penetration, saw cutting is not acceptable

- 2) The cutout location shall allow the air sealing grommet to be located in such a way that regardless of rack position or overall dimensions, that the unit will be position beneath the rack allowing for cable penetrations to enter the rack footprint.
 2. OPTION B (Perimeter Edge Cutout)
 - a. The flange shall align with the left edge of the panel
 - b. 7.75" from the top edge and bottom edge of the panel
 - 1) The cutout in the panel shall measure 7.875"x 9.25" and shall be a punched penetration, saw cutting is not acceptable.
 - B. Provide manufacturer's standard steps, ramps, fascia plate, perimeter support, and grommets where indicated on the contract drawings.
 - C. Provide 4 (four) spare floor panels and 16 (sixteen) square feet of understructure systems for each type used in the project for maintenance stock. Deliver to project in manufacturer's standard packaging clearly marked with the contents.
 - D. Provide 2 (two) panel lifting devices.
- 2.5 Finishes
- A. Factory finish the surface of floor panels with floor covering material as indicated on the contract drawings. Refer to Finish Legend, Finish Schedules and Finish Plans. Where floor coverings are by the access floor manufacturer, the type, color and pattern shall be selected from manufacturer's full product line. All areas to be furnished with laminated floor panels must be maintained at ambient temperature between 50° to 90° F and at humidity level between 20% to 80% relative and shall remain within these ranges through installation and occupancy.
 - B. Tile coverings that require trim edge shall be applied to the panel's top surface and shall not wrap around the panel's edge.
- 2.6 Fabrication Tolerances
- A. Floor panel flatness measured on a diagonal: +/- 0.035"
 - B. Floor panel flatness measured along edges: +/- 0.025"
 - C. Floor panel width or length of required size: +/- 0.010"
 - D. Floor panel squareness tolerance +/- 0.015"

PART 3 – EXECUTION

3.1 Preparation

- A. Examine structural subfloor for unevenness, irregularities and dampness that would affect the quality and execution of the work. Do not proceed with installation until structural floor surfaces are level, clean, and dry as completed by others.
- B. Concrete sealers, if used, shall be identified and proven to be compatible with pedestal adhesive. Verify that adhesive achieves bond to slab before commencing work.
- C. Verify dimensions on contract drawings, including level of interfaces including abutting floor, ledges and doorsills.
- D. The General Contractor shall provide clear access, dry subfloor area free of construction debris and other trades throughout installation of access floor system.

- E. Area to receive and store access floor materials shall be enclosed and maintained at ambient temperatures between 35° to 95° F and relative humidity levels between 20 to 80%. At least 24 hrs. before installation begins, all floor panels shall be stored at ambient temperatures between 50° to 90° F and relative humidity levels between 20% to 80% and shall remain within these environmental limits throughout occupancy.

3.2 Installation

- A. Pedestal locations shall be established from approved shop drawings so that mechanical and electrical work can be installed without interfering with pedestal installation.
- B. Installation of access floor shall be coordinated with other trades to maintain the integrity of the installed system. All traffic on access floor shall be controlled by access floor installer. No traffic but that of access floor installers shall be permitted on any floor area for 24 hours to allow the pedestal adhesive to set. Access floor panels shall not be removed by other trades for 72 hours after their installation.
- C. Floor system and accessories shall be installed under the supervision of the manufacturer's authorized representative and according to manufacturer's recommendations.
- D. No dust or debris producing operations by other trades shall be allowed in areas where access floor is being installed to ensure proper bonding of pedestals to subfloor.
- E. Access floor installer shall keep the subfloor broom clean as installation progresses.
- F. Partially complete floors shall be braced against shifting to maintain the integrity of the installed system where required.
- G. Additional pedestals as needed shall support panels where floor is disrupted by columns, walls, and cutouts.
- H. Understructure shall be aligned such that all uncut panels are interchangeable and fit snugly but do not bind when placed in alternate positions.
- I. Finished floor shall be level, not varying more than 0.062" in 10 feet or 0.125" overall.
- J. Inspect system prior to application of floor covering and replace any floor panels that are cracked, broken and structurally damaged and do not comply with specified requirements.
- K. Acceptance: General contractor shall accept floor in whole or in part prior to allowing use by other trades.

END OF SECTION

SECTION 097200
WALL COVERINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Wall covering.

1.2 RELATED REQUIREMENTS

- A. Section 016116 - Volatile Organic Compound (VOC) Content Restrictions.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- B. NSF/ANSI 342 - Sustainability Assessment for Wallcovering Products 2019.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on wall covering and adhesive.
- C. Shop Drawings: Indicate wall elevations with seaming layout.
- D. Samples: Submit two samples of wall covering, 24 by 24 inch in size illustrating color, finish, and texture.
- E. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.
- F. Manufacturer's Installation Instructions: Indicate special procedures.
- G. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Sustainability product data for Low-Emitting Materials.
- K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering; store where directed.
 - 3. Package and label each roll by manufacturer, color and pattern, and destination room number.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

1.7 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.1 Wall Coverings

- A. General Requirements:
 - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
- B. Wall Covering: Fabric-backed vinyl roll stock.
 - 1. Comply with NSF/ANSI 342 for Type II wallcovering.
 - 2. Roll Width: 54 inches.
 - 3. Backing: Woven, osnaburg fabric.
 - 4. Color and Pattern: As indicated on drawings. See Finish Legend, Finish Schedule and Finish Plans.
 - 5. Performance:
 - a. Fire Rating: Class A, as per ASTM E84.
 - b. Flame Spread: 20 maximum
 - c. Smoke Developed : 45 maximum
 - 6. Manufacturers:
 - a. Wolf-Gordon; Vinyl Wallcovering: www.wolfgordon.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.
- C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.
- D. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work, and comply with requirements of wall covering manufacturer.

- B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.
- C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.2 PREPARATION

- A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
- B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.
- C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.
- E. Vacuum clean surfaces free of loose particles.

3.3 INSTALLATION

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply adhesive to wall surface immediately prior to application of wall covering.
- C. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
- D. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- E. Butt edges tightly.
- F. Horizontal seams are not acceptable.
- G. Do not seam within 2 inches of internal corners or within 6 inches of external corners.
- H. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.
- I. Do not install wall covering more than 1/4 inch below top of resilient base.
- J. Cover spaces above and below windows, above doors, in pattern sequence from roll.
- K. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.4 CLEANING

- A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
- B. Reinstall wall plates and accessories removed prior to work of this section.

3.5 PROTECTION

- A. Do not permit construction activities at or near finished wall covering areas.

3.6 SCHEDULES - Refer to Finish Plans and Schedules.

END OF SECTION

SECTION 099000
PAINTING AND COATING - COMMERCIAL GUIDE SPEC - BENJAMIN MOORE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior and exterior painting, including surface preparation.
- B. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Elevator pit ladders.
 - 3. Prime surfaces to receive wall coverings.
 - 4. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, and hangers, brackets, collars and supports, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - d. Paint dampers exposed behind louvers, grilles, and convactor and baseboard cabinets to match face panels.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Exposed surfaces of steel lintels and ledge angles.
 - 3. Mechanical and Electrical:
 - a. On the roof and outdoors, paint equipment supports exposed to weather or to view, except factory-finished materials.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster, and stucco.
 - 10. Glass.
 - 11. Concrete masonry units in utility, mechanical, and electrical spaces.
 - 12. Acoustical materials, unless specifically indicated.
 - 13. Concealed pipes, ducts, and conduits.
 - 14. Non-metallic roofing and flashing
 - 15. Exterior Insulation Finish Systems (EIFS)

1.2 RELATED SECTIONS

- A. Section 055000 - Metal Fabrications.
- B. Section 055100 - Metal Stairs
- C. Section 055213 - Pipe and Tube Railings
- D. Section 062000 - Finish Carpentry.

1.3 REFERENCES

- A. US Green Building Council, (USGBC) - Green Seal standards for LEED paint credits.
- B. Occupational Safety and Health Act (OSHA) - Safety Standards.
- C. American National Standards Institute (ANSI) - Performance Standards.
- D. American Society for Testing Materials (ASTM) - Testing Methods.
- E. Master Paint Institute (MPI #) - Established paint categories and standards.
- F. SCAQMD 1168 - South Coast Air Quality Management District Rule #1168; October 3, 2003.
- G. SSPC (PM1) - Steel Structures Painting Manual, Vol. 1, Good Painting Practice; Society for Protective Coatings; 1993, Third Edition.
- H. SSPC (PM2) - Steel Structures Painting Manual, Vol. 2, Systems and Specifications; Society for Protective Coatings; 1995, Seventh Edition.
- I. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- J. SSPC SP-1 - Solvent Cleaning; Society for Protective Coatings, Current Edition.

1.4 DEFINITIONS

- A. Commercial as used in this Section refers to a product well suited for a commercial application.
- B. DFT as used in this Section refers to the Dry Film Thickness of the coating.
- C. Enamel refers to any acrylic or alkyd (oil) base paint which dries leaving an eggshell, pearl, satin, semi-gloss or high gloss enamel finish.
- D. DTM as used in this Section refers to paint that is applied Direct To Metal.
- E. LEED as used in this Section refers to Leadership in Energy and Environmental Design. Products listed meet LEED criteria for environmentally safe interior primers, paints and coatings.
- F. Premium as used in this Section refers to the best quality product "top of the line".
- G. VOC as used in this Section refers to Volatile Organic Compounds found in primers, paints, sealers and stains. The level of VOCs appears after each product listed in the Schedule in grams per liter (g/L).

- H. Paints are available in a wide range of sheens or glosses, as measured by a gloss meter from a 60 and/or 85 degree angle from vertical, as a percentage of the amount of light that is reflected. The following terms are used to describe the gloss of our products. The list below is provided for general guidance; refer to the technical data sheet for the actual gloss/sheen level for each product.
1. Flat - Less than 5 Percent.
 2. Eggshell - 5 - 20 Percent.
 3. Satin - 20 - 35 Percent.
 4. Semi-Gloss - 30 - 65 Percent.
 5. Gloss - Over 65 Percent.

1.5 SUBMITTALS

- A. Submit under provisions of Section 013000 - Administrative Requirements.
- B. Coordinate with Section 013000 - Administrative Requirements.
- C. LEED Certification Product Data:
1. Submittals Required:
 - a. MRc3 Resource Reuse (LEED Form).
 - b. MRc4 Recycled Content (LEED Form).
 - c. MRc5 Local and Regional Materials (LEED Form).
 - d. EQc4.2 Low Emitting Materials - Paint (VOC Certification Letter).
- D. Product Data: Provide a complete list of all products to be used, with the following information for each:
1. Manufacturer's name, product name and/or catalog number, and general product category.
 2. Cross-reference to specified paint system(s) that the product is to be used in; include description of each system.
- E. Samples: Submit three paper samples, 5 inches by 7 inches (127mm x 178mm) in size, illustrating selected colors for each color and system selected with specified coats cascaded.
- F. Manufacturer's Instructions: Indicate special surface preparation procedures.
- G. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
- B. Installer Qualifications: All products listed in this section are to be applied by a Painting Contractor with a minimum of five years demonstrated experience in surface preparation and field application of the same type and scope as specified.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- C. Disposal:

1. Never pour leftover coating down any sink or drain. Use up material on the job or seal can and store safely for future use.
2. Do not incinerate closed containers.
3. For specific disposal or recycle guidelines, contact the local waste management agency or district. Recycle whenever possible.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 WARRANTY

- A. Inspection of all surfaces to be coated must be done by the manufacturer's representative to insure proper preparation prior to application. All thinners, fillers, primers and finish coatings shall be from the same manufacturer to support a product warranty. Products other than those submitted shall be accompanied by a letter stating its fitness for use and compatibility.
- B. At project closeout, provide to the Owner or owner's representative an executed copy of the Manufacturer's standard form outlining the terms and conditions of and any exclusions to their Limited Warranty against Manufacturing Defect.

1.10 EXTRA MATERIALS

- A. At project closeout, supply the Owner or owner's representative one gallon of each product for touch-up purposes. Cans shall be clearly marked with color name, number and type of paint.
- B. At project closeout, provide the color mixture name and code to the Owner or owner's representative for accurate future color matching.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Benjamin Moore and Co., which is located at: 101 Paragon Dr ; Montvale, NJ 07645; Toll Free Tel: 866-708-9181; Email: info@benjaminmoore.com; Web: www.benjaminmoore.com or approved equal.
- B. Requests for substitutions will be considered in accordance with provisions of Section 016000 - Product Requirements.

2.2 LEED CRITERIA

- A. LEED Version 4:
 1. All interior paints and coatings wet-applied on site must meet the applicable VOC limits of the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011 (50g/l or less for interior flats, 100 g/l or less for non-flats, 150 g/l or less for non-flats high gloss).
 2. Ninety percent of all interior paints and coatings must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1-2010.

2.3 MATERIALS - GENERAL

- A. Volatile Organic Compound (VOC) Content:
 - 1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D-National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- B. Compatibility: Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.4 MIXING AND TINTING

- A. Except where specifically noted in this section, all paint shall be ready-mixed and pre-tinted. Agitate all paint prior to and during application to ensure uniform color, gloss, and consistency.
- B. Thinner addition shall not exceed manufacturer's printed recommendations. Do not use kerosene or other organic solvents to thin water-based paints.

2.5 INTERIOR PAINT SYSTEMS

- A. MASONRY: CMU - Concrete, Split Face, Scored, Smooth, High Density, Low Density, Fluted.
 - 1. Latex Systems:
 - a. Eggshell / Satin Finish:
 - 1) 1st Coat: Benjamin Moore Super Spec® Masonry Interior/Exterior Hi-Build Block Filler 206 (45 g/L), MPI # 4, X-Green 4, LEED 2009, LEED V4, CHPS Certified.
 - 2) 2nd Coat: Benjamin Moore Ultra Spec 500 Latex Eggshell N538 (0 g/L), MPI # 52, X-Green 52, 145, X-Green 145, 139, X-Green 139, LEED 2009, LEED V4, CHPS Certified.
 - 3) 3rd Coat: Benjamin Moore Ultra Spec 500 Latex Eggshell N538 (0 g/L), MPI # 52, X-Green 52, 145, X-Green 145, 139, X-Green 139, LEED 2009, LEED V4, CHPS Certified.
- B. METAL: Aluminum, Galvanized.
 - 1. Alkyd System:
 - a. Gloss Finish Waterborne Alkyd:
 - 1) 1st Coat: Benjamin Moore Super Spec® HP Acrylic Metal Primer P04 (47 g/L), MPI # 107, X-Green 107, 134, LEED 2009, CHPS Certified.
 - 2) 2nd Coat: Benjamin Moore Advance Waterborne Interior Alkyd High Gloss N794 (48 g/L), MPI # 157, X-Green 157, LEED 2009, LEED V4.
 - 3) 3rd Coat: Benjamin Moore Advance Waterborne Interior Alkyd High Gloss N794 (48 g/L), MPI # 157, X-Green 157, LEED 2009, LEED V4.
- C. METAL - (Miscellaneous and Ornamental Iron, Ferrous Metal)
 - 1. Alkyd System:
 - a. Gloss Finish Waterborne Alkyd:

- 1) 1st Coat: Benjamin Moore Super Spec® HP Alkyd Metal Primer P06 (323 g/L), MPI # 79.
 - 2) 2nd Coat: Benjamin Moore Advance Waterborne Interior Alkyd High Gloss N794 (48 g/L), MPI # 157, X-Green 157, LEED 2009, LEED V4.
 - 3) 3rd Coat: Benjamin Moore Advance Waterborne Interior Alkyd High Gloss N794 (48 g/L), MPI # 157, X-Green 157, LEED 2009, LEED V4.
- D. WOOD - (Trim):
1. Latex Systems:
 - a. Semi - Gloss Finish:
 - 1) 1st Coat: Benjamin Moore Fresh Start Multi-Purpose Primer N023 (44 g/L), MPI # 6, 17, X-Green 17, 39, 137, X-Green 137, LEED Credit, CHPS Certified.
 - 2) 2nd Coat: Coronado Rust Scat Waterborne Acrylic Semi-Gloss 90 (134 g/L), MPI # 153, LEED Credit.
 - 3) 3rd Coat: Coronado Rust Scat Waterborne Acrylic Semi-Gloss 90 (134 g/L), MPI # 153, LEED Credit.
- E. DRYWALL - (Walls, Ceilings, Gypsum Board and similar items)
1. Latex Systems:
 - a. Eggshell / Satin System:
 - 1) 1st Coat: Benjamin Moore Ultra Spec 500 Interior Latex Primer N534 (0 g/L), MPI # 50, X-Green 50, 149, X-Green 149, LEED 2009, LEED V4, CHPS Certified.
 - 2) 2nd Coat: Benjamin Moore Ultra Spec 500 Latex Eggshell N538 (0 g/L), MPI # 52, X-Green 52, 145, X-Green 145, 139, X-Green 139, LEED 2009 LEED V4, CHPS Certified.
 - 3) 3rd Coat: Benjamin Moore Ultra Spec 500 Latex Eggshell N538 (0 g/L), MPI # 52, X-Green 52, 145, X-Green 145, 139, X-Green 139, LEED 2009, LEED V4, CHPS Certified.
 - b. Flat System
 - 1) 1st Coat: Benjamin Moore Ultra Spec 500 Interior Latex Primer N534 (0 g/L), MPI # 50, X-Green 50, 149, X-Green 149, LEED 2009, LEED V4, CHPS Certified.
 - 2) 2nd Coat: Benjamin Moore Ultra Spec 500 Interior Latex Flat N536 (0 g/L), MPI # 53, X-Green 53, 143, X-Green 143, LEED 2009, LEED V4, CHPS Certified.
 - 3) 3rd Coat: Benjamin Moore Ultra Spec 500 Interior Latex Flat N536 (0 g/L), MPI # 53, X-Green 53, 143, X-Green 143, LEED 2009, LEED V4, CHPS Certified.

2.6 HIGH PERFORMANCE INTERIOR PAINT SYSTEMS

- A. CONCRETE - Smooth (Floors)
1. Epoxy System (Water Base):
 - a. Semi-Gloss/High Luster Finish:
 - 1) 1st Coat: Corotech 100% Solid Epoxy Pre-Primer V155 (100 g/L), LEED 2009.
 - 2) 2nd Coat: Corotech Waterborne Amine Epoxy V440 (206 g/L).
 - 3) 3rd Coat: Corotech Waterborne Amine Epoxy V440 (206 g/L).
- B. DRYWALL - (Walls, Ceilings, Gypsum Board)
1. Epoxy Systems (Water Base):
 - a. Gloss Finish:
 - 1) 1st Coat: Benjamin Moore Fresh Start Multi-Purpose Primer N023 (44 g/L), MPI # 6, 17, X-Green 17, 39, 137, X-Green 137, LEED Credit,

CHPS Certified.

- 2) 2nd Coat: Corotech Acrylic Epoxy V450 (168 g/L).
- 3) 3rd Coat: Corotech Acrylic Epoxy V450 (168 g/L).

2.7 EXTERIOR PAINT SYSTEMS

A. METAL: Aluminum, Galvanized.

1. Latex Systems:

a. Gloss Finish- Early Moisture Resistant Finish

- 1) 1st Coat: Benjamin Moore Ultra Spec D.T.M. Acrylic Gloss Enamel HP28 (142 g/L), MPI # 114, X-Green 114, 154, X-Green 154, 164, LEED 2009, LEED V4.
- 2) 2nd Coat: Benjamin Moore Ultra Spec D.T.M. Acrylic Gloss Enamel HP28 (142 g/L), MPI # 114, X-Green 114, 154, X-Green 154, 164, LEED 2009, LEED V4.

B. METAL: Misc. Iron, Ornamental Iron, Structural Iron and Steel, Ferrous Metal.

1. Latex Systems:

a. Semi-Gloss Finish

- 1) 1st Coat: Corotech Acrylic Metal Primer V110 (199 g/L), LEED Credit.
- 2) 2nd Coat: Benjamin Moore Ultra Spec HP D.T.M. Acrylic Semi-Gloss Enamel, HP29 (147 g/L), MPI # 141, X-Green 141, 153, X-Green 153, LEED 2009, LEED V4.
- 3) 3rd Coat: Benjamin Moore Ultra Spec HP D.T.M. Acrylic Semi-Gloss Enamel, HP29 (147 g/L), MPI # 141, X-Green 141, 153, X-Green 153, LEED 2009, LEED V4.

C. DRYWALL: Gypsum Board, Exterior Drywall.

1. Latex Systems:

a. Flat Finish:

- 1) 1st Coat: Benjamin Moore Fresh Start High-Hiding All Purpose Primer 046 (44 g/L), MPI # 6, 17, X-Green 17, 39, 50, X-Green 50, 137, X-Green 137, LEED Credit, CHPS Certified.
- 2) 2nd Coat: Benjamin Moore ben Waterborne Exterior Flat 541 (44 g/L), MPI # 10.
- 3) 3rd Coat: Benjamin Moore ben Waterborne Exterior Flat 541 (44 g/L), MPI # 10.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The Contractor shall review the product manufacturer's special instructions for surface preparation, application, temperature, re-coat times, and product limitations.
- B. The Contractor shall review product health and safety precautions listed by the manufacturer.
- C. The Contractor shall be responsible for enforcing on site health and safety requirements associated with the Work.
- D. Do not begin installation until substrates have been properly prepared.
- E. Ensure that surfaces to receive paint are dry immediately prior to application.
- F. Ensure that moisture-retaining substrates to receive paint have moisture content within tolerances allowed by coating manufacturer. Where exceeding the following values,

promptly notify Architect and obtain direction before beginning work.

1. Concrete and Masonry: 3-5 percent. Allow new concrete to cure a minimum of 28 days.
2. Exterior Wood: 17 percent.
3. Interior Wood: 15 percent.
4. Interior Finish Detail Woodwork, Including Trim, and Casework: 10 percent.
5. Plaster and Gypsum: 15 percent.
6. Concrete Slab-On-Grade: Perform calcium chloride test over 24 hour period or other acceptable test to manufacturer. Verify acceptable moisture transmission and pH levels.

G. Examine surfaces to receive coatings for surface imperfections and contaminants that could impair performance or appearance of coatings, including but not limited to, loose primer, rust, scale, oil, grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.

H. Correct conditions that could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.2 PREPARATION - GENERAL

A. Clean surfaces thoroughly prior to coating application.

B. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.

C. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; cover stains and marks which cannot be completely removed with isolating primer or sealer recommended by coating manufacturer to prevent bleed-through.

D. Remove Mildew, Algae, and Fungus using materials and methods recommended by coating manufacturer.

E. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.

F. Remove or protect adjacent hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings.

G. Move or protect equipment and fixtures adjacent to surfaces indicated to receive coatings to allow application of coatings.

H. Protect adjacent surfaces not indicated to receive coatings.

I. Prepare surfaces in accordance with manufacturer's instructions for specified coatings and indicated materials, using only methods and materials recommended by coating manufacturer.

J. Test galvanized metals for passivators using the following procedure:

1. Dissolve 20 grams of copper sulfate crystals in one liter of water.
2. Using the procedure specified in SSPC SP-1, perform a solvent wash of a 6" x 6" area of the galvanized part that you want to test.
3. Sand half of the test area using emery cloth. Do not sand the other half.
4. Using an absorbent cotton swab, swipe once through the sanded and unsanded areas of the test area.
5. If the sanded and unsanded areas both turn black at the same rate and in less than 10 seconds, there is no passivation on the surface other than light oil. If the unsanded

area turns black slower than the sanded area, or not at all, there is a passivator present on the galvanized steel. If neither surface turns black, the surface is probably an alloy of zinc or some other metal.

6. Prepare galvanized steel surfaces in accordance with the Surface Preparation section for the type of galvanized steel present.

3.3 SURFACE PREPARATION

- A. Concrete and Concrete Masonry: Clean surfaces free of loose particles, sand, efflorescence, laitance, form oil, curing compounds, and other substances which could impair coating performance or appearance.
- B. Concrete Floors: Remove contaminants which could impair coating performance or appearance. Verify moisture transmission and alkaline-acid balance recommended by coating manufacturer; mechanically abrade surface to achieve 80-100 grit medium-sandpaper texture.
- C. Existing Coatings:
 1. Remove surface irregularities by scraping or sanding to produce uniform substrate for coating application; apply one coat primer of type recommended by coating manufacturer for maximum coating adhesion.
 2. If presence of lead in existing coatings is suspected, cease surface preparation and notify Architect immediately.
- D. Gypsum Board: Repair cracks, holes and other surface defects with joint compound to produce surface flush with adjacent surfaces.
- E. Metals - Aluminum, Mill-Finish: Clean and etch surfaces with a phosphoric acid-water solution or water based industrial cleaner. Flush with clean water and allow to dry, before applying primer coat.
- F. Metals - Ferrous, Shop-Primed: Remove loose primer and rust, if present, by scraping and sanding, feathering edges of cleaned areas to produce uniform flat surface; solvent-clean surfaces and spot-prime bare metal with specified primer, feathering edges to produce uniform flat surface.
- G. Metals - Galvanized Steel (not passivated): Clean with a water-based industrial strength cleaner, apply an adhesion promoter followed by a clean water rinse. Alternately, wipe down surfaces using clean, lint-free cloths saturated with xylene or lacquer thinner; followed by wiping the surface dry using clean, lint-free cloths.
- H. Metals - Galvanized Steel, Passivated: Clean with water-based industrial strength cleaner. After the surface has been prepared, apply recommended primer to a small area. Allow primer to cure for 7 days, and test adhesion using the "cross-hatch adhesion tape test" method in accordance with ASTM D 3359. If the adhesion of the primer is positive, proceed with a recommended coating system for galvanized metal.
- I. Wood:
 1. Seal knots, pitch streaks, and sap areas with sealer recommended by coating manufacturer; fill nail recesses and cracks with filler recommended by coating manufacturer; sand surfaces smooth.
 2. Remove mill marks and ink stamped grade marks.
 3. Apply primer coat to back of wood trim and paneling.

3.4 APPLICATION - GENERAL

- A. Application of primers, paints, stains or coatings, by the Contractor, will serve as acceptance that surfaces were properly prepared in accordance with the manufacturer's

recommendation.

- B. Apply each coat to uniform coating thickness in accordance with manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
- C. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
- D. Inspect each coat before applying next coat; touch-up surface imperfections with coating material, feathering, and sanding if required; touch-up areas to achieve flat, uniform surface without surface defects visible from 5 feet (1.5 m).
- E. Remove dust and other foreign materials from substrate immediately prior to applying each coat.
- F. Where paint application abuts other materials or other coating color, terminate coating with a clean sharp termination line without coating overlap.
- G. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.
- H. Re-prepare and re-coat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

3.5 CLEANING

- A. Clean excess coating materials, and coating materials deposited on surfaces not indicated to receive coatings, as construction activities of this section progress; do not allow to dry.
- B. Re-install hardware, electrical equipment plates, mechanical grilles and louvers, lighting fixture trim, and other items that have been removed to protect from contact with coatings.
- C. Reconnect equipment adjacent to surfaces indicated to receive coatings.
- D. Relocate to original position equipment and fixtures that have been moved to allow application of coatings.
- E. Remove protective materials.

3.6 PROTECTION AND REPAIR

- A. Protect completed coating applications from damage by subsequent construction activities until completion of painting project.
- B. Touch-up coatings damaged by subsequent construction activities.

3.7 SCHEDULE: REFER TO DRAWINGS FOR FINISH LEGEND, FINISH SCHEDULE AND FINISH PLANS.

END OF SECTION

SECTION 101400
SIGNAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cash allowance for signs.
- B. Room and door signs.
- C. Emergency evacuation maps.
- D. Building identification signs.
- E. Plaque.

1.2 PRICE AND PAYMENT PROCEDURES

- A. See Section 012100 - Allowances, for cash allowances affecting this section.
- B. Allowance amount covers purchase and delivery but not installation.

1.3 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign, installation instructions and methods.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Shop Drawings for Plaque and Building Identification Signs: Provide information sufficient to completely define each sign for fabrication, including sign and letter size, fonts, and colors.

1. Request artwork for Town Seal plaques from Owner, through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 2. Submit for approval by Owner, through Architect, prior to fabrication.
- E. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- F. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- H. Installer's Qualification Statement
- I. Manufacturer's Qualification Statement.
- 1.5 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- B. Installer's Qualifications: Company specializing in installation of the products specified in this section with minimum five years of documented experience.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.
- 1.7 FIELD CONDITIONS
- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Flat Signs:
1. Best Sign Systems, Inc: Graphic Blast MP; www.bestsigns.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.
- B. Dimensional Letter Signs:
1. Impact Signs: Cut Stainless Steel: www.impactsigns.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.
- C. Plaques:
1. Impact Signs: Cast Aluminum Plaque; www.impactsigns.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.

2.2 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Character Height: 1 inch.
 - 4. Sign Height: 2 inches, unless otherwise indicated.
 - 5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
 - 6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Emergency Evacuation Maps:
 - 1. Allow for one map per elevator lobby.
- D. Building Identification Signs:
 - 1. Use individual metal letters.
 - 2. Mount on outside wall in location indicated on drawings.
- E. Plaque: See Allowance for details.

2.3 SIGN TYPES

- A. Interior Flat Signs: Signage media without frame.
 - 1. Edges: Square.
 - 2. Corners: Square.
 - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: Clear.
 - 4. Character Color: Contrasting color.

2.4 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
 - 1. Total Thickness: 1/16 inch.

2.5 PLAQUES

- A. Metal Plaques:
 - 1. Metal: Aluminum casting.

2. Metal Thickness: 1/8 inch, minimum.
3. Size and shape: As indicated on drawings.
4. Border Style: As indicated on drawings.
5. Background Texture: Stipple.
6. Surface Finish: Brushed, satin.
7. Painted Background Color: As selected by Architect from manufacturer's standard background colors.
8. Protective Coating: Manufacturer's standard clear coating.
9. Mounting: Blind studs.

2.6 DIMENSIONAL LETTERS

- A. Metal Letters:
 1. Metal: Stainless steel sheet, flat.
 2. Metal Thickness: 1/4 inch minimum.
 3. Letter Height: 12 inches.
 4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 5. Finish: Brushed, satin.
 6. Mounting: Concealed screws.

2.7 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 102113.19
PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.

1.2 RELATED REQUIREMENTS

- A. Section 061053 - Miscellaneous Rough Carpentry: Blocking and supports
- B. Section 102800 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

- A. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2019.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, installation instructions, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Samples: Submit two samples of partition panels, 12 by 12 inch in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Solid Plastic Toilet Compartments:
 - 1. ASI Global Partitions; Solid Plastic (HDPE) Partitions: www.asi-globalpartitions.com or approved equal.
 - 2. Substitutions: Section 016000 - Product Requirements.

2.2 PLASTIC TOILET COMPARTMENTS

- A. Solid Plastic Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), tested in accordance with NFPA

286; floor-mounted headrail-braced.

1. Color: As selected by Architect from manufacturer's standard product range..
2. Finish: Peeble-grained, homogeneous color throughout material.
3. Doors:
 - a. Thickness: 1 inch.
 - b. Width: 24 inch.
 - c. Width for Handicapped Use: 36 inch, out-swinging.
 - d. Height: 55 inch.
4. Panels:
 - a. Thickness: 1 inch.
 - b. Height: 55 inch.
 - c. Depth: As indicated on drawings.
5. Pilasters:
 - a. Thickness: 1 inch.
 - b. Width: As required to fit space; minimum 3 inch.
6. Screens: Without doors; to match compartments; mounted to wall with anodized aluminum, continuous panel bracket.

2.3 ACCESSORIES

- A. Pilaster Shoes: Stainless steel, satin finish, 3 inches high; concealing floor fastenings.
- B. Head Rails: Anodized, extruded aluminum, anti-grip profile.
 1. Size: Manufacturer's standard size.
- C. Wall and Pilaster Brackets: Anodized aluminum; continuous type.
- D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
- E. Hinges: Anodized aluminum, manufacturer's standard finish.
 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
- F. Door Hardware: Anodized aluminum, manufacturer's standard finish.
 1. Door Latch: Slide type with exterior emergency access feature.
 2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
 3. Provide door pull for outswinging doors.
- G. Coat Hook: One per compartment, mounted on door.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 102226 OPERABLE PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Manually operated, individual panel operable partitions.
- B. Related Sections include the following:
 - 1. Division 03 Sections for concrete tolerances required.
 - 2. Division 05 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
 - 3. Division 06 Sections for wood framing & supports, and all blocking at head and jambs as required.
 - 4. Division 09 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
- D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.

1.4 REFERENCE STANDARDS

- A. ASTM International
 - 1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
 - 2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. ASTM C1036 - Standard Specification for Flat Glass.
 - 4. ASTM C1048 - Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
 - 5. ASTM E84 - Surface Burning Characteristics of Building Materials.
 - 6. ASTM E413 - Classification for Rating Sound Insulation

- B. Health Product Declaration Collaborative
 - 1. Health Product Declaration Open Standard v2.1
 - C. International Standards Organization
 - 1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
 - D. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
 - 1. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.
 - 2. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
 - 3. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.
 - E. Other Standards
 - 1. ADA – Americans with Disabilities Act.
 - 2. ANSI Z97.1 - Safety Glazing Materials Used in Buildings.
 - 3. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
 - 4. NEMA LD3 - High Pressure Decorative Laminates.
- 1.5 SUBMITTALS
- A. Product Data: Material descriptions, construction details, finishes, installation details and instructions, and operating instructions for each type of operable partition, component, and accessory specified.
 - B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
 - C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
 - D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
 - E. Reports: Provide a complete and unedited written sound test report indicating test specimen matches product as submitted.
 - F. Create spaces that are healthy for occupants.
 - 1. Furnish products and materials with Health Product Declaration (HPD), Manufacturer Inventory, or other material health disclosure documentation. Products without an HPD or other disclosure documentation are not acceptable.
 - G. Furnish materials that generate the least amount of pollution.
 - 1. Furnish products and materials that have third party verified environmental product declarations (EPD's). Consider products and materials that have optimized environmental performance (reduced life cycle impacts). Products without an EPD or other disclosure documentation are not acceptable.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

- A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
- B. Warranty period: Two (2) years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

- A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
 - 1. Modernfold, Inc. (Basis of Design)
 - 2. An Approved Equal
- B. Products: Subject to compliance with the requirements, provide the following product:
 - 1. OP-01: Acousti-Seal #931 manually operated individual panel operable partition.
 - 2. OP-02: Acousti-Seal #931 manually operated individual panel operable partition.

2.2 OPERATION

- A. OP-01: Acousti-Seal #931: Series of individual flat panels, manually operated, top supported with operable floor seals.
- B. OP-02: Acousti-Seal #931: Series of individual flat panels, manually operated, top supported with operable floor seals.
- C. Final Closure:
 - 1. OP-01: Horizontally expanding panel edge with removable crank
 - 2. OP-02: Horizontally expanding panel edge with removable crank

2.3 PANEL CONSTRUCTION

- A. Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 18-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
- B. Panel skin shall be:
 - 1. OP-01: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
 - a. 52 STC
 - 2. OP-02: Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings

of panels with this construction minimum:

a. 52 STC

C. Hinges for Closure Panels, Pass Doors, and Pocket Doors shall be:

1. OP-01: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
2. OP-02: Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.

D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.

E. Panel Weights:

1. OP-01: 52 STC - 11 lbs./square foot
2. OP-02: 52 STC - 11 lbs./square foot

2.4 PANEL FINISH

A. Panel finish shall be:

1. OP-01: Reinforced vinyl with woven backing weighing not less than 21 ounces (595 grams) per lineal yard.
2. OP-02: Reinforced vinyl with woven backing weighing not less than 21 ounces (595 grams) per lineal yard.

B. Panel Trim: Exposed panel trim of one consistent color:

1. OP-01: To Be Advised
2. OP-02: To Be Advised

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.

B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.

C. Horizontal bottom floor seals shall be:

1. OP-01: Modernfold IC2 Bottom Seal. Manually activated operable bottom seals with removable handle providing nominal 2-inch (51mm) operating clearance with an operating range of +0.50-inch (13mm) to -1.50-inch (38mm). Seal shall be operable from panel edge or face.
2. OP-02: Modernfold IC2 Bottom Seal. Manually activated operable bottom seals with removable handle providing nominal 2-inch (51mm) operating clearance with an operating range of +0.50-inch (13mm) to -1.50-inch (38mm). Seal shall be operable from panel edge or face.

2.6 SUSPENSION SYSTEM

A. OP-01: RT100 Suspension System – Right Angle Turn

1. Suspension Tracks: Precision heat-treated extruded aluminum. Track to be supported by pairs of 0.38-inch (10mm) diameter threaded rods.

- a. Exposed track soffit: Aluminum, integral to track, pre-painted white.
- 2. Carriers: Shall have horizontal counter-rotating wheels with oversized heavy duty thrust steel bearings. Carriers permit panels to traverse L, T, or X intersections without mechanical switching.
- B. OP-02: RT100 Suspension System – Right Angle Turn
 - 1. Suspension Tracks: Precision heat-treated extruded aluminum. Track to be supported by pairs of 0.38-inch (10mm) diameter threaded rods.
 - a. Exposed track soffit: Aluminum, integral to track, pre-painted white.
 - 2. Carriers: Shall have horizontal counter-rotating wheels with oversized heavy duty thrust steel bearings. Carriers permit panels to traverse L, T, or X intersections without mechanical switching.

2.7 OPTIONS

- A. Pass Doors:
- B. Single Pass Doors:
 - 1. OP-01: Matching pass door same thickness and appearance as the panels. ADA compliant pass door equipped with friction latch and flush pulls for panic operation. No threshold will be permitted.
 - 2. OP-01: Matching pass door same thickness and appearance as the panels. ADA compliant pass door equipped with friction latch and flush pulls for panic operation. No threshold will be permitted.
- C. Pass Doors:
 - 1. OP-02: Matching pass door same thickness and appearance as the panels. ADA compliant pass door equipped with friction latch and flush pulls for panic operation. No threshold will be permitted.
 - 2. OP-02: Matching pass door same thickness and appearance as the panels. ADA compliant pass door equipped with friction latch and flush pulls for panic operation. No threshold will be permitted.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
- B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
- C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

- A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

- A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION

SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Under-lavatory pipe supply covers.
- D. Electric hand/hair dryers.
- E. Diaper changing stations.
- F. Utility room accessories.

1.2 RELATED REQUIREMENTS

- A. Section 061053 - Miscellaneous Rough Carpentry: Concealed supports for accessories, including in wall framing and plates and above ceiling framing.
- B. Section 102113.19 - Plastic Toilet Compartments.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service 2015a (Reapproved 2019).
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium 2017.
- E. ASTM C1036 - Standard Specification for Flat Glass 2021.
- F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- H. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2004, with Editorial Revision (2016).
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015 (Reapproved 2021)e1.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. American Specialties, Inc: www.americanspecialties.com or approved equal.
 - 2. Substitutions: Section 016000 - Product Requirements.
- B. Under-Lavatory Pipe Supply Covers:
 - 1. Truebro; Lav Shield and Lav Guard 2; www.truebro.com; or approved equal.
 - 2. Substitutions: Section 016000 - Product Requirements.
- C. Electric Hand/Hair Dryers:
 - 1. Dyson; Airblade V; www.dyson.com or approved equal.
 - 2. Substitutions: Section 016000 - Product Requirements.
- D. Diaper Changing Stations:
 - 1. American Specialties, Inc; Model #9012 Horizontal Baby Changing Station: www.americanspecialties.com or approved equal.
 - 2. Substitutions: 016000 - Product Requirements.
- E. Provide products of each category type by single manufacturer.

2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 4 keys for each accessory to Owner; master key lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.3 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.4 Commercial Toilet Accessories

- A. Toilet Paper Dispenser: Double roll, semi-recessed, stainless steel unit with pivot hinge, tumbler lock.
 - 1. Products:
 - a. American Specialties, Inc. #0032 - Partition Mounted Dual Twin Hide-A-Roll Toilet Paper Dispenser; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- B. Toilet Seat Cover Dispenser: Surface mounted, 18-8 stainless steel, type 304, 22 guage.
 - 1. Products:
 - a. American Specialties, Inc. #0477-SM; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- C. Combination Towel Dispenser/Waste Receptacle: Semi-Recessed , stainless steel; seamless wall flanges, continuous piano hinges.
 - 1. Products:
 - a. American Specialties, Inc.,; #0469-2; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- D. Automated Soap Dispenser: Liquid soap dispenser, deck-mounted on vanity, with container concealed below deck; chrome-plated brass with bright polished finish; chrome-plated deck escutcheon.
 - 1. Products:
 - a. Delta; Contemporary Soap Dispenser with Touch 20.xt Technology; www.deltafaucet.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- E. Mirrors: Framed, 1/4 inch thick annealed float glass; ASTM C1036.
 - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 - 2. Size: 24 inch wide x 36 inch high.
 - 3. Frame: solid, non-corrosive, drop-forged brass, satin nickle plated and polished.
 - 4. Support: Tamperproof hanging system with concealed hardware.
 - 5. Adjustable Tilt Mirror: Brackets at mid-point of mirror height allows for adjustable tilt up or down.
 - 6. Products:
 - a. American Specialties, Inc.; Inter-Lock Tilting Stainless Steel Framed Mirror ; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- F. Grab Bars: Brass, polished and plated. smooth surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, snap flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.

- c. Finish: Polished.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products:
 - 1) American Specialties, Inc.; 3700 Series; www.americanspecialties.com or approved equal.
 - 2) Substitutions: Section 016000 - Product Requirements.
- G. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
- 1. Products:
 - a. American Specialties, Inc.; #0852; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.

2.5 Commercial Shower and Bath Accessories

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- 1. Products:
 - a. American Specialties, Inc. #1214; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- B. Shower Curtain:
- 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Size: 36 by 72 inches, hemmed edges.
 - 3. Grommets: Clear, anodized aluminum; pierced through top hem on 6 inch centers.
 - 4. Color: White.
 - 5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
 - 6. Products:
 - a. American Specialties, Inc; #1200-V and 1200-SHU; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand, L-shaped, left hand, and rectangular seat.
- 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, color: white.
 - 2. Size: ADA Standards compliant.
 - 3. Products:
 - a. American Specialties, Inc; #8203; www.americanspecialties.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.
- D. Robe Hook: Polished zinc, single prong hook with backplate for concealed attachment, polished nickel finish.
- 1. Products:
 - a. Kohler; Tempered K-21956 Robe Hook; www.kohler.com or approved equal.
 - b. Substitutions: Section 016000 - Product Requirements.

2.6 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:

1. Insulate exposed drainage piping, including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
3. Construction: 1/8 inch flexible PVC.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - b. Comply with ICC A117.1.
 - c. Microbial and Fungal Resistance: Comply with ASTM G21.
4. Color: White.
5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.
6. Products:
 - a. Truebro; Lav Shield and Lav Guard 2; www.truebro.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.7 Electric Hand/Hair Dryers

- A. Electric Hand Dryer: High velocity air dryer
 1. Operation: Automatic, sensor-operated on and off
 2. Mounting: Surface mounted
 3. Cover: Chrome plated steel or die-cast zinc alloy.
- B. Electric Hand Dryer Products:
 1. Dyson; Airblade V; www.dyson.com or equal.
 2. Substitutions: See Section 016000 - Product Requirements

2.8 Diaper Changing Stations

- A. Diaper Changing Station: Wall-mounted folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
 1. Material: Polyethylene.
 2. Mounting: Surface.
 3. Color: As selected.
 4. Minimum Rated Load: 300 pounds.
 5. Products:
 - a. American Specialties, Inc; #9012; www.americanspecialties.com or approved equal.
 - b. Substitutions: 016000 - Product Requirements.

2.9 Utility Room Accessories

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 1. Drying rod: Stainless steel, 1/4 inch diameter.
 2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 4. Length: 36 inches.
 5. Products:
 - a. American Specialties, Inc; #1315-4; www.americanspecialties.com or approved equal.
 - b. Substitutions: 016000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.
- E. See Section 061053 - Miscellaneous Rough Carpentry for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

3.4 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 104400
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Roughed-in wall openings.

1.3 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems 2013a (Reapproved 2017).
- B. NFPA 10 - Standard for Portable Fire Extinguishers 2017, with Errata (2018).
- C. UL (DIR) - Online Certifications Directory Current Edition.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.5 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Kidde, a unit of United Technologies Corp; Multi-purpose ProPlus 10 MP #468002: www.kidde.com or approved equal.

2. Substitutions: See Section 016000 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:

1. Kidde, a unit of United Technologies Corp; Semi-Recessed: www.kidde.com or approved equal.
2. Substitutions: See Section 016000 - Product Requirements.

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

1. Provide extinguishers labeled by UL (DIR) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.

1. Class: A:B:C type.
2. Size: 10 pound.
3. Finish: Baked polyester powder coat, red color.

2.3 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Cabinet Construction: Non-fire rated.

1. Formed galvanized steel sheet; 0.036 inch thick base metal.

C. Fire Rated Cabinet Construction: One-hour fire rated.

1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.

D. Cabinet Configuration: Semi-recessed type.

1. Size to accommodate accessories.
2. Projected Trim: Returned to wall surface, with 5/8 inch projection, and 2 inch wide face.
3. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.

E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

F. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.

G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

H. Fabrication: Weld, fill, and grind components smooth.

I. Finish of Cabinet Exterior Trim and Door: Baked enamel, color as selected.

J. Finish of Cabinet Interior: White colored enamel.

2.4 ACCESSORIES

A. Extinguisher Brackets: Formed steel, chrome-plated.

B. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, 24 inches from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

3.3 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.

3.4 MAINTENANCE - SELF-SERVICE FIRE EXTINGUISHERS

- A. Monthly Inspections: Inspect self-service fire extinguishers on monthly basis in accordance with manufacturer's instructions, and requirements of the authorities having jurisdiction (AHJ).
- B. Annual Inspections: Inspect self-service fire extinguishers on annual basis in accordance with manufacturer's instructions, and requirements of the authorities having jurisdiction (AHJ).
- C. Inspection Certification Tag: Provide new tag indicating acceptable condition of fire extinguisher, date of inspection, and name of self-service inspector for each inspection.

END OF SECTION

SECTION 107316.13
METAL CANOPIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated metal canopies.

1.2 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2021a.
- C. ASTM E2950 - Standard Specification for Metal Canopy Systems 2020.

1.3 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit product data sheets, including material descriptions and finishes, and preparation instructions and recommendations.
- C. Shop Drawings: Prior to commencement of fabrication, submit detailed shop drawings, showing profiles, sections of components, finishes, fastening details, and installation instructions.
- D. Design Data: Submit comprehensive structural analysis of design for the specified loads. Stamp and sign calculations by professional engineer, licensed in the state in which canopy is to be installed.
- E. Manufacturer's Qualification Statement.
- F. Erector's Qualification Statement.
- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
 - 1. Comply with applicable code for submission of design calculations as required for acquiring permits.
- B. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.
 - 1. Not less than three years of documented experience.
- C. Erector Qualifications: Company specializing in performing the work of this section.

1. Not less than three years of documented experience and approved by canopy manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site ready for erection.
- B. Package using methods that prevent damage during shipping and storage on site.
- C. Store materials under cover and elevated above grade.

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Metal Canopies: Correct defective work within a two year period after Date of Substantial Completion.
- C. Finish Warranty: Provide manufacturer's one year warranty on factory finish against cracking, peeling, and blistering.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal Canopies:
 1. Mapes Architectural Canopies; www.mapes.com or approved equal.
 2. Substitutions: See Section 016000 - Product Requirements.

2.2 METAL CANOPIES

- A. Shop Fabricated Metal Canopy
 1. Pre-engineered system complying with ASTM E2950.
 2. Design and fabricate metal canopy system to resist wind, snow, live, and seismic loads without failure, damage, or permanent deflection in accordance with ASCE 7:
 - a. Loads: In compliance with local building codes.
 3. Thermal Movement: Design canopy system to accommodate thermal movement caused by ambient temperature range of 120 degrees F and surface temperature range of 180 degrees F without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects on assembly components.
- B. Configuration: Canopy clearance, fascia profile, and roof covering design as indicated on drawings.

2.3 COMPONENTS

- A. Deck:
 1. Sheet Metal Decking: Interlocking metal panels.
 - a. Panel Size: 16 inches wide by 3 inches deep; 20 gauge, 0.0359 inch thickness.
 - b. Material: ASTM A792/A792M aluminum-zinc alloy coated to AZ50/AZM150.
 - c. Provide canopy manufacturer's standard clip type fasteners for attaching covering to structural beams.
- B. Fascia: Manufacturer's standard flat profile, 12 inch high, "J" style.
 1. Material: Aluminum Composite Material (ACM) panel.

- C. Exposed Gutters and Downspouts: Prefinished aluminum, color to match canopy covering, manufacturer's recommended size for canopy specified.

2.4 SHOP FABRICATION

- A. Provide a complete system ready for erection at project site.
- B. Shop fabricate to the greatest extent possible; disassemble if necessary for shipping.
- C. All connections shall be mechanically assembled utilizing 3//16" fasteners with a minimum shear stress of 350 lbs. Pre-welded or factory-welded connections are not acceptable.
- D. Concealed drainage: Water shall drain from covered surfaces into integral fascia gutter and directed to the rear for ground level discharge via one or more designated downspouts.
- E. Fabricate connections for bolt, nut, and washer connectors.

2.5 FINISHES

- A. Aluminum Decking: 2-coat Kynar finish; color as selected from manufacturer's standard range.
- B. Fascia: Fluoropolymer finish; color as selected from manufacturer's standard range.

2.6 ACCESSORIES

- A. Trim, Closure Pieces, and Flashings: Same material, thickness and finish as sheet metal decking; factory-fabricated to required profiles.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and site area for conditions that might prevent satisfactory installation.
- B. Verify that placed anchors are in correct position.
- C. Verify that dimensions and elevations are as shown on shop drawings.
- D. Do not proceed with installation until all conditions are satisfactory.

3.2 INSTALLATION - General

- A. Install canopy in accordance with manufacturer's instructions.
- B. Install fascia panels, trim, and flashing as necessary.
- C. Install downspout and connect to drainage receptor.
- D. Separate dissimilar metals using concealed bituminous paint.
- E. Touch-up damaged finish coating using material provided by manufacturer to match original coating.

3.3 TOLERANCES

- A. Maximum Variation from Level: Plus/Minus 1/8 inch.

3.4 CLEANING

- A. Clean surfaces of dust and debris; follow manufacturer's cleaning instructions for the finish used.

3.5 PROTECTION

- A. Protect canopy after installation to prevent damage due to other work until Date of Substantial Completion.

END OF SECTION

SECTION 113013
RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Kitchen appliances.

1.2 RELATED REQUIREMENTS

- A. Section 260583 - Wiring Connections: Electrical connections for appliances.

1.3 REFERENCE STANDARDS

- A. UL (DIR) - Online Certifications Directory Current Edition.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data indicating dimensions, capacity, and operating features of each piece of residential equipment specified. Include manufacturer's installation instructions for each appliance to be installed.
- C. Copies of Warranties: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Electric Appliances: Listed and labeled by UL (DIR) and complying with NEMA Standards (National Electrical Manufacturers Association).

1.6 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five (5) year manufacturer warranty on refrigeration system of refrigerators.
- C. Provide ten (10) year manufacturer warranty on magnetron tube of microwave ovens.

PART 2 PRODUCTS

2.1 KITCHEN APPLIANCES

- A. Refrigerator: Free-standing, top-mounted freezer, and frost-free.
 - 1. Capacity: Total minimum storage of 18 cubic ft; minimum 15 percent freezer capacity.
 - 2. Energy Usage: Minimum 20 percent more energy efficient than energy efficiency standards set by U.S. Department of Energy (DOE).

3. Features: Include glass shelves.
 4. Exterior Finish: Stainless steel.
 5. Manufacturers:
 - a. Frigidaire Home Products: www.frigidaire.com.
 - b. GE Appliances: www.geappliances.com.
 - c. Whirlpool Corp: www.whirlpool.com.
 - d. Substitutions: See Section 016000 - Product Requirements.
- B. Microwave: Under-cabinet mounted.
1. Capacity: 0.9 cubic ft.
 2. Power: 1000 watts.
 3. Features: Include turntable, 2-speed exhaust fan, built-in trim kit, undercabinet mounting kit, and [_____].
 4. Exterior Finish: Black.
 5. Manufacturers:
 - a. Frigidaire Home Products: www.frigidaire.com/#sle.
 - b. GE Appliances: www.geappliances.com.
 - c. Whirlpool Corp: www.whirlpool.com.
 - d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Anchor built-in equipment in place.

3.2 CLEANING

- A. Remove packing materials from equipment and properly discard.
- B. Wash and clean equipment.

END OF SECTION

SECTION 122400
WINDOW SHADES - MECHOSHADE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manual roller shades and accessories.
- B. Motorized roller shades and accessories.
- C. Motor controls, interfaces, and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 061053 - Miscellaneous Rough Carpentry: Concealed wood blocking for attachment of shade brackets and accessories.
- B. Division 26 Electrical Sections: Lighting control system, for interface with motorized shades.
- C. Division 26 Electrical Sections: Audio-video systems, for control interface with motorized shades.

1.3 REFERENCE STANDARDS

- A. C2C (DIR) - C2C Certified Products Registry; Cradle to Cradle Products Innovation Institute Current Edition.
- B. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films 2019.
- D. UL (GGG) - GREENGUARD Gold Certified Products Current Edition.
- E. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.
- F. WCMA A100.1 - Safety of Window Covering Products 2018.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
 - 2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product to be used including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 - 1. Motorized Shades: Include power requirements, standard wiring diagrams, and installation instructions solely for the specified products.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
 - 1. Motorized Shades: Include one-line diagrams, wire counts, coverage patterns, and physical dimensions of each item. Include location plan showing all switch and control zones, switches, sensors and other control accessories.
- D. Selection Samples: Include fabric samples in full range of available colors and patterns.
- E. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- F. Project Record Documents: Record actual locations of control system components and show interconnecting wiring.
- G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Motorized Shades: Comply with NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of this type with minimum ten years of documented experience with shading systems of similar size, type, and complexity; manufacturer's authorized representative.

1.7 MOCK-UP

- A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets or as required to simulate jobsite conditions when applicable.
 - 1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
 - 2. Full-sized mock-up may become part of the final installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.9 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

- B. Provide manufacturer's standard, non-depreciating warranty, for interior shading only, covering the following:
 - 1. Shade Hardware: 10 years unless otherwise indicated.
 - a. Mecho /5 with ThermoVeil, EuroVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25 years.
 - b. ElectroShade with ThermoVeil, EuroVeil, EuroTwill, Soho, Equinox, Midnite, Chelsea, or Classic Blackout shade fabric: 25 years.
 - 2. Shade Fabric: 10 years unless otherwise indicated.
 - 3. Electric Motors, Controls, and Accessories: Five years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: MechoShade Systems LLC; www.mechoshade.com or approved equal.
- B. Substitutions: See Section 016000 - Product Requirements.
 - 1. Proposed substitutions must be submitted in writing for approval by Architect a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutions must be accompanied by certification of compliance with specifications listing all exceptions.
 - 2. Products other than basis of design are subject to compliance with specified requirements and prior approval of Architect. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

2.2 ROLLER SHADES

- A. General:
 - 1. Provide shade system components that are capable of being removed or adjusted without removing mounted shade brackets or cassette support channel.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.
 - 3. Provide shade system that is Cradle-to-Cradle certified and listed in C2C (DIR).
 - 4. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Individual testing of components will not be acceptable in lieu of system testing. Where applicable, system components to be FCC compliant.
- B. Roller Shades Type RS - Basis of Design: MechoShade Systems LLC; Mecho/5 System; www.mechoshade.com.
 - 1. Description: Single roller, manually operated fabric window shades.
 - a. Drop Position: Regular roll.
 - b. Mounting: Ceiling mounted.
 - c. Size: As indicated on drawings.
 - d. Fabric: As indicated under Shade Fabric article.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Steel, 1/8 inch thick.
 - 3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the

- roller tube.
- d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
- 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
- 5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
 - a. Provide a permanently lubricated brake assembly mounted on a oil-impregnated hub with wrapped spring clutch.
 - b. Brake must withstand minimum pull force of 50 pounds in the stopped position.
 - c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
- 6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pound minimum breaking strength. Provide upper and lower limit stops.
 - a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
- 7. Accessories:
 - a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
 - 1) Fascia to be capable of installation across two or more shade bands in one piece.
 - 2) Provide single fascia to accommodate regular roll shades.
 - 3) Color: As selected by Architect from manufacturer's full product color range.
 - 4) Profile: Square.
 - 5) Configuration: Captured, fascia stops at captured bracket end.
- C. Roller Shades Type MS - Basis of Design: MechoShade Systems LLC; ElectroShade with WhisperShade IQ2 EDU, line voltage (120 VAC); www.mechoshade.com/#sle.
 - 1. Description: Single roller, motor operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll.
 - b. Mounting: Ceiling mounted.
 - c. Size: As indicated on drawings.
 - d. Fabric: As indicated under Shade Fabric article.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Steel, 1/8 inch thick.
 - 3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
 - 5. Accessories:
 - a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.

- 1) Fascia to be capable of installation across two or more shade bands in one piece.
- 2) Color: as selected by Architect from manufacturer's full product color range.
- 3) Profile: Square.
- 4) Configuration: Captured, fascia stops at captured bracket end.

2.3 Shade FABRIC

- A. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
1. Material Composition:
 - a. PVC coated polyester yarns.
 2. Material Certificates and Product Disclosures:
 - a. Low-Emitting Material Certification: Greenguard Gold certified and listed in UL (GGG).
 - b. Health Product Declaration (HPD): Complete, published declaration with full disclosure of known hazards.
 - c. Declare label.
 3. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large or small scale test.
 4. Openness Factor: 5%, nominal.
 5. Color: #1903 - Broome.
 6. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.
 7. Products:
 - a. MechoShade Systems LLC Inc; Soho - 1900 Series (5% open):
www.mechoshade.com or approved equal.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.4 INTELLIGENT ENCODED ELECTRONIC DRIVE SYSTEM

- A. Electronic Drive Unit (EDU) System - General Requirements:
1. System to be certified and labelled as a UL 325 listed solution. Recognized component certification is not acceptable in lieu of system testing. Listing label and motor rating to be readily visible for inspection without requiring dismounting of shade assembly for motor or EDU to be removed from shade roller tube.
 2. EDU size and configuration to be as recommended by manufacturer for the type, size, and arrangement of shades to be operated.
 3. Conceal EDU inside shade roller tube.
 4. Use EDU's rated at the same nominal speed for shades in the same room.
 5. Total hanging weight of shade band not to exceed 80 percent of rated lifting capacity of shade EDU and tube assembly.
 6. Provide EDU with capability of upgrading firmware from anywhere on network without touching the motor.
- B. Line Voltage EDU (120 VAC):
1. Basis of Design: MechoShade Systems LLC; WhisperShadeIQ2 System;
www.mechoshade.com or approved equal.
 2. Description: Tubular, asynchronous (non-synchronous), with integral AC motor and reversible capacitor operating at 120 VAC, single phase, 60 Hz; temperature Class B, thermally-protected, totally enclosed, maintenance-free; powered by line voltage power supply connection equipped with locking disconnect plug assembly furnished with EDU.

3. Audible Noise: 46 dBA or less measured 3 feet from the motor unit, depending on motor torque.
 4. Nominal Speed: Minimum of 34 RPM; does not vary due to load/lift capacity.
 5. EDU to provide isolated, low voltage power supply for powering external accessories connected to either the dry contact port or the network port. Products that require accessories to be powered by a plug-in or externally-supplied power supply are not acceptable.
- C. Modes of Operation:
1. Uniform Mode: Allows for shades to move only to defined intermediate stop positions in order to maintain aesthetic uniformity.
 2. Normal Mode: Allows for shades to move to defined intermediate stop positions plus any position between defined upper and lower limits.
 3. Maintenance Mode: Prevents shade from moving to newly commanded positions via dry contact or network control commands until EDU has been serviced and/or Maintenance Mode has been cleared/disabled.
- D. Control Methods: Support both local isolated dry contact input and network control.
1. Local Isolated Dry Contact Inputs:
 - a. Supports local switch control and third party system integration without separate interface.
 - b. Supports moving EDU/shade to upper and lower limits and to local switch preset positions.
 - c. Allows for configuration of upper and lower limits, custom presets, and key modes of operation without requiring a PC or similar microprocessor-based tools.
 - d. Supports configuration under protected sequences to prevent changes by casual user.
 - e. Switch Personalities: Allows for configuration of the dry contact control port over network such that virtually any type of dry contact keypad/third-party interface and actuation methodology (maintained and/or momentary actuation) can be used to operate shade. Dry contact control connection options to include:
 - 1) 1-button.
 - 2) 2-button.
 - 3) 3-button with ability to support configuring limits, presets, and key operating modes (default).
 - 4) 3-button without configuration capability in order to prevent accidental changes in settings.
 2. Network Control:
 - a. Supports bi-directional network communication in order to enable commanding the operation of large groups of shades over a common backbone.
 - b. Each EDU to support eight network addresses capable of being employed for various levels of group control.
 - c. Dry contact port for each EDU to be assigned its own local switch address which can be matched by other EDUs (within their eight network addresses) in order to support group control when dry contact commands are received. The EDU receiving dry contact commands may or may not be configured to operate based on commands coming through its own dry contact input port.
 - d. Each EDU to be provided with an independent unique identifier address (UID) to enable the EDU to be independently controlled and configured over network via handheld configurator and/or PC controller.
 - e. Network communication card to be integral with tubular EDU assembly.
 - f. Supports configuration of upper and lower limits using either a handheld removable program module/configurator or a local switch.

- g. Supports configuration of addresses using a handheld removable program module/configurator.
 - E. Alignment Positions:
 - 1. Each EDU to support positioning commands from 0 to 100 percent in 1 percent increments and 32 customizable presets, including three intermediate dry contact presets resulting in repeatable and precisely aligned shade positions and limits.
 - 2. Shades on the same switch circuit or with the same network group address with the same opening height to align at each limit or preset (intermediate stopping position) when traveling from any position, up or down.
 - 3. Shades of differing heights to be capable of custom, aligned intermediate stop positions when traveling from any position, up or down.
 - 4. Alignment of standard shade bands mechanically aligned on the same EDU not to exceed plus/minus 0.125 inch when commanded to the same alignment position.
 - 5. Alignment of standard shades on adjacent EDU's not to exceed plus/minus 0.25 inch when commanded to the same alignment position.
 - F. Local Switch Presets:
 - 1. Provide a minimum of three customizable preset positions accessible over the local dry contact control inputs and over the network connection.
 - 2. Preset positions to be customizable to any position between and including the defined upper and lower limits (initially defaults to 25, 50, and 75 percent of shade travel).
 - 3. Support configuration of custom preset positions using either a handheld removable program module/configurator or a local switch.
 - G. Network Presets:
 - 1. Provide a minimum of 32 customizable preset positions (including the three local switch presets) accessible via network commands.
 - 2. Preset positions to be customizable to any position between and including the defined upper and lower limits (initially defaults to defined lower limit).
 - 3. Support configuration of custom preset positions using a handheld removable program module/configurator.
- 2.5 MOTOR CONTROLS
- A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.
 - B. Provide all components and connections necessary to interface with other systems as indicated.
 - C. Digital Network Controls:
 - 1. Basis of Design: MechoShade Systems LLC; MechoNet; www.mechoshade.com or approved equal.
 - 2. Low-voltage network utilizes standard Category 5/6 UTP cable; maximum of 4,000 feet, 250 nodes.
 - 3. Capable of reprogrammed control without requiring wiring modifications.
 - 4. Provide 10-year non-volatile power failure memory for system configuration settings.
 - 5. Network Interface Components:
 - a. MechoNet Network Interface; MNI Series: Four configurable motor/EDU ports (models available for RJ45 or terminal block wiring); four configurable switch ports; one infrared (IR) remote control port; one configurable serial port for RS232/RS485 communication.

2.6 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.2 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.4 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.5 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.

- C. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.7 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 125000
FURNITURE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Contractor-furnished and installed furniture.

1.2 RELATED REQUIREMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Alternates:
 - 1. See Section 012300 - Alternates for product alternates affecting this section.
 - 2. This section includes base bid item(s).

1.4 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications 2016.
- B. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
- C. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the relocation of existing furniture items indicated on plans with the Owner prior to relocation.
- B. Coordination: Coordinate layout and installation of electrical wiring and devices with seating and table layout to ensure that floor junction boxes for electrical devices are accurately located to allow connection without exposed conduit.
- C. Sequencing: Install furniture items only after all other work is completed.
- D. Scheduling: Schedule installation of all furniture items with Owner.

1.6 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's product data for all items to be furnished in this Section, including product type, manufacturer, model number, style number and quantity.
 - 1. Include construction details, material descriptions, dimension of components, and finishes.
- C. Samples for Initial Selection: Two samples for each upholstery fabric, veneer product, and furniture supports, 6 by 6 inches in size, indicating color, texture, finish, and grain as applicable.

- D. Samples for Verification: For each type of exposed finish required, prepared Samples of size indicated below:
 - 1. Chair Unit: Full-size unit of each type and combination of finishes.
 - 2. Plastic Laminate: Manufacturer's standard-size unit, not less than 3 inches square.
 - 3. Chrom Finishes: Manufacturer's standard-size unit, not less than 3 inches square.
 - 4. upholstery Fabric: Full width by 36 inches long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.
 - 5. Full-size samples of chair units, if approved, will be returned to Contractor for use in the Project.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.
 - 1. Material Certificates: For each type of flame-retardant treatment of upholstery fabric.
- F. Manufacturer's qualification statement.
- G. Operation and Maintenance Data: Provide the following manufacturer's documentation for furniture to include in operation and maintenance manuals.
 - 1. Methods for maintaining upholstery fabric
 - 2. Precautions for cleaning materials and methods that could be detrimental to furniture finishes and performance.
- H. Specimen warranty.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 016000 - Product Requirements for additional provisions.
 - 2. Chair Seats and Backs: Five percent of quantity installed for each type and size of chair seat and back.
 - 3. Extra Fabric Stock Materials: Five percent on the bolt of quantity installed for each type.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Fabricator Qualifications: Company specializing in fabricating products specified in this section, with at least three years of documented experience.

1.8 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide two-year manufacturer warranty from date of Substantial Completion for failure of materials or workmanship. Complete forms in Owner's name and register with manufacturer.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures.
 - b. Wear and deterioration of fabric and stitching beyond normal use.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal wear and tear.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source International; Cache Out Armless Stacking Chair; www.sourceinternationaldesign.com, or an approved equal.
- B. OFS Brands; www.OFS.com, or an approved equal.
 - 1. Kasura Swivel High Back Chair
 - 2. Intermix Conference Table
 - 3. Lectern
- C. Substitutions: See Section 016000 - Product Requirements.
- D. Source Limitations: Furnish each type of product produced by single manufacturer and obtained from single supplier.
 - 1. Upholstery Fabric: Obtain fabric of a single dye lot for each color and pattern of fabric required.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics of Upholstered Chairs:
 - 1. Fabric and Padding:
 - a. Fabric: Class 1 according to DOC CS 191 or CFR 1610, tested according to California Technical Bulletin 117-2013.
 - b. Padding: Comply with California Technical Bulletin 117-2013.

2.3 MATERIALS AND FINISHES - See Furniture Tag Legend on drawings for more information.

- A. MDF (Medium-Density Fiberboard): ANSI A208.2 , Grade MD .
- B. Concealed Plywood: HPVA HP-1 hardwood plywood or DOC PS 1 softwood plywood as standard with manufacturer.
- C. Hardwood Lumber and Veneer Faces: Maple selected to be free of visible defects.
 - 1. Stain and Finish: As selected by Architect from manufacturer's full range.
- D. Plastic Laminate: NEMA LD 3, Grade VGS for vertical surfaces and Grade HGS for horizontal surfaces.
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range.
- E. Fabric: Manufacturer's standard 100% vinyl with flame-retardant treatment if required to meet performance requirements.
 - 1. Weight: minimum 30 oz/linear yard
 - 2. Color and Pattern: As selected by Architect from manufacturer's full range.
- F. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.
- G. Metal Finish: Finish exposed metal parts with manufacturer's standard polished aluminum or soft chrome finish as indicated on Furniture Tag Legend.

2.4 FABRICATION

- A. Upholstery: Fabricate fabric-covered seats with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered

component, install pile and pattern run in a consistent direction.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and in locations indicated on drawings.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Test for proper lectern A/V connection and operation in accordance with manufacturer's recommendations.

3.3 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION

SECTION 142100
ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Electric Traction Elevators.
- B. Products Supplied But Not Installed Under this Section:
 - 1. Hoist Beam
 - 2. Inserts mounted in block walls for rail attachments
- C. Products Both Supplied And Installed
 - 1. Pit Ladder
- D. Work Supplied Under Other Sections:
 - 1. Temporary lighting, including temporary lighting in hoistway for machine space with switch located in hoistway on the strike jamb side of top landing door.
 - 2. Main line disconnects for each elevator.
 - a. One fused three phase permanent power in building electrical distribution room
 - b. One non fused three phase permanent power in hoist way at top landing
 - 3. Hoistway ventilation shall be in accordance with local and national building code requirements.
 - 4. Guide Rail Support shall be structurally adequate to extend from pit floor to top of hoistway, with spans in accordance with requirements of authority having jurisdiction and final layouts.
 - 5. Removable barricades at all hoistway openings, in compliance with OSHA 29 CFR 1926.502 in addition to any local code requirements.
 - 6. Lifeline attachments capable of withstanding 5000 lb load in accordance with OSHA 29 CFR 1926.502. Provide a minimum of 2 at the top, front of each hoistway.
 - 7. Pit lighting: Fixture with switch and guards. Provide illumination level equal to or greater than that required by ASME A17.1/CSA B44 2000, or applicable version.
 - 8. Control space lighting with switch. Coordinate switch with lighting for machine space as allowable by code.

1.2 RELATED SECTIONS:

- A. Section 015000 - Temporary Facilities and Controls
- B. Section 033000 - Cast-in-Place Concrete:
- C. Section 042000 - Unit Masonry
- D. Section 055000 - Metal Fabrications
- E. Section 071326 - Sheet Waterproofing Membrane
- F. Section 071326.01 - Self-Adhering Sheet Waterproofing
- G. Section 230000 - Heating, Ventilating, and Air Conditioning
- H. Section 260000 - Electrical
- I. Section 263000 - Electric Power Generating and Storing Equipment

- J. Section 273000 - Voice Communications
 - K. Section 283100 - Fire Detection and Alarm
 - L. Section 310000 - Earthwork
- 1.3 INDUSTRY AND GOVERNMENT STANDARDS
- A. ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities
 - B. ADAAG - Accessibility Guidelines for Buildings and Facilities
 - C. ANSI/NFPA 70, National Electrical Code
 - D. ANSI/NFPA 80, Standard for Fire Doors and Fire Windows
 - E. ASME/ANSI A17.1, Safety Code for Elevators and Escalators.
- 1.4 DESCRIPTION OF ELEVATOR
- A. Elevator Equipment: KONE MonoSpace 300™ gearless traction elevator
 - B. Equipment Control: KCM831
 - C. Drive: Non Regenerative
 - D. Quantity of Elevators: 1
 - E. Landings: 3
 - F. Openings: 3 Front Openings
 - G. Travel: 29 Feet.
 - H. Rated Capacity: 3000 lbs
 - I. Rated Speed: 150 fpm
 - J. Clear Inside Dimensions (W x D): 6'-5" x 5'-0"
 - K. Cab Height: 8' 0"
 - L. Clear height under suspended ceiling: 7'-6"
 - M. Entrance Width and Type: 3'-6" and Right
 - N. Entrance Height: 7'-0"
 - O. Main Power Supply: 208 Volts + 5%, three-phase
 - P. Operation: Simplex
 - Q. Machine Location: Inside the hoistway mounted on car guide rail
 - R. Control Space Location: Integrated Control
 - S. Elevator Equipment shall conform to the requirements of seismic zone: non-seismic.
 - T. Maintenance Service Period: 12 months

1.5 PERFORMANCE REQUIREMENTS

- A. Car Performance
 - 1. Car Speed $\pm 5\%$ of contract speed under any loading condition or direction of travel.
 - 2. Car Capacity: Safely lower, stop and hold (per code) up to 125% of rated load.
- B. System Performance
 - 1. Vertical Vibration (maximum): 25 mg
 - 2. Horizontal Vibration (maximum): ISO 18738/ISO 8041 system pk-pk 12 mg
 - 3. Jerk Rate (maximum): 1 m/sec³
 - 4. Acceleration (maximum) 0.4m/sec²
 - 5. In Car Noise: = 55 dB(A)
 - 6. Leveling Accuracy: ± 0.2 inches
 - 7. Starts per hour (maximum): 180

1.6 SUBMITTALS

- A. Comply with Section 013300 - Submittal Procedures.
- B. Product Data: Submit manufacturer's product literature for each proposed system.
 - 1. Cab design, dimensions and layout.
 - 2. Layout, finishes, and accessories and available options.
 - 3. Controls, signals and operating system.
 - 4. Color selection charts for cab and entrances.
- C. Shop Drawings:
 - 1. Clearances and travel of car.
 - 2. Clear inside hoistway and pit dimensions.
 - 3. Location and layout of equipment and signals.
 - 4. Car, guide rails, buffers and other components in hoistway.
 - 5. Maximum rail bracket spacing.
 - 6. Maximum loads imposed on building structure.
 - 7. Hoist beam requirements.
 - 8. Location and sizes of access doors.
 - 9. Location and details of hoistway door and frames.
 - 10. Electrical characteristics and connection requirements.
- D. Operation and maintenance data:
 - 1. Provide manufacturer's standard maintenance and operation manual.
- E. Diagnostic Tools
 - 1. Prior to seeking final acceptance for the completed project as specified by the Contract Documents, the Elevator Contractor shall deliver to the Owner any specialized tool(s) that may be required to perform diagnostic evaluations, adjustments, and/or parametric software changes and/or test and inspections on any piece of control or monitoring equipment installed. This shall include any specialized tool(s) required for monitoring, inspection and/or maintenance where the means of suspension other than conventional wire ropes are furnished and installed by the Elevator Contractor. Any and all such tool(s) shall become property of the Owner. Any diagnostic tool provided to the Owner by the Elevator Contractor shall be configured to perform all levels of diagnostics, systems adjustment and parametric software changes which are available to the Elevator Contractor. In those cases where diagnostic tools provided to the Owner require periodic recalibration/or re-initiation, the Elevator Contractor shall perform such tasks at no additional cost to the Owner for a period equal to the term of the maintenance agreement from the date of final

acceptance of the completed project During those intervals in which the Owner might find it necessary to surrender a diagnostic tool for re-calibration, re-initiation, or repair, the Elevator Contractor shall provide a temporary replacement for the tool at no additional cost to the Owner. The Elevator Contractor shall deliver to the Owner, printed instructions for the proper use of any tool that may be necessary to perform diagnostic evaluations, system adjustment, and/or parametric software changes on any unit of microprocessor-based elevator control equipment and means of suspension other than standard elevator steel cables furnished and install by the Elevator Contractor. Accompanying the printed instructions shall be any and all access codes, password, or other proprietary information that is necessary to interface with the microprocessor-control equipment.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Minimum of fifteen years experience in the fabrication, installation and service of elevators of the type and performance of the specified. The manufacturer shall have a documented quality assurance program.
- B. Installer: The equipment manufacturer shall install the elevator.
- C. Inspection and Testing: In accordance with requirements of local jurisdiction, obtain required permits, inspections and tests.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's recommendations for delivery, storage and handling.
- B. If the construction site is not prepared to receive the elevator equipment at the agreed ship date, the General Contractor shall be responsible to provide a safe, dry, and easily accessible storage area on or off the premises. Additional labor costs for double handling will be the responsibility of the general contractor.
- C. Delivered elevator materials shall be stored in a protected environment in accordance with manufacturer recommendations. A minimum storage area of 10 feet by 20 feet is required adjacent to the hoistway.

1.9 WARRANTY

- A. Provide manufacturer warranty for a period of one year. The warranty period is to begin upon Substantial Completion of the Contract. Warranty covers defects in materials and workmanship. Damage due to ordinary use, vandalism, improper or insufficient maintenance, misuse, or neglect do not constitute defective material or workmanship.

1.10 MAINTENANCE SERVICE

- A. The elevator manufacturer shall provide maintenance service consisting of regular examinations and adjustments of the elevator equipment for a period of 12 months after date of substantial completion. Replacement parts shall be produced by the original equipment manufacturer.
- B. Maintenance service be performed during regular working hours of regular working days and shall include emergency 24-hour call back service.
- C. Maintenance service shall not include adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Provide AC gearless machine room-less elevator systems subject to compliance with the design and performance requirements of this specification. Elevator manufacturers may include but are not limited to one of the following:
 - 1. Basis of Design: MonoSpace 300™ traction elevators by KONE, Inc. (www.kone.com).
 - 2. Other acceptable machine room-less products: manufacturer with minimum 15 years experience in manufacturing, installing, and servicing elevators of the type required for the project.

2.2 EQUIPMENT: CONTROL COMPONENTS AND CONTROL SPACE

- A. Controller: Provide microcomputer based control system to perform all of the functions.
 - 1. All high voltage (110V or above) contact points inside the controller cabinet shall be protected from accidental contact in a situation where the controller doors are open.
 - 2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed and physically segregated from the rest of the controller.
 - 3. Provide a serial cardrack and main CPU board containing a non-erasable EPROM and operating system firmware.
 - 4. Variable field parameters and adjustments shall be contained in a non-volatile memory module.
- B. Drive: Provide Variable Voltage Variable Frequency AC drive system to develop high starting torque with low starting current.
- C. Controller Location: Locate controller in the front wall integrated with the top landing entrance frame, machine side of the elevator. A separate control space should not be required. Provide one non-fused three phase permanent power in hoistway at top landing.

2.3 EQUIPMENT: HOISTWAY COMPONENTS

- A. Machine: AC gearless machine, with permanent magnet synchronous motor, direct current electro-mechanical disc brakes and integral traction drive sheave, mounted to the car guide rail at the top of the hoistway.
- B. Governor: Friction type over-speed governor rated for the duty of the elevator specified.
- C. Buffers, Car and Counterweight: Polyurethane buffer.
- D. Hoistway Operating Devices:
 - 1. Emergency stop switch in the pit
 - 2. Terminal stopping switches.
 - 3. Emergency stop switch on the machine
- E. Positioning System: System consisting of magnets and proximity switches.
- F. Guide Rails and Attachments: Steel rails with brackets and fasteners.

2.4 EQUIPMENT: HOISTWAY ENTRANCES

- A. Hoistway Entrances

1. Sills: Aluminum extruded.
2. Doors: Hollow metal construction with vertical internal channel reinforcements.
3. Fire Rating: Entrance and doors shall be UL fire-rated for 1-1/2 hour.
4. Entrance Finish: Brushed Stainless Steel.
5. Entrance Markings Jamb Plates: Provide standard entrance jamb tactile markings on both jambs, at all floors. Plate Mounting: Refer to manufacturer drawings.

2.5 EQUIPMENT: CAR COMPONENTS

- A. Car Frame: Provide car frame with adequate bracing to support the platform and car enclosure.
- B. Platform: Platform shall be all steel construction.
- C. Car Guides: Provide guide-shoes mounted to top and bottom of both car and counterweight frame. Each guide-shoe assembly shall be arranged to maintain constant contact on the rail surfaces. Provide retainers in areas with Seismic design requirements.
- D. Steel Cab Finish: Laminate Series
 1. Car Wall Finish: Non-removable vertical panels Metal #6262 Satin Brushed Medim Bronze.
 2. Car Front Finish: Brushed stainless steel.
 3. Car Door Finish: Brushed stainless steel.
 4. Ceiling:
 - a. Round LED Down Light Drop Ceiling - LF-88: Satin Finished Stainless Steel three panel suspended ceiling with two holes per panel for Round LED lights.
 5. Handrail:
 - a. 1-1/4" Stainless Steel, round, satin finish.
 - b. Rails to be located on side and back wall of car enclosure.
 6. Flooring: By others. (Not to exceed 3 lb/sqft and 1/2" finished depth.)
 7. Threshold: Aluminum, extruded
- E. Emergency Car Signals
 1. Emergency Siren: Siren mounted on top of cab that is activated when the alarm button in the car operating panel is engaged. Siren shall have rated sound pressure level of 80 dB(A) at a distance of three feet from device. Siren shall respond with a delay of not more than one second after activation of alarm button.
 2. Emergency Car Lighting: Provide emergency power unit employing a 12-volt sealed rechargeable battery and totally static circuits shall illuminate the elevator car and provide current to the alarm bell in the event of building power failure.
 3. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.
 4. Ventilation: Fan.

2.6 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: Provide car operating panel with all push buttons, key switches, and message indicators for elevator operation. KSS 570, flush mount. Fixture finish to be: brushed stainless steel.
 1. Flush mounted car operating panel shall contain a bank of round, mechanical, illuminated buttons marked to correspond to landings served, emergency call button, door open button, door close button, and key switches for lights, inspection, and exhaust fan. Buttons have White Dot Matrix illumination (halo). All buttons to have raised text and Braille marking on left hand side. The car operating display panel shall be White Dot Matrix. All texts, when illuminated, shall be White Dot Matrix. The car operating panel shall have a brushed stainless steel finish.
 2. Additional features of car operating panel shall include:

- a. Car Position Indicator within operating panel, white.
 - b. Elevator Data Plate marked with elevator capacity and car number on car top.
 - c. Help buttons with raised markings.
 - d. In car stop switch per local code.
 - e. Firefighter's hat.
 - f. Firefighter's Phase II Key-switch.
 - g. Call Cancel Button.
 - h. Pre-programmed integrated ADA phone (complete description of krms features included as standard)
 - i. Help Button/Communicator. Activation of help button will initiate two-way communication between car and a location inside the building, switching over to alternate location if call is unanswered, where personnel are available to take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
 - j. Firefighter's Phase II emergency in-car operating instructions.
 - k. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
- B. Hall Fixtures: Jamb mounted hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Jamb mounted hall fixtures shall have a brushed stainless steel finish. KSS 570, flush mounted.
1. Hall fixtures shall feature round, mechanical, buttons in applied mount face frame. Hall fixtures shall correspond to options available from that landing. Buttons shall be in a vertically mounted fixture. Landing Call Stations shall be jamb-mounted. Landing Call Stations shall feature white illumination.
 2. Hall Lanterns and Chime: A directional lantern visible from the corridor shall be provided at each hall entrance, frame head mounted. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound. The chime will sound once for up and twice for down. Lanterns shall be in a horizontally mounted fixture, mounted in the head of the door frame, white illumination.

2.7 EQUIPMENT: ELEVATOR OPERATION AND CONTROLLER

- A. Elevator Operation
1. Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.
 2. Zoned Car Parking.
 3. Relative System Response Dispatching.
- B. Standard Operating Features to include:
1. Full Collective Operation
 2. Fan and Light Control.
 3. Load Weighing Bypass.
 4. Ascending Car Uncontrolled Movement Protection
 5. Top of Car Inspection Station.
- C. Additional Operating Features to include:
1. Hoistway Access Top Landing
 2. Car Secure Access.
 3. Provision for Card Reader in Car (Card Reader provided and Installed by Electrical Contractor)
 4. Intercom Provisions
 5. Emergency Battery Power Supply

- a. When the main line power is lost for longer than 5 seconds the emergency battery power supply provides power automatically to the elevator controller. The elevator will rise or lower to the first available landing, open the doors, and shut down. The elevator will return to service upon the return of normal main line power. An auxiliary contact on the main line disconnect and shunt trip breaker (if used) will be provided by Electrical Contractor.
- D. Elevator Control System for Inspections and Emergency
 1. Provide devices within controller to run the elevator in inspection operation.
 2. Provide devices on car top to run the elevator in inspection operation.
 3. Provide within controller an emergency stop switch to disconnect power from the brake and prevents motor from running.
 4. Provide the means from the controller to mechanically lift and control the elevator brake to safely bring car to nearest available landing when power is interrupted.
 5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
 6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
 7. Provide the means for the control to reset elevator earthquake operation.

2.8 EQUIPMENT: DOOR OPERATOR AND CONTROL

- A. Door Operator: A closed loop permanent magnet VVVF high-performance door operator shall be provided to open and close the car and hoistway doors simultaneously. Door movement shall be cushioned at both limits of travel. Electro-mechanical interlock shall be provided at each hoistway entrance to prevent operation of the elevator unless all doors are closed and locked. An electric contact shall be provided on the car at each car entrance to prevent the operation of the elevator unless the car door is closed.
- B. The door operator shall be arranged so that, in case of interruption or failure of electric power, the doors can be readily opened by hand from within the car, in accordance with applicable code. Emergency devices and keys for opening doors from the landing shall be provided as required by local code.
- C. Doors shall open automatically when the car has arrived at or is leveling at the respective landings. Doors shall close after a predetermined time interval or immediately upon pressing of a car button. A door open button shall be provided in the car. Momentary pressing of this button shall reopen the doors and reset the time interval.
- D. Door hangers and tracks shall be provided for each car and hoistway door. Tracks shall be contoured to match the hanger sheaves. The hangers shall be designed for power operation with provisions for vertical and lateral adjustment. Hanger sheaves shall have polyurethane tires and pre-lubricated sealed-for-life bearings.
- E. Electronic Door Safety Device. The elevator car shall be equipped with an electronic protective device extending the full height of the car. When activated, this sensor shall prevent the doors from closing or cause them to stop and reopen if they are in the process of closing. The doors shall remain open as long as the flow of traffic continues and shall close shortly after the last person passes through the door opening.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Field measure and examine substrates, supports, and other conditions under which elevator work is to be performed.

- B. Do not proceed with work until unsatisfactory conditions are corrected.
- C. Prior to start of Work, verify hoistway is in accordance with shop drawings. Dimensional tolerance of hoistway from shop drawings: -0 inches +2 inches. Do not begin work of this section until dimensions are within tolerances.
- D. Prior to start of Work, verify projections greater than 2 inches (4 inches if ASME A17.1/CSA B44 2000 applies) must be beveled not less than 75 degrees from horizontal.
- E. Prior to start of Work, verify landings have been prepared for entrance sill installation. Traditional sill angle or concrete sill support shall not be required.
- F. Prior to start of Work, verify elevator pit has been constructed in accordance with requirements, is dry and reinforced to sustain vertical forces, as indicated in approved submittal. Verify that sumps or sump pumps located within pit will not interfere with installed elevator equipment.
- G. Prior to start of Work, verify control space has been constructed in accordance with requirements, with access coordinated with elevator shop drawings, including Sleeves and penetrations.
- H. Verify installation of GFCI protected 20-amp in pit and adjacent to each signal control cabinet in control space.

3.2 PREPARATION

- A. Coordinate installation of anchors, bearing plates, brackets and other related accessories.

3.3 INSTALLATION

- A. Install equipment, guides, controls, car and accessories in accordance with manufacturer installation methods and recommended practices.
- B. Properly locate guide rails and related supports at locations in accordance with manufacturer's recommendations and approved shop drawings. Anchor to building structure using isolation system to minimize transmission of vibration to structure.
- C. All hoistway frames shall be securely fastened to fixing angles mounted in the hoistway. Coordinate installation of sills and frames with other trades.
- D. Lubricate operating system components in accordance with manufacturer recommendations.
- E. Perform final adjustments, and necessary service prior to substantial completion.

3.4 CONSTRUCTION

- A. Interface with Other Work:
 - 1. Guide rail brackets attached to steel shall be installed prior to application of fireproofing.
 - 2. Coordinate construction of entrance walls with installation of door frames and sills. Maintain front wall opening until elevator equipment has been installed.
 - a. Ensure adequate support for entrance attachment points at all landings.
 - b. Coordinate wall openings for hall push buttons, signal fixtures and sleeves. Each elevator requires sleeves within the hoistway wall.
 - c. Coordinate emergency power transfer switch and power change pending signals as required for termination at the primary elevator signal control cabinet in each group.

- d. Coordinate interface of elevators and fire alarm system.
- e. Coordinate interface of dedicated telephone line.
- f. Coordinate the installation of the non fused three phase permanent power disconnect in hoist way at top landing

3.5 TESTING AND INSPECTIONS

- A. Perform recommended and required testing in accordance with authority having jurisdiction.
- B. Obtain required permits and provide originals to Owner's Representative.

3.6 DEMONSTRATION

- A. Prior to substantial completion, instruct Owner's Representative on the proper function and required daily maintenance of elevators. Instruct personnel on emergency procedures.

END OF SECTION

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Fire-suppression equipment and piping demolition.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Painting and finishing.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining CPVC Plastic Piping: ASTM F 493.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6 .
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.5 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 210500

SECTION 210548 - VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Restraining braces.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: B.
 - 2. Design Spectral Response Acceleration at Short Periods (0.2 Second)
 - 3. Design Spectral Response Acceleration at 1-Second Period.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

- a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 2. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Welding certificates.
- D. Qualification Data: For testing agency.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- D. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- F. Restrained Mounts: All-directional mountings with seismic restraint.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate

with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 13 Section "Water-Based Fire-Suppression Systems" for piping flexible connections.

END OF SECTION 210548

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Fire-department connections.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Control panels.
 - 8. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 2. Sprinkler Occupancy Hazard Classifications:
 - a. Building Service Areas: Ordinary Hazard, Group 1.
 - b. Churches: Light Hazard.
 - c. Electrical Equipment Rooms: Ordinary Hazard, Group 1
 - d. General Storage Areas: Ordinary Hazard, Group 1.
 - e. Library Stack Areas: Ordinary Hazard, Group 2.
 - f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - g. Office and Public Areas: Light Hazard.
 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 4. Maximum Protection Area per Sprinkler: Per UL listing.
 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.6 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
 2. Compressed air piping.
 3. HVAC hydronic piping.
 4. Items penetrating finished ceiling include the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- E. Qualification Data: For qualified Installer and professional engineer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Welding certificates.
- H. Fire-hydrant flow test report.
- I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- J. Field quality-control reports.
- K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
1. NFPA 13, "Installation of Sprinkler Systems."
 2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.
- C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Black Steel Couplings: ASTM A 865, threaded.
- E. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 2. Pressure Rating: 175 psig minimum.
 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- K. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following.
 - a. Victaulic Company.

2.3 COVER SYSTEM FOR SPRINKLER PIPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. DecoShield Systems, Inc.
- B. Description: System of support brackets and covers made to protect sprinkler piping.
- C. Brackets: Glass-reinforced nylon.
- D. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
1. Valves shall be UL listed or FM approved.
 2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anvil International, Inc.
 - b. Victaulic Company.
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Anvil International, Inc.
 - b. Fivalco Inc.
 - c. Global Safety Products, Inc.
 - d. Kennedy Valve; a division of McWane, Inc.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Pratt, Henry Company.
 - h. Shurjoint Piping Products.
 - i. Tyco Fire & Building Products LP.
 - j. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. AFAC Inc.
 - b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - c. Anvil International, Inc.
 - d. Clow Valve Company; a division of McWane, Inc.
 - e. Crane Co.; Crane Valve Group; Crane Valves.
 - f. Crane Co.; Crane Valve Group; Jenkins Valves.
 - g. Crane Co.; Crane Valve Group; Stockham Division.
 - h. Fire-End & Croker Corporation.
 - i. Fire Protection Products, Inc.
 - j. Fivalco Inc.
 - k. Globe Fire Sprinkler Corporation.
 - l. Groeniger & Company.
 - m. Kennedy Valve; a division of McWane, Inc.
 - n. Matco-Norca.
 - o. Metraflex, Inc.

- p. Milwaukee Valve Company.
 - q. Mueller Co.; Water Products Division.
 - r. NIBCO INC.
 - s. Potter Roemer.
 - t. Reliable Automatic Sprinkler Co., Inc.
 - u. Shurjoint Piping Products.
 - v. Tyco Fire & Building Products LP.
 - w. United Brass Works, Inc.
 - x. Venus Fire Protection Ltd.
 - y. Victaulic Company.
 - z. Viking Corporation.
 - aa. Watts Water Technologies, Inc.
- 2. Standard: UL 312.
 - 3. Pressure Rating: 250 psig minimum.
 - 4. Type: Swing check.
 - 5. Body Material: Cast iron.
 - 6. End Connections: Flanged or grooved.

E. Iron OS&Y Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
 - b. American Valve, Inc.
 - c. Clow Valve Company; a division of McWane, Inc.
 - d. Crane Co.; Crane Valve Group; Crane Valves.
 - e. Crane Co.; Crane Valve Group; Jenkins Valves.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. Hammond Valve.
 - h. Milwaukee Valve Company.
 - i. Mueller Co.; Water Products Division.
 - j. NIBCO INC.
 - k. Shurjoint Piping Products.
 - l. Tyco Fire & Building Products LP.
 - m. United Brass Works, Inc.
 - n. Watts Water Technologies, Inc.
- 2. Standard: UL 262.
- 3. Pressure Rating: 250 psig minimum.
- 4. Body Material: Cast or ductile iron.
- 5. End Connections: Flanged or grooved.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

- 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating: 175 psig minimum.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Affiliated Distributors.
 - b. Anvil International, Inc.
 - c. Barnett.
 - d. Conbraco Industries, Inc.; Apollo Valves.
 - e. Fire-End & Croker Corporation.
 - f. Fire Protection Products, Inc.
 - g. Flowserve.
 - h. FNW.
 - i. Jomar International, Ltd.
 - j. Kennedy Valve; a division of McWane, Inc.
 - k. Kitz Corporation.
 - l. Legend Valve.
 - m. Metso Automation USA Inc.
 - n. Milwaukee Valve Company.
 - o. NIBCO INC.
 - p. Potter Roemer.
 - q. Red-White Valve Corporation.
 - r. Southern Manufacturing Group.
 - s. Stewart, M. A. and Sons Ltd.
 - t. Tyco Fire & Building Products LP.
 - u. Victaulic Company.
 - v. Watts Water Technologies, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.

- b. Globe Fire Sprinkler Corporation.
 - c. Reliable Automatic Sprinkler Co., Inc.
 - d. Tyco Fire & Building Products LP.
 - e. Venus Fire Protection Ltd.
 - f. Victaulic Company.
 - g. Viking Corporation.
- 2. Standard: UL 193.
 - 3. Design: For horizontal or vertical installation.
 - 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
 - 5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 - 6. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Automatic (Ball Drip) Drain Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
- 2. :
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
- 3. Standard: UL 1726.
- 4. Pressure Rating: 175 psig minimum.
- 5. Type: Automatic draining, ball check.
- 6. Size: NPS 3/4.
- 7. End Connections: Threaded.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Exposed-Type, Fire-Department Connection:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. AFAC Inc.
 - b. Elkhart Brass Mfg. Company, Inc.
 - c. Fire-End & Croker Corporation.
 - d. Fire Protection Products, Inc.
 - e. GMR International Equipment Corporation.
 - f. Guardian Fire Equipment, Inc.
 - g. Tyco Fire & Building Products LP.
 - h. Wilson & Cousins Inc.
- 2. Standard: UL 405.
- 3. Type: Exposed, projecting, for wall mounting.
- 4. Pressure Rating: 175 psig minimum.
- 5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Round, brass, wall type.
9. Outlet: Back, with pipe threads.
10. Number of Inlets: Three.
11. Escutcheon Plate Marking: Similar to " AUTO SPKR."
12. Finish: Rough brass or bronze.
13. Outlet Size: NPS 4.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 213.
3. Pressure Rating: 175 psig.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Company, Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer.
2. Standard: UL 199.
3. Pressure Rating: 175 psig .
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.9 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFAC Inc.
 - 2. Globe Fire Sprinkler Corporation.
 - 3. Reliable Automatic Sprinkler Co., Inc.
 - 4. Tyco Fire & Building Products LP.
 - 5. Venus Fire Protection Ltd.
 - 6. Victaulic Company.
 - 7. Viking Corporation.
- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Automatic Sprinklers: 175 psig.
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Nonresidential Applications: UL 199.
 - 2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Sprinkler Finishes:
 - 1. Chrome plated.
 - 2. Bronze.
 - 3. Painted.
- E. Special Coatings:
 - 1. Wax.
 - 2. Lead.
 - 3. Corrosion-resistant paint.
- F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- G. Sprinkler Guards:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.

- c. Victaulic Company.
 - d. Viking Corporation.
- 2. Standard: UL 199.
 - 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES

A. Electrically Operated Alarm Bell:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
- 2. Standard: UL 464.
- 3. Type: Vibrating, metal alarm bell.
- 4. Size: 6-inch minimum diameter.
- 5. Finish: Red-enamel factory finish, suitable for outdoor use.

B. Water-Flow Indicators:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
- 2. Standard: UL 346.
- 3. Water-Flow Detector: Electrically supervised.
- 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 5. Type: Paddle operated.
- 6. Pressure Rating: 250 psig.
- 7. Design Installation: Horizontal or vertical.

C. Pressure Switches:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AFAC Inc.

- b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Potter Electric Signal Company.
 - e. System Sensor; a Honeywell company.
 - f. Tyco Fire & Building Products LP.
 - g. United Electric Controls Co.
 - h. Viking Corporation.
- 2. Standard: UL 346.
 - 3. Type: Electrically supervised water-flow switch with retard feature.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design: Signals that controlled valve is in other than fully open position.

2.11 MANUAL CONTROL STATIONS

- A. Description: UL listed or FM approved, hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.12 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AMETEK; U.S. Gauge Division.
 - 2. Ashcroft, Inc.
 - 3. Brecco Corporation.
 - 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

- D. Pressure Gage Range: 0 to 250 psig.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

2.13 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.14 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Molded-PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- D. Molded-PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
- G. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set-screws.

2.15 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex, Inc.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.16 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping
- B. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal

seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

- N. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices.
- O. Fill sprinkler system piping with water.
- P. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2144. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- O. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.7 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 - 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
 - 3. Deluge Valves: Install in vertical position, in proper direction of flow, and in main supply to deluge system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

3.8 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.9 FIRE-DEPARTMENT CONNECTION INSTALLATION

- A. Install wall-type, fire-department connections.
- B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.10 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, stamped steel with spring clips.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.
 - 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Molded PVC
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Install sleeves that are large enough to provide annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 5. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. PVC-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.12 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe

and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run excess-pressure pumps.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.15 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.16 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.17 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2 or smaller, shall be **one of** the following:
 - 1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 2. Schedule 10, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 - 3. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:
 - 1. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 2. Schedule 40, black-steel pipe with plain ends; welding fittings; and welded joints.

3.18 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 - 3. Wall Mounting: Sidewall sprinklers.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 2. Upright and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Specialty valves.
 - 3. Sprinkler specialty pipe fittings.
 - 4. Sprinklers.
 - 5. Alarm devices.
 - 6. Manual control stations.
 - 7. Control panels.
 - 8. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For dry-pipe sprinkler systems.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. Compressed air piping.
 - 3. HVAC hydronic piping.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
- B. Qualification Data: For qualified Installer and professional engineer.
- C. Design Data:
 - 1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations.
- D. Fire-hydrant flow test report.
- E. Field Test Reports:
 - 1. Fire-hydrant flow test report.
 - 2. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

1.9 FIELD CONDITIONS

- ### A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
1. Notify Architect and Owner no fewer than three days in advance of proposed interruption of sprinkler service.
 2. Do not proceed with interruption of sprinkler service without Owner's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

- #### A. Dry-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing compressed air. Opening of sprinklers releases compressed air and permits water pressure to open dry-pipe valve. Water then flows into piping and discharges from opened sprinklers.

2.2 PERFORMANCE REQUIREMENTS

- #### A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- #### B. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
1. NFPA 13.
 2. NFPA 13R.
- #### C. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- #### D. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design dry-pipe sprinkler systems.
1. Available fire-hydrant flow test records indicate the following conditions:
 - a. Date: 03/29/2019

- b. Time: 11:05 pm
 - c. Performed by: Aquarion Water Company.
 - d. Location of Residual Fire Hydrant R: Library Faucet.
 - e. Location of Flow Fire Hydrant F: Whittlesey Avenue #11(1-054).
 - f. Static Pressure at Residual Fire Hydrant R: 62 psig
 - g. Measured Flow at Flow Fire Hydrant F: 1200 gpm, 2179@20 psig.
 - h. Residual Pressure at Residual Fire Hydrant R: 48 psig.
- E. Sprinkler system design shall be approved by authorities having jurisdiction.
- 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Electrical Equipment Rooms: Ordinary Hazard, Group 1
 - b. General Storage Areas: Ordinary Hazard, Group 1
 - c. Libraries except Stack Areas: Light Hazard
 - d. Library Stack Areas: Ordinary Hazard, Group 2
 - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1
 - f. Office and Public Areas: Light Hazard
 - 3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - 4. Maximum Protection Area per Sprinkler: According to UL listing.
 - 5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 120 sq. ft..
 - b. Storage Areas: 130 sq. ft..
 - c. Mechanical Equipment Rooms: 130 sq. ft..
 - d. Electrical Equipment Rooms: 130 sq. ft..
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
 - 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
- F. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7

2.3 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

- B. Schedule 30, Galvanized-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E ; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- C. Thinwall Galvanized-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- D. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- E. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.
- F. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME B16.1, Class 125.
- I. Plain-End-Pipe Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn or screwed retainer pin to secure pipe in fitting.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products USA Inc.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products USA Inc.
 - e. Smith-Cooper International.
 - f. Tyco Fire Products LP.
 - g. Victaulic Company.
 - 2. Pressure Rating: 175-psig minimum.
 - 3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 SPECIALTY VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Dry-Pipe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Globe Fire Sprinkler Corporation.
- b. Reliable Automatic Sprinkler Co., Inc. (The).
- c. Tyco Fire Products LP.
- d. Venus Fire Protection Ltd.
- e. Victaulic Company.
- f. Viking Corporation.

2. Standard: UL 260.

3. Design: Differential-pressure type.

4. Include UL 1486, quick-opening devices, trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

5. Air-Pressure Maintenance Device:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Globe Fire Sprinkler Corporation.
- 2) Reliable Automatic Sprinkler Co., Inc. (The).
- 3) Tyco Fire Products LP.
- 4) Venus Fire Protection Ltd.
- 5) Victaulic Company.
- 6) Viking Corporation.

6. Standard: UL 260.

7. Type: Automatic device to maintain minimum air pressure in piping.

8. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

9. Air Compressor:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Gast Manufacturing Inc.
- 2) General Air Products, Inc.

3) Viking Corporation.

- b. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- c. Motor Horsepower: Fractional.
- d. Power: 120-V ac, 60 Hz, single phase.

G. Automatic (Ball Drip) Drain Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products LP.
- 2. Standard: UL 1726.
- 3. Pressure Rating: 175-psig minimum.
- 4. Type: Automatic draining, ball check.
- 5. Size: NPS 3/4.
- 6. End Connections: Threaded.

2.5 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

B. Branch Outlet Fittings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products USA Inc.
 - d. Tyco Fire Products LP.
 - e. Victaulic Company.
- 2. Standard: UL 213.
- 3. Pressure Rating: 175-psig minimum
- 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
- 5. Type: Mechanical-tee and -cross fittings.
- 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
- 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
- 8. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc. (The).
 - c. Tyco Fire Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Brass Mfg. Co., Inc.
 - b. Fire-End & Croker Corporation.
 - c. Potter Roemer LLC.
2. Standard: UL 199.
3. Pressure Rating: 175-psig minimum.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

E. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Pressure Rating: 175-psig minimum
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

F. Low Supervisory Air Pressure Test Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC; Bleeder valve model BVL or a comparable product by one of the following:

- a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products LP.
 - c. Viking Corporation.
2. Valve Body Material: Bronze.
3. Maximum Pressure Rating: 300 psig.
4. End Connections: NPS 1/2.
5. Exhaust Orifice Size: 0.125 inches.

G. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aegis Technologies, Inc.
 - b. CECA, LLC.
 - c. Corcoran Piping System Co.
 - d. Merit Manufacturing.
2. Standard: UL 1474.
3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

H. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. Victaulic Company.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.6 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Globe Fire Sprinkler Corporation.
 2. Reliable Automatic Sprinkler Co., Inc. (The).
 3. Tyco Fire Products LP.

4. Venus Fire Protection Ltd.
5. Victaulic Company.
6. Viking Corporation.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Sprinkler Finishes: Chrome plated.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch vertical adjustment.

F. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc. (The).
 - b. Tyco Fire Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.7 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Tyco Fire Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL 753.
3. Type: Mechanically operated, with Pelton wheel.
4. Alarm Gong: Cast aluminum with red-enamel factory finish.
5. Size: 10-inch diameter.
6. Components: Shaft length, bearings, and sleeve to suit wall construction.
7. Inlet: NPS 3/4.
8. Outlet: NPS 1 drain connection.

C. Electrically Operated Alarm Notification Appliances:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC; PBA Series AC Bell or SASH 120 Strobe/Horn with sign, or a comparable product by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Notifier.
2. PBA Series Electric Bell:
 - a. Standard: UL 464.
 - b. Type: Vibrating, metal alarm bell.
 - c. Size: 8-inch- minimum diameter.
 - d. Voltage: 120 V ac, 60 Hz.
 - e. Finish: Red-enamel, or polyester powder coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.
 - f. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. SASH 120 Series Strobe/Horn with Integrated Sprinkler Fire Alarm Sign:
 - a. Standard: UL 464 Listed strobe/horn.
 - b. Tone: Selectable, steady, Temporal-3 (T-3), 2400 Hz, electromechanical, broadband.
 - c. Voltage: 120 V ac, 60 Hz.
 - d. Effective Intensity: 110 cd.
 - e. Finish: Red, suitable for outdoor use with approved and listed weatherproof backbox.
 - f. Sign: Mounts between backbox and strobe/horn with text visible on both sides, above and below strobe/horn. Shaped to cover surface mount weatherproof backbox. Consists of white lettering on red plastic identifying it as a Sprinkler Fire Alarm instructing viewers to call 911, police, or fire department.

D. Pressure Switches – Water Flow Alarm Detection:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC; PS10-2 or a comparable product by one of the following:
 - a. Potter Electric Signal Company, LLC.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Tyco Fire Products LP.
 - e. United Electric Controls Co.
 - f. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised, pressure activated, water-flow switch.
4. Components: Two single-pole, double-throw switches.
5. Design Operation: Rising pressure to 6 psi plus or minus 2 psi, signals water flow.

6. Conduit Openings: Two.
7. Electrical Rating: 10 A at 125/250 V ac, 2 A at 30 V dc.
8. Adjustability: Each switch is independently adjustable.
9. Wire Separation: Pressure switch shall provide for separation of wiring to each switch connection to allow for low and high voltage connections to comply with NFPA 70 Article 760 requirements.

E. Pressure Switches – Low/High Air Pressure Supervisory:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC; PS15-2, PS25-2, or PS40-2, depending on supervisory air pressure, or a comparable product by one of the following:
 - a. Potter Electric Signal Company, LLC.
 - b. Barksdale, Inc.
 - c. Detroit Switch, Inc.
 - d. Tyco Fire Products LP.
 - e. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised pressure supervisory switch.
4. Components: Two single-pole, double-throw switches.
5. Design Operation: Detects increase and/or decrease from normal supervisory air pressure.
6. Conduit Openings: Two.
7. Electrical Rating: 10 A at 125/250 V ac, 2 A at 30 V dc.
8. Adjustability: Each switch is independently adjustable.
9. Wire Separation: Pressure switch shall provide for separation of wiring to each switch connection to allow for low and high voltage connections to comply with NFPA 70 Article 760 requirements.

F. Valve Supervisory Switches:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC; OSYSU-2 for use on outside screw and yoke valves, PCVS-2 for use on post indicator valves and butterfly valves without factory internal supervisory switches, RBVS for use on quarter-turn lever operated ball valves, or a comparable product by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell International company.
 - b. Kennedy Valve Company; a division of McWane, Inc.
2. General Requirements for Valve Supervisory Switches:
 - a. Standard: UL 346.
 - b. Type: Electrically supervised.
 - c. Design: Signals that operating wheel/lever of controlled valve has turned two revolutions or moved 1/5 from the fully open position.
 - d. Wire Terminal Designations: Indicates normal switch position when the switch is properly installed on the valve and the valve is fully open.
3. Requirements for OS&Y Valve Supervisory Switches:

- a. Components: One or two Single-Pole, Double-Throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
 - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
 - d. Mounting Hardware: Knurled mounting bracket grips the valve yoke and prevents movement of switch assembly on OS&Y valve.
 - e. Trip Rod Length: Adjustable.
4. Requirements for PIV and Butterfly Valve Supervisory Switches:
- a. Components: Two Single-Pole, Double-Throw switches.
 - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
 - c. Mounting Hardware: Removable nipple.
 - d. Trip Rod Length: Adjustable.
5. Requirements for Ball Valve Supervisory Switch:
- a. Components: One Single-Pole, Double-Throw switch.
 - b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
 - c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves or backflow preventers sized from NPS 1/2 to NPS 2.

2.8 MANUAL CONTROL STATIONS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" for hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve.
- B. Include metal enclosure labeled "MANUAL CONTROL STATION" with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.9 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
 - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
 - 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.

- C. Manual Control Stations: Hydraulic operation, with union, NPS 1/2 pipe nipple, and bronze ball valve. Include metal enclosure labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- D. Panels Components:
 - 1. Power supply.
 - 2. Battery charger.
 - 3. Standby batteries.
 - 4. Field-wiring terminal strip.
 - 5. Electrically supervised solenoid valves and polarized fire-alarm bell.
 - 6. Lamp test facility.
 - 7. Single-pole, double-throw auxiliary alarm contacts.
 - 8. Rectifier.

2.10 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AGF Manufacturing Inc.
 - 2. AMETEK, Inc.
 - 3. Ashcroft Inc.
 - 4. Brecco Corporation.
 - 5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0- to 250-psig minimum
- E. Label: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to water-service piping for service entrance to building.

- B. Retain one of two paragraphs below. Backflow preventers are recommended and are usually required by authorities having jurisdiction.
- C. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 211100 "Facility Fire-Suppression Water-Service Piping."
- D. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.3 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Section 221116 "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements in Section 221119 "Domestic Water Piping Specialties" for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.4 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.

- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.
- K. Connect compressed-air supply to dry-pipe sprinkler piping.
- L. Connect air compressor to the following piping and wiring:
 - 1. Pressure gages and controls.
 - 2. Electrical power system.
 - 3. Fire-alarm devices, including low-pressure alarm.
- M. Install alarm devices in piping systems.
- N. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13. In seismic-rated areas, refer to Section 210548 "Vibration and Seismic Controls for Fire-Suppression Piping and Equipment."
- O. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.
- P. Drain dry-pipe sprinkler piping.
- Q. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices and air compressors.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.5 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- J. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2104. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.6 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 - 1. Install valves in vertical position for proper direction of flow, in main supply to system.
 - 2. Install dry-pipe valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
 - a. Install air compressor and compressed-air-supply piping.
 - b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling;

- pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psi maximum inlet pressure.
- c. Install compressed-air-supply piping from building's compressed-air piping system.

3.7 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install sprinklers with water supply from heated space. Do not install pendent or sidewall sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run air compressors.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire department equipment.
- B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.10 CLEANING

- A. Clean dirt and debris from sprinklers.

- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller shall be one of the following:
 - 1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight Schedule 30 or thinwall, galvanized-steel pipe with plain ends; plain-end-pipe fittings; and twist-locked joints.
 - 3. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- D. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be[one of] the following:
 - 1. Standard-weight or Schedule 30, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight or Schedule 30, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers
 - 2. Rooms with Suspended Ceilings: Dry concealed sprinklers
 - 3. Wall Mounting: Dry sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Dry pendent sprinklers
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.

3. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211316

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Plumbing demolition.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- D. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.
- E. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.

2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

1.5 QUALITY ASSURANCE

- A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.

2. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:

- a. Capitol Manufacturing Co.
- b. Central Plastics Company.
- c. Eclipse, Inc.
- d. Epco Sales, Inc.
- e. Hart Industries, International, Inc.
- f. Watts Industries, Inc.; Water Products Div.
- g. Zurn Industries, Inc.; Wilkins Div.

- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- minimum working pressure as required to suit system pressures.

1. Available Manufacturers:

- a. Capitol Manufacturing Co.
- b. Central Plastics Company.
- c. Epco Sales, Inc.
- d. Watts Industries, Inc.; Water Products Div.

- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Available Manufacturers:

- a. Advance Products & Systems, Inc.
- b. Calpico, Inc.
- c. Central Plastics Company.
- d. Pipeline Seal and Insulator, Inc.

2. Separate companion flanges and steel bolts and nuts shall have 150-psig minimum working pressure where required to suit system pressures.

- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

- a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw.
- 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to

extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

- 1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

END OF SECTION 220500

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Dial-type pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.

- B. Related Sections:

1. Division 21 Section "Facility Fire-Suppression Water-Service Piping" for fire-protection water-service meters outside the building.
2. Division 22 Section " Domestic Water Piping" for water meters inside the building.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Certificates: For each type of meter and gage, from manufacturer.
- C. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Ashcroft Inc.
2. Ernst Flow Industries.
3. Marsh Bellofram.
4. Miljoco Corporation.
5. Nanmac Corporation.
6. Noshok.
7. Palmer Wahl Instrumentation Group.
8. REOTEMP Instrument Corporation.
9. Tel-Tru Manufacturing Company.
10. Trerice, H. O. Co.
11. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
12. Weiss Instruments, Inc.
13. WIKA Instrument Corporation - USA.
14. Winters Instruments - U.S.

- C. Standard: ASME B40.200.

- D. Case: Liquid-filled type(s); stainless steel with 3-inch nominal diameter.

- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F and deg C.

- F. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

- G. Connector Size: 1/2 inch , with ASME B1.1 screw threads.

- H. Stem: 0.25 or 0.375 inc) in diameter; stainless steel.

- I. Window: Plain glass.

- J. Ring: Stainless steel.

- K. Element: Bimetal coil.

- L. Pointer: Dark-colored metal.

- M. Accuracy: Plus or minus **1** percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Trerice, H. O. Co.
2. Standard: ASME B40.200.

3. Case: Cast aluminum 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F deg F and deg C.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.

- j. Tel-Tru Manufacturing Company.
 - k. Trerice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
-
- 2. Standard: ASME B40.100.
 - 3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
 - 4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - 5. Pressure Connection: Brass, with NPS 1/4 ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - 6. Movement: Mechanical, with link to pressure element and connection to pointer.
 - 7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi
 - 8. Pointer: Dark-colored metal.
 - 9. Window: Glass.
 - 10. Ring: Metal
 - 11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1. Flow Design, Inc.
 - 2. Miljoco Corporation.
 - 3. National Meter, Inc.
 - 4. Peterson Equipment Co., Inc.
 - 5. Sisco Manufacturing Company, Inc.
 - 6. Trerice, H. O. Co.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 8. Weiss Instruments, Inc.
- B. Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water booster pump.
- L. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Test plug with chlorosulfonated polyethylene synthetic or EPDM self-sealing rubber inserts.
- B. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 150 deg F.
- B. Scale Range for Domestic Hot-Water Piping: 20 to 240 deg F

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be one of the following:
 - 1. Liquid-filled direct-mounted, metal case.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:
 - 1. Liquid-filled direct-mounted, metal case.
- C. Pressure gages at suction and discharge of each domestic water pump shall be the following:
 - 1. Liquid-filled direct-mounted, metal case.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping: 0 to 100 psi.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Bronze lift check valves.
 - 4. Bronze swing check valves.
 - 5. Bronze gate valves.
 - 6. Lubricated plug valves.
- B. Related Sections:
 - 1. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.

2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

2.5 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.

- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded[or solder joint].
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron[, bronze, or aluminum].

2.6 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short
 - e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or gate valves.
 - 2. Throttling Service: ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
5. For Grooved-End Copper Tubing: Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two-piece, full port, brass or bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, nonmetallic disc.
4. Bronze Gate Valves: Class 125, NRS.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.
 - 7. Pipe positioning systems.
 - 8. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 3. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
 - 4. Pipe positioning systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.
 - 3. Pipe stands. Include Product Data for components.
 - 4. Equipment supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.

13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Copper Metallic Coatings: For copper piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass] with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass].

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Available Manufacturers:

- a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Available Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2 .
 - 9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.

10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 12. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 8. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 9. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 10. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.

11. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- G. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.

- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- N. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 : 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - 5. Insert Material: Length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Freestanding and restrained spring isolators.
 - 2. Housed spring mounts.
 - 3. Elastomeric hangers.
 - 4. Spring hangers.
 - 5. Spring hangers with vertical-limit stops.
 - 6. Pipe riser resilient supports.
 - 7. Resilient pipe guides.
 - 8. Seismic snubbers.
 - 9. Restraining braces and cables.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: A.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.
 - a. Component Importance Factor: 1.0.
 - b. Component Response Modification Factor: 1.5.
 - c. Component Amplification Factor: 1.0.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second):.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Qualification Data: For testing agency.

- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.

- D. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- E. Restrained Mounts: All-directional mountings with seismic restraint.
1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- F. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- G. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- H. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- I. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
 - J. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 1. Amber/Booth Company, Inc.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 4. Hilti, Inc.
 5. Kinetics Noise Control.
 6. Loos & Co.; Cableware Division.
 7. Mason Industries.
 8. TOLCO Incorporated; a brand of NIBCO INC.
 9. Unistrut; Tyco International, Ltd.
- D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
- F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- G. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- H. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- B. Install cables so they do not bend across edges of adjacent equipment or building structure.
- C. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- D. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- E. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. Test and adjust air-mounting system controls and safeties.
 10. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of sprint isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220548

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Warning signs and labels.
 - 2. Pipe labels.
 - 3. Stencils.
 - 4. Valve tags.
 - 5. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

- B. Letter Color: Black.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Brass.
 - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.

- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Domestic Hot and Cold Water Piping:
 - a. Background Color: White.
 - b. Letter Color: Green.
 - 2. Sanitary Waste and Vent Piping:
 - a. Background Color: White.
 - b. Letter Color: Yellow.

3.3 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Cold Water: 2 inches, round.
 - b. Hot Water: 2 inches, round.
 - 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - 3. Letter Color:
 - a. Cold Water: Green.
 - b. Hot Water: Red.

3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied fabric-reinforcing mesh.
 - 9. Field-applied cloths.
 - 10. Field-applied jackets.
 - 11. Tapes.
 - 12. Securements.
 - 13. Corner angles.
- B. Related Sections include the following:
 - 1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at pipe expansion joints for each type of insulation.
 - 3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

4. Detail removable insulation at piping specialties, equipment connections, and access panels.
 5. Detail application of field-applied jackets.
 6. Detail application at linkages of control devices.
 7. Detail field application for each equipment type.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
1. Sample Sizes:
 - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
 - b. Sheet Form Insulation Materials: 12 inches square.
 - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
 - d. Sheet Jacket Materials: 12 inches square.
 - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data: For qualified Installer.
- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000(Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Insulco, Division of MFS, Inc.; Triple I.
- b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Insulco, Division of MFS, Inc.; SmoothKote.
- b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
- c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-96.
- b. Foster Products Corporation, H. B. Fuller Company; 81-33.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Chemical Company (The); 739, Dow Silicone.
 - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Speedline Vinyl Adhesive.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-30.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
 - c. ITW TACC, Division of Illinois Tool Works; CB-25.
 - d. Marathon Industries, Inc.; 501.
 - e. Mon-Eco Industries, Inc.; 55-10.
 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
 3. Service Temperature Range: 0 to 180 deg F.
 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 5. Color: White.

2.4 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-52.
 - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
 - c. Marathon Industries, Inc.; 130.
 - d. Mon-Eco Industries, Inc.; 11-30.
 - e. Vimasco Corporation; 136.
 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 3. Service Temperature Range: Minus 50 to plus 180 deg F.
 4. Color: White.

2.5 SEALANTS

- A. Joint Sealants:
1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.

- c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
5. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: Color-code jackets based on system.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
 5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- 0.135-inch-diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.

- 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
1. Install insulation continuously through hangers and around anchor attachments.
 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 1. Draw jacket tight and smooth.
 2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 1. Vibration-control devices.
 2. Testing agency labels and stamps.
 3. Nameplates and data plates.
 4. Manholes.
 5. Handholes.
 6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
- 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
- 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and

- replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
 - 1. NPS 1 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - 2. NPS 1-1/4 and Larger: Insulation shall be the following:
 - a. Cellular Glass: 1-1/2 inches thick.
- B. Domestic Hot Water:
 - 1. NPS 1-1/4 and Smaller: Insulation shall be the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - 2. NPS 1-1/2 and Larger: Insulation shall be the following:
 - a. Cellular Glass: 1-1/2 inches thick.
- C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch thick.
 - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Polyolefin: 1 inch thick.
- D. Exposed Horizontal Storm Water Piping:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 1/2 inch thick.
 - b. Polyolefin: 1 1/2 inch thick.

- E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

- 1. All Pipe Sizes: Insulation shall be the following:

- a. Cellular Glass: 1-1/2 inches thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 - 1. PVC: 30 mils thick.
 - 2. Aluminum, Smooth: 0.020 inch thick.
- D. Piping, Exposed:
 - 1. PVC: 30 mils thick.
 - 2. Aluminum, Smooth: 0.020 inch thick.

END OF SECTION 220700

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
 - 2. Underslab domestic water pipes, tubes, fittings and specialties
 - 3. Encasement for piping.
 - 4. Specialty valves.
 - 5. Flexible connectors.
 - 6. Escutcheons.
 - 7. Sleeves and sleeve seals.
 - 8. Wall penetration systems.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.4 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Water penetration systems.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.

2. Domestic water piping.
3. Propane Gas piping.
4. HVAC hydronic piping.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 1. Notify Architect or Owner no fewer than two days in advance of proposed interruption of water service.
 2. Do not proceed with interruption of water service without Architect's or Owner's written permission.

1.7 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 5. Copper Pressure-Seal-Joint Fittings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
6. Copper-Tube Extruded-Tee Connections:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2144.
7. Grooved-Joint Copper-Tube Appurtenances:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.
- 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.

- c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch-thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The).
 - d. JCM Industries.
 - e. Romac Industries, Inc.
 - f. Smith-Blair, Inc; a Sensus company.
 - g. Viking Johnson; c/o Mueller Co.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Hart Industries International, Inc.
 - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
 - 2. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. EPCO Sales, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Description:

- a. Nonconducting materials for field assembly of companion flanges.
- b. Pressure Rating: 150 psig.
- c. Gasket: Neoprene or phenolic.
- d. Bolt Sleeves: Phenolic or polyethylene.
- e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
- 2. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Victaulic Company.
- 2. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Flex Pression, Ltd.
 - 4. Flex-Weld, Inc.
 - 5. Hyspan Precision Products, Inc.
 - 6. Mercer Rubber Co.
 - 7. Metraflex, Inc.
 - 8. Proco Products, Inc.

9. Tozen Corporation.
10. Unaflex, Inc.
11. Universal Metal Hose; a Hyspan company

- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

2.8 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew or spring clips.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.9 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

2.10 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex, Inc.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.11 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 3. Housing-to-Sleeve Gasket: EPDM rubber.
 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.12 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.13 UNDER-BUILDING PIPING SCHEDULE

- A. Under-building-slab, domestic water piping, NPS 3 and larger, shall be the following:
 1. Ductile Iron; with ductile iron fittings, and mechanical joints.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- B. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- F. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- G. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- H. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- I. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- J. Install piping adjacent to equipment and specialties to allow service and maintenance.
- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install thermostats in hot-water circulation piping.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

- B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flanges.

3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install bronze-hose flexible connectors in copper domestic water tubing.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4 : 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

3.9 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome-plated finish.

3.10 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. Seal space outside of sleeves in concrete slabs and walls with grout.
- H. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
 - 1. Sleeves for Piping Passing through Gypsum-Board Partitions:

- a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- 2. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
- 3. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
- I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 WALL PENETRATION SYSTEM INSTALLATION

- A. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.13 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.14 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify Architect at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

- a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.15 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.17 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 1. Hard copper tube, ASTM B 88, Type L, or ASTM B 88, Type M; cast- or wrought-copper solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.

3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper push-on-joint fittings; and push-on joints.
- E. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; cast- or wrought-copper solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint copper-tube appurtenances; and grooved joints.
- F. Underground-, domestic water, building-service piping shall be:
1. Mechanical-joint, ductile-iron pipe; standard pattern mechanical-joint fittings; and mechanical joints.
 2. Push-on-joint, ductile-iron pipe; standard pattern push-on-joint fittings; and gasketed joints.
 3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- 3.18 VALVE SCHEDULE
- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller.
 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Strainers.
 - 5. Drain valves.
 - 6. Water hammer arresters.
 - 7. Air vents.
 - 8. Trap-seal primer valves.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
- 3. Standard: ASSE 1001.
- 4. Size: NPS 1/4 to NPS 3, as required to match connected piping.
- 5. Body: Bronze.
- 6. Inlet and Outlet Connections: Threaded.
- 7. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.

- i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
- 3. Standard: ASSE 1011.
 - 4. Body: Bronze, nonremovable, with manual drain.
 - 5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 6. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
- 4. Standard: ASSE 1020.
- 5. Operation: Continuous-pressure applications.
- 6. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- 7. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.2 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- 2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
- 3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 4. Screen: Stainless steel with round perforations, unless otherwise indicated.
- 5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4 0.062 inch.
- 6. Drain: Factory-installed, hose-end drain valve.

2.3 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.4 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Metal bellows.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.5 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.6 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
3. Standard: ASSE 1018.
4. Pressure Rating: 125 psig minimum.
5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.7 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.

- d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
- 4. Standard: ASSE 1013.
 - 5. Operation: Continuous-pressure applications.
 - 6. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 - 7. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 - 8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 9. Configuration: Designed for horizontal, straight through flow.
 - 10. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Double-Check Backflow-Prevention Assemblies

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
- 4. Standard: ASSE 1015.
 - 5. Operation: Continuous-pressure applications, unless otherwise indicated.
 - 6. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
 - 7. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 - 8. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - 9. Configuration: Designed for horizontal, straight through configuration flow.
 - 10. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.
- C. Install Y-pattern strainers for water on supply side of each control valve.
- D. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
 - 1. Install shutoff valve on outlet if specified.
 - 2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."
- E. Install water hammer arresters in water piping according to PDI-WH 201.
- F. Install air vents at high points of water piping.
- G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Supply-type, trap-seal primer valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each pressure vacuum breaker according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
 - 2. Sovent Drainage System: Include plans, elevations, sections, and details.
- C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.
 - a. Available Manufacturers:
 - 1) MG Piping Products Co.
- D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. ANACO.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
 - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
 - 3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.6 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.

- c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.
 - f. Plastic Oddities, Inc.
- 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.
- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Available Manufacturers:
 - a. ANACO.
- D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
 - 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
- E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.
- F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with

AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Available Manufacturers:
 - a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings and solvent stack fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 4. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Underground, soil, waste, and vent piping, below building slab, NPS 4 and smaller shall be any of the following:
 1. Extra-Heavy class, cast-iron soil piping; calking materials; and calked joints.
 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

- B. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- H. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

- 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect drainage and vent piping to the following:
 - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221416 – STORM WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Storm Water Piping: 10-foot head of water.

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Shop Drawings:

1. Materials of Construction.
 2. Piping Layout: Include plans at 1/4" scale.
- C. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

- a. Available Manufacturers:

- 1) MG Piping Products Co.

- D. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

- a. ANACO.

2.5 SPECIAL PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

- a. Dallas Specialty & Mfg. Co.
- b. Fernco, Inc.
- c. Logan Clay Products Company (The).
- d. Mission Rubber Co.
- e. NDS, Inc.
- f. Plastic Oddities, Inc.

2. Sleeve Materials:

- a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
- b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
- c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

- a. Cascade Waterworks Mfg. Co.
- b. Mission Rubber Co.

- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

- a. ANACO.
- D. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.
 - 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
- E. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Available Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.
- F. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Available Manufacturers:
 - a. SIGMA Corp.

2.6 PVC PIPES AND FITTINGS

- A. Drainage Pipe and Fittings, NPS 8 and Smaller:
 - 1. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40
 - 2. Solvent-cemented joints.
- B. Sewer Pipe and Fittings, NPS 8 and Smaller:
 - 1. ASTM D 3034, SDR 35
 - 2. Solvent-cemented or gasketed joints.
 - a. Gaskets: ASTM F 477, elastomeric seals.
- C. Perforated storm sewer pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, and M294. Pipe and fittings shall be made from virgin PE compounds which confirm to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350.
 - 1. Underdrain piping less than or equal to eight (8) inch in diameter shall be perforated single-wall pipe fitted with soil-tight joints meeting ASTM standards F405 and F606 as

manufactured by Advanced Drainage Systems, Inc. (ADS), Columbus, OH, (614) 457-3051 or approved equal. Provide fabric wrap around piping.

2.7 FILTER FABRIC

- A. Filter fabric shall be AASHTO M288 class 2 non-woven, TC Mirafi 140N or approved equal.
- B. Filter fabric in high-scour applications (e.g. riprap aprons) shall be AASHTO M288 class 1 woven, TC Mirafi FW500 or approved equal.
- C. See plans for specified locations. USGS.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, storm water piping NPS 4 and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless cast-iron soil pipe and fittings and solvent stack fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Underground, under building slab, storm water piping NPS 4 and smaller shall be any of the following:
 - 1. Extra-Heavy class, cast-iron soil piping; calking materials; and calked joints.
 - 2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Dissimilar Pipe-Material Couplings: Rigid, unshielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Underground, storm water piping, below addition, shall be PVC as noted above.
- E. Underground, footing drain piping and underslab drainage piping shall be perforated PVC.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- D. Make changes in direction for storm water piping using appropriate branches, bends, and long-sweep bends. Tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- F. Install storm water piping at the following minimum slopes, unless otherwise indicated:
 - 1. Horizontal Storm Water Piping: 1/4" per foot downward in direction of flow.
- G. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- I. Laying plastic pipe
 - 1. Curvilinear installation shall not be permitted.
 - 2. Plastic pipe can be easily carried to the trench and in sizes below 24 inches, installed by hand without the use of special equipment. Do not drop the pipe into the trench.

3.4 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install supports for vertical cast-iron soil piping every 15 feet.
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect storm water piping to the following:
 - 1. Storm Drains: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Storm Trench Drains: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - D. Test storm water piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test storm water piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After drains have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221416

SECTION 224000 – PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents:

1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

B. Section Includes:

1. Water closets
2. Urinals
3. Lavatories
4. Sinks
5. Service sinks
6. Showers
7. Drinking fountains
8. Electric water coolers

C. Related Sections:

1. Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment".
2. Division 22 Section "Plumbing Specialties".
3. Division 22 Section "Plumbing Equipment".

1.2 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.
4. Refer to Division 22 Section "Common Results for Plumbing" for codes and standards, and other general requirements.

B. American National Standards Institute (ANSI)

1. ANSI A112.6.1 Supports for Off-the-Floor Plumbing Fixtures for Public Use
2. ANSI A112.18.1 Finished and Rough Brass Plumbing Fixture Fittings
3. ANSI A112.19.1 Enameled Cast Iron Plumbing Fixtures
4. ANSI A112.19.2 Vitreous China Plumbing Fixtures
5. ANSI A112.19.3 Stainless Steel Plumbing Fixtures (Designed for Residential Use)
6. ANSI A112.19.4 Porcelain Enameled Formed Steel Plumbing Fixtures
7. ANSI A112.19.5 Trim for Water-Closet Bowls, Tanks, and Urinals
8. ANSI Z124.1 Gel-Coated Glass-Fiber Reinforced Polyester Resin Bathtub Units

- 9. ANSI Z124.2 Gel-Coated Glass-Fiber Reinforced Polyester Resin Shower Receptor and Shower Stall Units
 - 10. ANSI Z358.1 Emergency Eye Wash and Shower Equipment
- C. Air-Conditioning and Refrigeration Institute ARI 1010 Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers

1.3 SUBMITTALS

- A. Submit under provisions of Division 22 Section "Common Results for Plumbing - Review of Materials."
- B. LEED Submittals:
 - 1. Product Data for Credit WE: Documentation indicating flow and water consumption requirements.
- C. Submit Product Data for fixtures, including sizes, utility sizes, trim, and finishes.
- D. Operation and Maintenance Data:
 - 1. Submit operation and maintenance data under Division 01 Section "General Requirements – Operation and Maintenance Data"
 - 2. Include fixture trim exploded view and replacement parts lists.

1.4 QUALITY ASSURANCE

- A. Fixtures: By same manufacturer throughout for each product specified.
- B. Trim: By same manufacturer throughout for each product specified.

1.5 WARRANTY

- A. Provide 5-year manufacturer's warranty.
- B. Warranty: Include coverage of electric water-cooler compressor.

PART 2 - PRODUCTS

- 2.1 Water Efficient Products. Where available, the contractor must purchase Water Sense SM labeled products and other water efficient products and choose irrigation contractors who are certified through a Water Sense SM labeled program.

2.2 WATER CLOSET

- A. See drawings for specifications on fixture.

2.3 URINAL

- A. See drawings for specifications on fixture.

2.4 LAVATORY

- A. See drawings for specifications on fixture.

2.5 SINK

- A. See drawings for specifications on fixtures.

2.6 SHOWER

- A. See drawings for specifications on fixtures.

2.7 ELECTRIC WATER COOLER

- A. See drawings for specifications on fixture.

2.8 MOP BASIN

- A. See drawings for specifications on fixtures.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Review architectural woodwork Shop Drawings. Confirm location and size of fixtures and openings before rough-in and installation.
- B. Verify that adjacent construction is ready to receive rough-in work of this section.

3.2 INSTALLATION

- A. Install each fixture with a trap that is easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- C. Install components level and plumb
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant, color to match fixture.

F. Install fixtures to the following mounting heights above finished floor:

Water Closet:

Standard 15 inches (381 mm) to top of bowl rim

Handicapped 18 inches (457 mm) to top of seat

Urinal:

Standard 22 inches (559 mm) to top of bowl rim

Handicapped 19 inches (483 mm) to top of bowl rim

Lavatory:

Standard 31 inches (787 mm) to top of basin rim

Handicapped 32 inches (813 mm) to top of basin rim

Drinking Fountain:

Standard 40 inches (1016 mm) to top of basin rim

Handicapped 36 inches (914 mm) to top of basin rim

Water Closet Flush Valves:

Standard 11 inches (280 mm) minimum above bowl rim

Recessed 10 inches (254 mm) minimum above bowl rim

Shower Heads:

Adult 69.5 inches (1765 mm) to bottom of head

3.3 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water-flow rate to fixtures without splashing, noise, or overflow.
- B. At completion, clean plumbing fixtures and equipment.
- C. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. HVAC demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Painting and finishing.
 - 10. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.5 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

1.8 COMMISSIONING

- A. Provide independent licensed company to commission the systems as required under New York State Energy Code section C408.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Available Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

- A. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION 230500

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe loops and swing connections.
 - 2. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- C. Welding certificates.
- D. Product Certificates: For each type of expansion joint, from manufacturer.
- E. Maintenance Data: For expansion joints to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adscos Manufacturing LLC.
 - b. Advanced Thermal Systems, Inc.
 - c. Flex-Hose Co., Inc.
 - d. Flexicraft Industries.
 - e. Flex-Weld, Inc.
 - f. Hyspan Precision Products, Inc.
 - g. Metraflex, Inc.
 - h. Senior Flexonics Pathway.
 - i. Unisource Manufacturing, Inc.
 - j. U.S. Bellows, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

- a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
- b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
- c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 PIPE LOOP AND SWING CONNECTION INSTALLATION

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.2 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 230516

SECTION 230519 – METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Gage attachments.
 - 2. Test plugs.
 - 3. Test-plug kits.
- B. Related Sections:
 - 1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.
 - 2. Division 23 Section "Steam and Condensate Heating Piping" for steam and condensate meters.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Product Certificates: For each type of meter and gage, from manufacturer.
- D. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.
- E. LEED Submittals:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

PART 2 - PRODUCTS

2.1 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR
4. Material for Use with Steel Piping: CRES
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin

2.2 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2 ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F

F. Core Inserts: EPDM self-sealing rubber.

2.3 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.

6. Trerice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
-
- B. Furnish one test-plug kit(s) containing **one** thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
 - C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F
 - D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F
 - E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig
 - F. Carrying Case: Metal or plastic, with formed instrument padding.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install valve and snubber in piping for each pressure gage for fluids (except steam).
- H. Install test plugs in piping tees.
- I. Install flow indicators in piping systems in accessible positions for easy viewing.
- J. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

END OF SECTION 230519

SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Bronze swing check valves.
 - 4. Iron swing check valves.
 - 5. Iron, grooved-end swing-check valves.
 - 6. Bronze gate valves.
 - 7. Iron gate valves.
 - 8. Lubricated plug valves.
 - 9. Eccentric plug valves.
 - 10. Chainwheels.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig .

- c. CWP Rating: 600 psig .
- d. Body Design: Two piece.
- e. Body Material: Forged brass.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

B. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - d. Hammond Valve.
 - e. Jamesbury; a subsidiary of Metso Automation.
 - f. Kitz Corporation.
 - g. Marwin Valve; a division of Richards Industries.
 - h. Milwaukee Valve Company.
 - i. RuB Inc.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig .
 - c. CWP Rating: 600 psig .
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.

- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Red-White Valve Corporation.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Hammond Valve.
- d. Lance Valves; a division of Advanced Thermal Systems, Inc.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- h. <Insert manufacturer's name>.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig .
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.

- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DynaQuip Controls.
- f. Hammond Valve.
- g. Lance Valves; a division of Advanced Thermal Systems, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig.
- c. CWP Rating: 600 psig.
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig .
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.
 - i. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Hammond Valve.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.5 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, .

C. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Kitz Corporation.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Powell Valves.
 - f. Red-White Valve Corporation.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

D. Class 150, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - i. Zy-Tech Global Industries, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.6 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.

2. Description:

- a. Standard: MSS SP-78, Type II.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
- d. Pattern: Regular or short.
- e. Plug: Cast iron or bronze with sealant groove.

C. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
- 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - e. Pattern: Regular or short.
 - f. Plug: Cast iron or bronze with sealant groove.

2.7 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to ball and plug valve stems.
 - 3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball, gate and plug valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or gate valves.
 - 2. Throttling Service except Steam: Globe or ball valves.

3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 1. For Copper Tubing, NPS) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 5. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.

3.5 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two-piece, full port, brass or bronze with stainless-steel trim.
 3. Bronze Swing Check Valves: Class 125, nonmetallic disc.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe stands.
 - 6. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Structural Steel" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 - 3. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 4. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

- D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

- B. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. Masterset Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Available Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
 - 1. Available Manufacturers:

- a. MIRO Industries.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
- 1. Available Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
 - c. Portable Pipe Hangers.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
- 1. Available Manufacturers:
 - a. Portable Pipe Hangers.
 - 2. Bases: One or more plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
 - 9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 - 10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 - 11. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 - 12. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 13. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 - 14. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 - 15. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 - 16. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 3. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 4. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 5. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 6. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 7. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation mounts.
 - 2. Restrained elastomeric isolation mounts.
 - 4. Restrained spring isolators.
 - 5. Housed spring mounts.
 - 6. Elastomeric hangers.
 - 7. Spring hangers.
 - 8. Spring hangers with vertical-limit stops.
 - 9. Pipe riser resilient supports.
 - 10. Resilient pipe guides.
 - 11. Seismic snubbers.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 3. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Qualification Data: For testing agency.
- F. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data performed by an independent agency.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ace Mountings Co., Inc.
 - 2. Amber/Booth Company, Inc.
 - 3. California Dynamics Corporation.
 - 4. Isolation Technology, Inc.
 - 5. Kinetics Noise Control.
 - 6. Mason Industries.
 - 7. Vibration Eliminator Co., Inc.
 - 8. Vibration Isolation.
 - 9. Vibration Mountings & Controls, Inc.
- B. Mounts Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

- C. Restrained Spring Isolators Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- D. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- E. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 - 3. Maximum 1/4-inch air gap, and minimum 1/4-inch- thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized -steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or

- drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 5. Set anchors to manufacturer's recommended torque, using a torque wrench.
 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Hydronic Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 5. Test to 90 percent of rated proof load of device.
 6. Measure isolator restraint clearance.
 7. Measure isolator deflection.
 8. Verify snubber minimum clearances.
 9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.
- D. Remove and replace malfunctioning units and retest as specified above.

- E. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Duct labels.
 - 4. Valve tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.

- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.

- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Pipe Label Color Schedule:
 - 1. Refrigerant Piping:
 - a. Background Color: Blue.
 - b. Letter Color: Black.
 - 2. Hot Water Piping:
 - a. Background Color: Red.
 - b. Letter Color: Black.
 - 3. Chilled water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: Black.
 - 4. Condenser water piping:
 - a. Background Color: Green.
 - b. Letter Color: Black.
 - 5. Condensate piping
 - a. Background Color: Light Green.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.

2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
 - a. All: 1-1/2 inches round.
 - b. Select contrasting valve-tag color and letter color in two subparagraphs below for each service. Retain "Natural" option for brass or stainless-steel valve tags.
 2. Valve-Tag Color:
 - a. Refrigerant: Blue
 - b. Hot Water: Red
 - c. Chilled Water: Blue
 - d. Condenser Water: Green
 - e. Condensate: Light Green
 3. Letter Color:
 - a. Refrigerant: Black
 - b. Hot Water: Black
 - c. Chilled Water: Black
 - d. Condenser Water: Black
 - e. Condensate: Black

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. LEED Submittal:
 - 1. Air-Balance Report for LEED Prerequisite EQ 1: Documentation of work performed for ASHRAE 62.1-2019, Section 7.2.2, "Air Balancing."
- B. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- C. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

- D. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- E. Certified TAB reports.
- F. Sample report forms.
- G. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- J. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in ASHRAE 111 and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1-2004, Section 7.2.2, "Air Balancing."
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 - 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 - 8. Record final fan-performance data.

- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
 - a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR CONSTANT AND VARIABLE FLOW HYDRONIC SYSTEMS

- A. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- E. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- F. Check settings and operation of each safety valve. Record settings.

3.9 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.10 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the refrigerant charge.
4. Check the condition of filters.
5. Check the condition of coils.
6. Check the operation of the drain pan and condensate-drain trap.
7. Check bearings and other lubricated parts for proper lubrication.
8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

3.11 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent

3.12 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.13 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.

8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report.
Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Inlet vane settings for variable-air-volume systems.
 - f. Settings for supply-air, static-pressure controller.
 - g. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:

- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm
 - b. Total system static pressure in inches wg
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg
 - e. Filter static-pressure differential in inches wg
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm .
 - j. Return airflow in cfm .
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F .
 - e. Return-air, wet- and dry-bulb temperatures in deg F .
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm .
 - i. Water pressure differential in feet of head or psig .
 - j. Entering-water temperature in deg F .
 - k. Leaving-water temperature in deg F .

- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F .
- o. Inlet steam pressure in psig

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
- 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

H. Instrument Calibration Reports:

- 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.14 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect
3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.15 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230700 - MECHANICAL: INSULATION

PART 1 – GENERAL

1.1 DESCRIPTION

- A. The work required under this Section shall conform to the requirements of “General Conditions of Contractor for Construction”, “Supplementary General Conditions”, and “Supplementary Conditions for Mechanical and Electrical Trades”.

1.2 WORK INCLUDED

- A. All labor, materials, equipment, and services shall be provided. All operations required for complete installation of insulation and related work, as indicated on the Drawings or specified herein, shall be performed. The execution of the work shall be in strict accordance with the insulation manufacturer’s recommendations and the best practice of the trade.

1.3 GENERAL REQUIREMENTS

- A. Clean and dry all surfaces to be insulated of rust, scale, dirt, oil, water, and other foreign matter.
- B. Apply insulation to completely cover metal surfaces. Apply surface finish to present a tight, smooth appearance.
- C. Apply insulation to permit expansion or contraction of metal without causing damage to insulation or surface finish.
- D. Do not apply seal or cement until all previous application of cements and adhesives have thoroughly dried.
- E. Fill surface imperfections in the insulation such as chipped edges, small joints or cracks, and small voids or holes with insulation material and smooth with a skim coat of insulating cement.
- F. Extend the surface finish to protect all insulation surfaces. No raw edges or ends shall be exposed.
- G. Do not staple through vapor barrier finishes.
- H. Contractor shall submit for approval the name of the manufacturer, type, and conductivity together with samples of insulation material.

1.4 PIPING INSULATION

- A. Fit inside diameter of insulation sections or segments to outside curvature of pipe.
- B. Where standard insulation shapes are not available, cut, score or miter segmental, or flat block to fit contour of pipe. Stagger joints of adjoining segments. Fit insulation carefully and secure with wire. Smooth with insulating cement.
- C. Insulate valves, strainers, fittings, and flanges with identical material density, thickness and surface finish as the piping insulation. Use pre-molded insulation material where available, otherwise use shape block segments wired on with all edges filled with insulated cements or filler.
- D. Insulate the entire surface of fittings and strainers. Insulate valves up to end including bonnets.
- E. Bevel the ends of pipe insulation adjacent to flanges to permit bolt removal. Provide a collar of sectional block insulation over the flanges and extend a minimum of 2" over the adjacent pipe insulation. Fasten with wire or bands to permit easy removal. Fill annular spaces with loose insulation.
- F. Insulate strainers to permit removal of the basket without disturbing the insulation of the strainer body.
- G. Where pipelines pass through floor slab sleeves, interrupt the insulation at the sleeve for all piping services except chilled water and cold water.
- H. Where pipelines pass through interior masonry walls or floor, completely fill the space between outside of pipe or insulation and the inside of the sleeve or frames opening with loose insulation.
- I. Where insulation saddles are used, fill with insulating cement similar to the cement used with the piping insulation.
- J. When in direct contact with the pipe, hangers and supports shall be insulated separately and sealed from the pipe in the same manner as the fittings. The vapor barrier shall be continuous and its integrity maintained throughout.

1.5 DUCTWORK INSULATION

- A. Cut, score, or miter insulation to fit shape and contour of equipment. Where surfaces are flat, cylindrical or regularly curved, use pre-molded blocks or segments. Apply insulation in single layers up to 3" thickness; over 3" thick apply in multiple layers. Stagger the insulation joints.
- B. Provide permanently fastened angles or plates, where required, to support insulation.
- C. Apply insulation on cover plates, heads, and access openings as separate sections, with insulation cut back for access to bolt heads and other fasteners.

- D. Do not insulate over nameplates. Cut back the insulation and line the insulation edges with 24 gauge galvanized steel.

1.6 FIRE AND SMOKE REQUIREMENTS

- A. Insulation Materials: All insulations to be of non-combustible materials. All insulations, coverings, vapor barriers, and adhesive to have a flame-spread rating no higher than 25, a fuel contributed rating no higher than 50, and a smoke developed rating no higher than 50. Ratings as determined by the “Method of Test Surface Burning Characteristics of Buildings Materials”, NFPA No. 255, ASTM E84-70, Underwriters’ Laboratories, Inc. Standard.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The insulation shall be the product of Owens Corning (whose product numbers are specified herein), KNAUF, or Certain Teed Corp. All insulation and adhesives shall have a flame-spread rating no higher than 25 and a smoke developed rating no higher than 50 as determined by test method ASTM E84.

2.2 PIPE INSULATION – INDOOR PIPE

- A. Insulation P-1
 - 1. Fiberglass SSL-II heavy density with ASJ/SSL jacket.
 - 2. Maximum K-factor: 0.25 at 75°F mean.
 - 3. Temperature Range: 0°F to 850°F.
- B. Factory Applied Jacket
 - 1. White, flame retardant, all service, vapor barrier jacket of minimum .001” aluminum foil laminated to kraft paper with a flame retardant snuffer type adhesive, reinforced with glass fibers and self-sealing lap.
 - 2. Permeability: .02 perm.
 - 3. Provide 2” longitudinal lap and 4” circumferential sealing strips.
- C. Application
 - 1. Pipe: Fit insulation to pipe, staggering longitudinal joints. Seal laps and sealing strips applied on circumferential joints per manufacturer’s recommendations.

2. Fittings, Valves, and Flanges: Apply fabricated segments of insulation or pre-molded PVC fitting covers equal in thickness to adjoining pipe insulation.

D. Surface Finish

1. Piping – Exposed and Concealed: None.

2.3 PIPE INSULATION – OUTDOOR PIPE

A. Insulation P-2

1. Fiberglass SSL-II heavy density with ASJ/SSL jacket.
2. Maximum K-factor: 0.25 at 75°F mean.
3. Temperature Range: 0°F to 850°F.

B. Factory Applied Jacket

1. White, flame retardant, all service, vapor barrier jacket of minimum .001” aluminum foil laminated to kraft paper with a flame retardant snuffer type adhesive, reinforced with glass fibers and self-sealing lap.
2. Permeability: .02 perm.
3. Provide 2” longitudinal lap and 4” circumferential sealing strips.

C. Application

1. Pipe: Fit insulation to pipe, staggering longitudinal joints. Seal laps and sealing strips applied on circumferential joints per manufacturer’s recommendations.
2. Fittings, Valves, and Flanges: Apply fabricated segments of insulation or pre-molded PVC fitting covers equal in thickness to adjoining pipe insulation.
3. All outdoor piping shall be provided with aluminum jacket over insulation installed with seams down.

D. Surface Finish

1. Piping – Exposed and Concealed: None.

2.4 DUCT INSULATION – FLEXIBLE BLANKET – TYPE D-2

A. Insulation

1. Flexible fibrous glass blanket.

2. Minimum Density: 1 ½ pounds per cubic foot.
 3. Maximum K-factor: 0.27 at 75°F mean.
 4. Temperature Range: 40°F to 250°F.
- B. Factory Applied Facing: Vapor barrier facing of minimum 0.7 mil aluminum foil laminated to fire-resistant Kraft paper and reinforced with glass fibers. Permeability -- 0.02 perm.
- C. Installation
1. Prepare metal surface to receive adhesive in accordance with the requirements of the adhesive manufacturer.
 2. Cement insulation to duct with fire-resistive adhesive of brush consistency and secure with annealed copper wires spaces not more than 12" on center.
 3. Seal all insulation joints with pressure-sensitive tape matching the facing to maintain vapor barrier
 4. Provide 1" acoustic lining of first 10 feet from self-contained rooftop units. Duct sizes on drawings are free area sizes. Acoustic lining on switch area systems are limited to 10 feet upstream of return fans only.
- D. Alternate Manufacturers
1. Certain Teed: "Duct Wrap"
 2. KNAUF Fiberglass: "Duct Wrap"

2.5 INSULATION SCHEDULE

A. Pipe

<u>Service</u>	<u>Pipe Size</u>	<u>Spec. Type</u>	<u>Thickness</u>
Chilled Water, Indoor	All	P-1	1"
Condenser water, indoor	All	P-1	1"
Condenser water, outdoor	All	P-2	1"
Hot Water, Indoor	0 - 1 1/2"	P-1	1 1/2"
	>1 1/2"	P-1	2"
Refrigerant	All	P-1	1 1/2"

Condensate Drain Piping at HVAC Units	All	P-2	1"
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- B. Ductwork and plenums shall be insulated per the schedule below unless otherwise noted on the drawings.

<u>Service</u>	<u>Description</u>	<u>Type</u>	<u>Thickness</u>
<u>Outdoor Air</u>	<u>All</u>	D-2	1 1/2"
AC Supply and return 15 feet from units	All	Interior lining	1"
AC Supply (other)	All	D-2	1 1/2"

PART 3 – EXECUTION

3.1 INSTALLATION AND WORKMANSHIP

- A. No insulation shall be applied until all tests have been completed. Only insulation and finish materials including adhesives, cements, and mastics, which conform to the requirements of all governing codes and ordinances, shall be used.

END OF SECTION

SECTION 230923 - DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls. (WEBsN4)

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Supplied but Not Installed Under This Section:
 - 1. Control valves.
 - 2. Flow switches.
 - 3. Wells, sockets and other inline hardware for water sensors (temperature, pressure, flow).
 - 4. Automatic control dampers, where not supplied with equipment.
 - 5. Airflow measuring stations.
 - 6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
 - 7. Variable frequency drives. (This does not include VFDs integral to machinery such as chillers or boilers).
- B. Products Installed but Not Supplied Under This Section:
 - 1. None.
- C. Products Not Furnished or Installed but Integrated with the Work of This Section:
 - 1. Chiller control systems.
 - 2. Boiler control systems.
 - 3. Pump control packages.
 - 4. In-line meters (gas, water, power).
 - 5. Refrigerant monitors.
 - 6. Chemical water treatment.
 - 7. Smoke detectors (through alarm relay contacts).
- D. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 RELATED SECTIONS

- A. Section 23 05 00 - Common Work Results for HVAC.

1.4 SYSTEM DESCRIPTION

Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: LonTalk, BACnet, MODBUS). The BMS system for the new addition shall be interconnected with the existing

Andover control system in the existing building. All graphics and control logic shall be incorporated into the new system.

1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
 2. System architecture shall fully support a multi-vendor environment and be able to integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
 3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
 4. All control devices furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools for post-installation maintenance shall not be acceptable.
 5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
 6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
 7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included.
 8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
 9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*"and "accept.wb.in=*"and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
 10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
 11. To ensure quality, any JACE 3E, 6E, or 7 hardware products used on this project shall come through the Tridium Richmond, VA shipping facility. JACE hardware products not meeting this requirement will not be allowed.
- B. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
1. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices.
 2. FCC, Part 15, Subpart B, Class B
 3. FCC, Part 15, Subpart C
 4. FCC, Part 15, Subpart J, Class A Computing Devices.
 5. UL 504 - Industrial Control Equipment.
 6. UL 506 - Specialty Transformers.
 7. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.

8. UL 916 - Energy Management Systems All.
9. UL 1449 - Transient Voltage Suppression.
10. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.
11. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
12. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.
13. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.
14. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - a. NEMA 250 - Enclosures for Electrical Equipment.
15. NEMA ICS 1 - Industrial Controls and Systems.
16. NEMA ST 1 - Specialty Transformers.
17. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.
18. CE 61326.
19. C-Tick.
20. cUL.

1.5 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
 2. AI: Analog Input.
 3. AO: Analog Output.
 4. Analog: Continuously variable state over stated range of values.
 5. AUC: Advanced Unitary Controller.
 6. BCT: BACnet Touchscreen Communicating Thermostat.
 7. BMS: Building Management System.
 8. DDC: Direct Digital Control.
 9. Discrete: Binary or digital state.
 10. DI: Discrete Input.
 11. DO: Discrete Output.
 12. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
 13. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
 14. GUI: Graphical User Interface.
 15. HMI: Human Machine Interface.
 16. HVAC: Heating, Ventilating and Air Conditioning.
 17. IDC: Interoperable Digital Controller.
 18. ILC: Interoperable Lon Controller.
 19. LAN: Local Area Network.
 20. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
 21. Motorized: Control device with actuator.
 22. NAC: Network Area Controller.
 23. NC: Normally closed position of switch after control signal is removed or normally

- closed position of manually operated valves or dampers.
24. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
 25. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
 26. Operator: Same as actuator.
 27. PC: Personal Computer.
 28. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
 29. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
 30. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
 31. PICS: BACnet Product Interoperability Compliance Statement.
 32. PICU: Programmable IP Control Unit.
 33. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
 34. Point: Analog or discrete instrument with addressable database value.
 35. PPCU: Programmable Plant Control Unit.
 36. UICU: Unitary IP Control Unit.
 37. WAN: Wide Area Network.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 1. Preparation instructions and recommendations.
 2. Storage and handling requirements and recommendations.
 3. Installation methods.
- C. Submit documentation of vendor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. Five copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. Upon completion of the work, provide 5 complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and on Flash media.
- G. Any deviations from these specifications or the work indicated on the drawings shall be

clearly identified in the Submittals.

H. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1.

1.7 QUALITY ASSURANCE

- A. The Control System Vendor shall have a full service DDC office within 50 miles of the job site. The office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. Single Source Responsibility of Supplier: The Control System Vendor shall be responsible for the complete installation and proper operation of the control system. The Control System Vendor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Vendor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 5 years. All control panels shall be assembled by the Control System Vendor in a UL-Certified 508A panel shop.
- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.8 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Honeywell Building Technologies, which is located at: 715 PeachtreeSt. NE, Atlanta, GA30308; Toll Free Tel: 888-793-8193; Email:[request info \(buildingcontrols@honeywell.com\)](mailto:requestinfo@buildingcontrols@honeywell.com); Web:buildingcontrols.honeywell.com. Only Honeywell registered WEBs Vendors are acceptable as defined as:
 - 1. Authorized Controls Integrator (ACI Direct, ACI Elite or ACI)
 - 2. Building Control Specialist (BCS)
 - 3. WEBs Vendor
- B. Requests for substitutions will be considered in accordance with provisions of Specifications

2.2 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. The installed system shall provide secure password access to all features, functions and data contained in the overall BMS.

2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data shall not be acceptable.
- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.4 BAS SERVER HARDWARE

- A. Minimum Computer Configuration (Hardware Independent).
 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
 2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
 3. Memory: 2 GB or more recommended for large systems, 8 GB or more recommended for the Windows 64-bit version.
 4. Hard Drive: 256 GB minimum, more recommended depending on archiving requirements.
 5. Display: Video card and monitor capable of displaying 1024 x 768 pixel resolution or greater.
 6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
 7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e. T1, ADSL, cable modem).
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.5 SYSTEM NETWORK CONTROLLER (SNC)

- A. These controllers are designed to manage communications between the Programmable IP Control Units (PICU), Programmable Plant Control Units (PPCU), Unitary IP Control Unit (UICU), Advanced Unitary Controllers (AUC), and BACnet Touchscreen Communication Thermostats (BCT) which are connected to its communications trunks or directly on the IP network, manage communications between itself and other system network controllers (SNC), PICUs, PPCUs, UICUs, and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- B. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.
- C. The controllers shall be capable of peer-to-peer communications with other SNC's, PICUs, PPCUs, UICUs, and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 FoxS, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- E. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- F. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:

1. BACnet
 2. Lon
 3. MODBUS
 4. SNMP
 5. KNX
- G. The SNC shall be capable of executing application control programs to provide:
1. Calendar functions.
 2. Scheduling.
 3. Trending.
 4. Alarm monitoring and routing.
 5. Time synchronization.
 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 7. Network management functions for all SNC, PICU, PPCU, UICU, AUC and BCT based devices.
- H. The SNC shall provide the following hardware features as a minimum:
1. Two 10/100 Mbps Ethernet ports.
 2. Two Isolated RS-485 ports with biasing switches.
 3. 1 GB RAM
 4. 4 GB Flash Total Storage / 2 GB User Storage
 5. Wi-Fi (Client or WAP)
 6. USB Flash Drive
 7. High Speed Field Bus Expansion
 8. -20-60 degrees C Ambient Operating Temperature
 9. Integrated 24 VAC/DC Global Power Supply
 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- I. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- J. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- K. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.

- L. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- M. The SNC shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.
 - 5. LDAP and Kerberos integration of access management.
- N. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - 1. Metadata: Descriptive tags to define the structure of properties.
 - 2. Tagging: Process to apply metadata to components
 - 3. Tag Dictionary
- O. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PICU, PPCU, UICU, AUC) shall have an associated template file for reuse on future project additions.
- P. The SNC shall be provided with a 3Year Software Maintenance license. Labor to implement not included.

2.6 PROGRAMMABLE IP CONTROL UNIT (PICU)

- A. HVAC PICU controllers shall be fully programmable to meet the unique requirements of the facility it shall control. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation". PICU shall be BACnet BTL; AWS/C, WSP listed. PICU shall meet the BACnet Building Controller (B-BC) Profile.
- B. All PICUs shall be application programmable and shall always maintain their certification. All control sequences within or programmed into the PICU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- C. The controllers shall be capable of daisy-chain IP communications with other PICU's and peer-to-peer communications with SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
 - 1. Daisy Chain IP connectivity Integrated Fail-safe utilizing Rapid Spanning Tree Protocol 802.1w.
- D. The communication protocols utilized for peer-to-peer communications between PICU's will be Niagara 4 FoxS or BACnet TCP/IP. Use of a proprietary communication protocol for peer-to-peer communications between PICU's is not allowed.
- E. The PICU shall be licensed and enabled to support four (4) devices and shall be licensed with the following Open protocol drivers by default:
 - 1. BACnet IP

- F. The PICU shall be provided with Lifetime Software Maintenance license. Labor to implement not included.
- G. The PICU shall be capable of executing application control programs to provide:
 - 1. Calendar functions.
 - 2. Scheduling.
 - 3. Trending.
 - 4. Alarm monitoring and routing.
 - 5. Time synchronization.
 - 6. Integration of all daisy-chain PICU's.
 - 7. Network management functions for all daisy-chain PICU's.
- H. Programming software shall be embedded into the PICU. The PICU shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the embedded Niagara 4 environment.
- I. The PICU shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.
 - 5. Encrypted (PKI) Secure IP Stack Communication Security.
 - 6. FIPS 140-2 Level 1 Cryptographic Module Compliant.
- J. The minimum controller Environmental ratings.
 - 1. Operating Temperature Ambient Rating: -4 degrees to 131 degrees F (-20 degrees to 55 degrees C).
 - 2. Storage Temperature Ambient Rating: -4 degrees to 150 degrees F (-20 degrees to 65 degrees C).
 - 3. Relative Humidity: 5% to 95% non-condensing
- K. The controller shall have the additional approval requirements, listings, and approvals:
 - 1. UL 60730-1.
 - 2. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
 - 3. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity).
 - 4. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).
 - 5. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (2.3" x 5.3" x 4.3"; 57.4mm x 135mm x 110mm).
- L. The PICU shall provide the following hardware features as a minimum:
 - 1. The PICU shall provide LED indication of Power, Fault, Ethernet TX/RX/Traffic/Speed without cover removal.
 - 2. Four 10/100/1000 Mbps Ethernet unmanaged switch, RJ-45 ports.
 - 3. ARM 9 32-bit processor, 800MHz
 - 4. 1 GB RAM
 - 5. 512 KB MRAM
 - 6. 2 GB Flash Memory

7. One USB 2.0 port.
 8. 2.0 A fast-acting Overcurrent Protection.
 9. Integrated 20-30 VAC Global Power Supply
 10. Real Time Clock, 24 hour, 365 day, multi-year calendar +/- 1 minute per month at 77F (25C).
 11. RTC Power Failure Backup, 24 hours at 32 degrees to 100 degrees F (0 degrees to 38 degrees C)
 12. Power Output: 20 VDC +/- 10% at 7 mA maximum.
 13. AC power consumption at 9VA, max 100VA.
 14. Removable Terminal Blocks.
 15. Sensor, Actuator, and I/O Module Expandability via a 2-wire, polarity insensitive local PICU communication bus.
 16. 150 Point Base License (Expandable).
 17. LED for each hardware I/O point.
 18. Output H-O-A Switches.
 19. VAV PICU shall include an internal differential pressure sensor.
 - a. Operating Range: 0 to 2 inch WC (0 to 374 Pa).
 - b. Accuracy: +/- 2% of full scale at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
- M. The PICU shall support standard Web browser access via the Intranet/Internet.
- N. The PICU shall be able to route any alarm condition to any defined user location whether connected to a local network or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 3. The following shall be recorded by the PICU for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- O. PICU Controllers shall support at minimum the following control techniques:
1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
 2. General-purpose, non-linear control loops.
 3. Start/stop Loops.
 4. If/Then/Else logic loops.
 5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).
 6. Analytic calculations.
- P. The following six [6] integral Universal Inputs/Outputs shall be supported per each PICU:
1. UI/O as Analog Inputs; 16 Bit resolution (Thermistor or RTD configurable from 100

- to 100K Ohm, 0-10 VDC, 4-20 mA).
 - 2. UI/O as Digital Inputs; Dry Contact / Totalizer.
 - a. Dry Contact to detect Open / Closed Circuit (Voltage Rating: 0-30 VDC Open Circuit: Resistance Rating; Open Circuit >3,000 Ohms, Closed Circuit <500 Ohms).
 - b. Totalizer – Dry Contact (100 Hz, 360,000 pulses per hour maximum frequency: Minimum Duty Cycle 5 ms ON / 5 ms OFF).
 - 3. UI/O as Analog Outputs ([3] UI/O can be configured as AO)
 - a. 0-10.0 Vdc, 10.0mA maximum.
 - b. 0-20.0 mA, 550 Ohms maximum.
 - 4. LED for each hardware I/O point.
- Q. The following six [6] integral Digital Outputs (Triac) shall be supported per each PICU:
- 1. Solid State Relay normally open contacts, 20-30 VAC @ 50/60 Hz, at 1.0 A Continuous, 3.5 A Inrush.
 - 2. LED for each hardware I/O point.
 - 3. Output H-O-A Switches.
- R. The PICU shall employ a 150 Point Base License (expandable) device count capacity license model that supports I/O expansion capabilities.
- S. Each PICU shall have expansion ability to support additional I/O requirements through the use of remote input/output modules and a local communication bus. Each PICU shall be able to support a maximum of 15 Expansion I/O Modules for a maximum of 312 physical I/O points.
- 1. Mixed Expansion I/O Modules (UI/O & DO) shall communicate with PICU via a 2-wire bus and include removable terminals for field device wires.
 - 2. Mixed Expansion I/O Modules shall be available in the following configurations:
 - a. 3 UI/O, 2 AO, and 2 DO (7 Points).
 - b. 14 UI/O (5 can be configured as AO), and 6 DO (20 Points).
 - 3. Universal Inputs/Outputs shall be supported per each Expansion I/O Module:
 - a. UI/O as Analog Inputs; 16 Bit resolution (Thermistor or RTD configurable from 100 to 100K Ohm, 0-10 VDC, 4-20 mA).
 - b. UI/O as Digital Inputs; Dry Contact / Totalizer.
 - 1) Dry Contact to detect Open / Closed Circuit (Voltage Rating: 0-30 VDC Open Circuit: Resistance Rating; Open Circuit >3,000 Ohms, Closed Circuit <500 Ohms).
 - 2) Totalizer – Dry Contact (100 Hz, 360,000 pulses per hour maximum frequency: Minimum Duty Cycle 5 ms ON / 5 ms OFF).
 - c. UI/O as Analog Outputs (UI/O can be configured as AO)
 - 1) 0-10.0 Vdc, 10.0mA maximum.
 - 2) 0-20.0 mA, 550 Ohms maximum.
 - d. LED for each hardware I/O point.
 - 4. Digital Outputs (Triac) shall be supported per each Expansion I/O Module:
 - a. Solid State Relay normally open contacts, 20-30 VAC @ 50/60 Hz, at 1.0 A Continuous, 3.5 A Inrush.
 - b. LED for each hardware I/O point.
 - c. Output H-O-A Switches.
- T. The PICU shall not include an integrated Local Operator Interface but shall be capable of utilizing a standard browser-based device such as a Tablet, Touch Screen Device, etc.

2.7 PROGRAMMABLE PLANT CONTROL UNIT (PPCU)

- A. HVAC PPCU controllers shall be fully programmable to meet the unique requirements of the facility it shall control. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
- B. All PPCUs shall be application programmable and shall always maintain their certification. All control sequences within or programmed into the PPCU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- C. The PPCUs shall be capable of daisy-chain IP communications with other PPCU's and peer-to-peer communications with SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between PPCU's will be Niagara 4 FoxS or BACnet TCP/IP. Use of a proprietary communication protocol for peer-to-peer communications between PPCU's is not allowed.
- E. The PPCU shall be licensed and enabled to support five (5) devices and shall be licensed with the following Open protocol drivers by default:
 - 1. BACnet (MS/TP and IP [ISO 16484-5])
 - 2. LonTalk (ISO 14908)
 - 3. MODBUS (RTU and TCP)
- F. The PPCU shall be provided with a 1 Year Software Maintenance license. Labor to implement not included if greater than 1 year is required.
- G. The PPCU shall provide LED indication of communication and controller performance to the technician, without cover removal.
- H. The PPCU shall be capable of executing application control programs to provide:
 - 1. Calendar functions.
 - 2. Scheduling.
 - 3. Trending.
 - 4. Alarm monitoring and routing.
 - 5. Time synchronization.
 - 6. Integration of all daisy-chain PPCU's.
 - 7. Network management functions for all daisy-chain PPCU's.
- I. Programming software shall be embedded into the PPCU. The PPCU shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the embedded Niagara 4 environment.
- J. The PPCU shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.

- K. The PPCU shall provide the following hardware features as a minimum:
 - 1. Two 10/100 Mbps Ethernet ports.
 - 2. Two RS-485 ports, one isolated and one non-isolated, with biasing switches.
 - 3. ARM 9 32-bit processor, 1 GHz
 - 4. 1 GB RAM
 - 5. 512 KB MRAM
 - 6. 4 GB Flash Memory
 - 7. Two USB 2.0 ports
 - 8. One HMI port to connect onboard or remote HMI.
 - 9. 0-50 degrees C Ambient Operating Temperature
 - 10. Integrated 24 VAC/DC Global Power Supply
 - 11. Real Time Clock
- L. The PPCU shall support standard Web browser access via the Intranet/Internet.
- M. The PPCU shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
 - 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 - 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 - 3. The following shall be recorded by the PPCU for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- N. PPCU Controllers shall support at minimum the following control techniques:
 - 1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
 - 2. General-purpose, non-linear control loops.
 - 3. Start/stop Loops.
 - 4. If/Then/Else logic loops.
 - 5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).
- O. The following twenty-six [26] integral Inputs/Outputs shall be supported per each PPCU:
 - 1. Six integral 12 Bit resolution Universal Inputs (configurable as 20K NTC, 10K NTC, 0/2-10V, 0/4-20mA, 0.4Hz Dry Contact).
 - 2. Four integral dry contact / totalizer Digital Inputs. Totalizer: 15Hz (25ms on, 25ms off, 5ms bounce).
 - 3. Four integral 8 Bit 0-10 Vdc Analog Outputs with configurable safety position selections.
 - 4. Eight integral Digital Outputs.
 - a. Four Relay normally open contact at 3A, 250Vac, 30Vdc.

- b. One Relay normally open contact at 10A, 250Vac, 30Vdc with configurable safety position selections.
 - c. Three Relay normally open contact with common feed at 3A, 250Vac, 30Vdc with configurable safety position selections.
- P. The PPCU shall employ a device count capacity license model that supports I/O expansion capabilities.
- Q. Each PPCU shall have expansion ability to support additional I/O requirements through the use of remote input/output modules and a local communication bus. Each PPCU shall be able to support a maximum of 1,200+ physical I/O points.
 - 1. I/O-specific modules (UI, BI, AO, BO) shall require a Terminal Socket Module that includes screw or push-in terminals for field device wires, communication, and port to accept pluggable I/O-specific Module. I/O-specific Modules shall be hot pluggable and shall be replaceable without rewiring.
 - 2. Remote Universal Input Module (8 UI).
 - a. Eight Universal Inputs; 0/2-10V, 0/4-20mA, 20K NTC, 10K NTC, PT1000-1, PT1000-2, NI1000TK5000, PT3000, BALCO500, Binary Input (0 / 10V with pull-up).
 - 3. Remote Binary Input Module (12 BI).
 - a. Twelve Binary Inputs; Dry contact or Totalizer (20Hz)
 - b. Each Binary Input shall include a configurable status LED (Alarm: red/green; Status: yellow/off).
 - 4. Remote Analog Output Module (8 AO).
 - a. Eight Analog Outputs with configurable safety position selections. 8 Bit Analog Outputs; 0-10V, Floating Actuator, Binary Output (0V / 10V).
 - b. Each Analog Output shall include a RED status LED that varies brightness based on signal level & flashes in override mode (with manual override Module).
 - c. Optional version with manual override potentiometer per output.
 - 5. Remote Relay Output Module (6 BO).
 - a. Six Relay Outputs with configurable safety position selections.
 - b. Each Relay Output shall include a yellow status LED.
 - c. Optional version with manual override switch per output (Auto, 0, 1).
 - 6. Remote Floating Output Module (3 FO).
 - a. Three Floating Outputs with configurable safety position selections. 2 Relays per Floating Output.
 - b. Each Floating Output shall include a RED status LED (opening) and a GREEN status LED (closing).
 - c. Manual override potentiometer per output.
 - 7. Remote Mixed I/O Module (8 UI, 12 BI, 8 AO, 6 BO)
 - a. Eight Universal Inputs; 0/2-10V, 20K NTC, Binary Input (dry contact).
 - b. Twelve Binary Inputs; Dry contact or Totalizer (15Hz)
 - 1) Each Binary Input shall include a yellow status LED.
 - c. Eight Analog Outputs with configurable safety position selections. 10 Bit Analog Outputs; 0-10V, Binary Output (0V / 10V).
 - d. Six Relay Outputs.
 - 1) Each Relay Output shall include a yellow status LED.
- R. The PPCU shall be provided with an integrated Local Operator Interface.
 - 1. Local Operator Interface shall allow for User-ID and password protected access.

2. Local Operator Interface shall provide a backlit display, with automatic backlight time-out.
 - a. The display backlight shall automatically light upon press of a key or operation of the push & turn wheel. The display backlight will extinguish if operating keys or push & turn wheel is not used for two minutes.
3. Local Operator Interface shall provide full display of long text information.
 - a. Automatic left and right scrolling shall ensure that text information longer than the display width can be viewed.
4. Local Operator Interface shall provide configurable screens for viewing and adjusting data points and parameters, including the following operations.
 - a. Automatics and visual notification of all critical alarms.
 - b. Read and write access to all data points.
 - c. Full length names of data points, schedules, calendars, parameters, alarm texts, state texts and alarms.
 - d. Read and write access to all application parameters.
 - e. Read and write access to all schedules and calendars.
 - f. Read access to the onboard alarm buffer.
 - g. Overview of all data points in manual override.
 - h. Overview of all data points in alarm.
5. Local Operator Interface shall allow user access to text information via a push & turn operation wheel.
 - a. Scrolling through a list of information shall be accomplished by turning the operation wheel.
 - b. Selecting and acknowledging information shall be accomplished by pushing the operation wheel.
6. Changing information shall be accomplished by turning the operation wheel.

2.8 UNITARY IP CONTROL UNIT (UICU)

- A. HVAC UICU controllers shall be fully programmable to meet the unique requirements of the HVAC equipment it shall control. The controller platform shall provide options and advanced system functions, programmable and configurable using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
- B. All UICUs shall be application programmable and shall always maintain their certification. All control sequences within or programmed into the UICU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained.
- C. The controllers shall be capable of daisy-chain IP communications with other UICU's and peer-to-peer communications with SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- D. The communication protocols utilized for peer-to-peer communications between UICU's will be Niagara 4 FoxS or BACnet TCP/IP. Use of a proprietary communication protocol for peer-to-peer communications between UICU's is not allowed.
- E. The UICU shall be licensed and enabled to support three (3) devices and shall be licensed with the following Open protocol drivers by default:
 1. BACnet IP and BACnet MSTP
 2. Modbus TCP and Modbus RTU

3. SNMP
- F. The UICU shall be provided with Lifetime Software Maintenance license. Labor to implement not included.
- G. The UICU shall be capable of executing application control programs to provide:
 1. Calendar functions.
 2. Scheduling.
 3. Trending.
 4. Alarm monitoring and routing.
 5. Time synchronization.
 6. Integration of all daisy-chain UICU's.
 7. Network management functions for all daisy-chain UICU's.
- H. Programming software shall be embedded into the UICU. The UICU shall not require any external configuration tool or programming tool. All configuration and programming tasks shall be accomplished and accessible from within the embedded Niagara 4 environment.
- I. The UICU shall support the following security functions.
 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 3. Require users to use strong credentials.
 4. Data in Motion and Sensitive Data at Rest be encrypted.
 5. Encrypted (PKI) Secure IP Stack Communication Security.
 6. FIPS 140-2 Level 1 Cryptographic Module Compliant.
- J. The minimum controller Environmental ratings.
 1. Operating Temperature Ambient Rating: -4 degrees to 140 degrees F (-20 degrees to 60 degrees C).
 2. Storage Temperature Ambient Rating: -40 degrees to 185 degrees F (-40 degrees to 85 degrees C).
 3. Relative Humidity: 5% to 95% non-condensing
- K. The controller shall have the additional approval requirements, listings, and approvals:
 1. Meets FCC Part 15, Class B (radiated emissions) requirements.
 2. C-UL
 3. CE
 4. UL916, Open Energy Management Class 2
 5. RoHS2
 6. REACH
 7. WEEE
 8. CAN/CSA-C22.2 No. 205-12
 9. The controller housing shall be UL plenum rated mounting to either a panel or DIN rail (2.40" x 7.04" x 4.53"; 61mm x 179mm x 115mm).
- L. The UICU shall provide the following hardware features as a minimum:
 1. The UICU shall provide LED indication of Power, Fault, Ethernet TX/RX/Traffic/Speed without cover removal.
 2. ARM Cortex-A9/M4 9, 800 MHz
 3. 512 MB DDR SDRAM

4. 2 GB Flash Memory
 5. Powered from 24VAC/DC source
 6. Two 10/100 MB Ethernet ports capable of daisy chaining
 7. 1 RS-485 Serial Port
 8. Real Time Clock
 9. Secure Boot
 10. Ten [10] onboard IO points
 11. Supports up to 3 devices or 50 Points
- M. The UICU shall support standard Web browser access via the Intranet/Internet.
- N. The UICU shall be able to route any alarm condition to any defined user location whether connected to a local network or wide-area network.
1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.
 - c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 3. The following shall be recorded by the UICU for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- O. UICU Controllers shall support at minimum the following control techniques:
1. General-purpose control loops that can incorporate Demand Limit Control strategies, Set point reset, adaptive intelligent recovery, and time of day bypass.
 2. General-purpose, non-linear control loops.
 3. Start/stop Loops.
 4. If/Then/Else logic loops.
 5. Math Function loops (MIN, MAX, AVG, SUM, SUB, SQRT, MUL, DIV, ENTHALPY).
- P. The following five [5] Universal Inputsshall be supported per each UICU:
1. Type 3 10K Thermistor
 2. 0-100K ohm
 3. 0-10 VDC
 4. 0-20mA with external resistor
 5. Dry Contact
- Q. The following two [2] Analog Outputs shall be supported per each UICU:
1. 0-10VDC, 4mAmax output current
- R. The following three [3] Digital Outputsshall be supported per each UICU:
1. Triac, 24VAC @ 0.5 amp
- S. The UICU shall employ a 50 Point Base License that supports one [1] IO-R-34 expansion

module over a shielded RS-485 bus or three [3] devices via the embedded protocols.

- T. Each UICU shall have expansion ability to support additional I/O requirements through the use of a remote input/output module connected to an RS-485 local communication bus. Each UICU shall be able to support a maximum of one [1] 34 Point Expansion I/O Modules for a maximum of 44 physical I/O points.
 - 1. 34 Point Mixed Expansion I/O Module shall communicate with UICU via a 2-wire RS-485m bus.
 - 2. Sixteen [16] Universal Inputs shall be supported via 34 Point Expansion I/O Module:
 - a. Type 3 10K Thermistor
 - b. 0-100K ohm
 - c. 0-10 VDC
 - d. 0-20mA with external resistor
 - 3. Eight [8] Analog Outputs shall be supported via 34 Point Expansion I/O Module:
 - a. 0-10.0 Vdc
 - 4. Ten [10] Digital Outputs (Relay) shall be supported via 34 Point Expansion I/O Module:
 - a. Form A Contacts, 24VAC at 0.5 A rated
- U. The UICU shall not include an integrated Local Operator Interface.

2.9 ADVANCED UNITARY CONTROLLER (AUC)

- A. The advanced unitary controller (AUC) platform shall be designed specifically to control HVAC - ventilation, filtration, heating, cooling, humidification, and distribution. Equipment includes: constant volume air handlers, VAV air handlers, packaged RTU, heat pumps, unit vents, fan coils, natural convection units and radiant panels. The control shall use BACnet based devices where the application has a LonMark profile or BTL Listed PICS defined. Where LonMark devices are not available for a particular application, devices based on LonWorks shall be acceptable. For each LonWorks device that does not have LonMark certification, the device supplier shall provide an XIF file for the device. The controller platform shall provide options and advanced system functions, programmable and configurable, using Niagara 4 Framework, that allow standard and customizable control solutions required in executing the "Sequence of Operation".
- B. Minimum Requirements:
 - 1. The controller shall be fully programmable or configurable with full functionality on any Niagara 4 brand platform.
 - a. Support downloads to the controller in Niagara 4 platform.
 - b. Support uploads from the controller to Niagara 4 platform.
 - c. Support simulation/debug mode of the controller.
 - d. Maintain native GUI.
 - e. Native function-block programming software and all controller "Setup Wizards" shall be embedded within the Niagara 4 environment.
 - 2. The AUC shall be capable of either integrating with other devices or stand-alone operation.
 - 3. For VAV box applications, the AUC shall have an internal velocity pressure sensor.
 - a. Sensor Type: Microbridge air flow sensor with dual integral restrictors.
 - b. Operating Range: 0 to 1.5 inch H₂O (0 to 374 Pa).
 - c. Accuracy: +/- 2% of full scale at 32 degrees to 122 degrees F (0 degrees to 50 degrees C); +/- 1% of full scale at null pressure.

4. The AUC shall have two microprocessors. The Host processor contains on-chip FLASH program memory, FLASH information memory, and RAM to run the main HVAC application. The second processor for network communications. Controller memory minimum requirements include:
 - a. FLASH Memory Capacity: 60 Kilobytes with 8 Kilobytes for application program.
 - b. FLASH Memory settings retained for ten years.
 - c. RAM: 2 Kilobytes.
5. The AUC shall have an internal time clock with the ability to automatically revert from a master time clock on failure.
 - a. Operating Range: 24 hour, 365 day, multi-year calendar including day of week and configuration for automatic day-light savings time adjustment to occur on configured start and stop dates.
 - b. Accuracy: +/- 1 minute per month at 77 degrees F (25 degrees C).
 - c. Power Failure Backup: 24 hours at 32 degrees to 122 degrees F (0 degrees to 50 degrees C).
6. The AUC shall have Significant Event Notification, Periodic Update capability, and Failure Detect when network inputs fail to be detected within their configurable time frame.
7. The AUC shall have an internal DC power supply to power external sensors.
 - a. Power Output: 20 VDC +/- 10% at 75 mA.
8. The AUC shall have a visual indication (LED) of the status of the device:
 - a. Controller operating normally.
 - b. Controller in process of download.
 - c. Controller in manual mode under control of software tool.
 - d. Controller lost its configuration.
 - e. No power to controller, low voltage, or controller damage.
 - f. Processor and/or controller are not operating.
9. The minimum AUC Environmental ratings.
 - a. Operating Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C) for an AUC in unconditioned space.
 - b. Storage Temperature Ambient Rating: -40 degrees to 150 degrees F (-40 degrees to 65.5 degrees C) for an AUC in unconditioned space.
 - c. Operating Temperature Ambient Rating: 32 degrees to 122 degrees F (0 degrees to 50 degrees C) for an AUC in conditioned space.
 - d. Storage Temperature Ambient Rating: 32 degrees to 122 degrees F (0 degrees to 50 degrees C) for an AUC in conditioned space.
 - e. Relative Humidity: 5% to 95% non-condensing.
10. The AUC shall have the additional approval requirements, listings, and approvals:
 - a. UL/cUL (E87741) listed under UL916 (Standard for Open Energy Management Equipment) with plenum rating.
 - b. CSA (LR95329-3) Listed.
 - c. Meets FCC Part 15, Subpart B, Class B (radiated emissions) requirements.
 - d. Meets Canadian standard C108.8 (radiated emissions).
 - e. Conforms requirements European Consortium standard EN 61000-6-1; 2001 (EU Immunity).
 - f. Conforms requirements European Consortium standard EN 61000-6-3; 2001 (EU Emission).
11. The AUC housing shall be UL plenum rated mounting to either a panel or DIN rail (standard EN50022; 7.5mm x 35mm).

12. For VAV box applications, the AUC shall provide an integrated actuator option.
 - a. Actuator type: Series Floating.
 - b. Rotation stroke: 95 degrees +/- 177;3 degrees for CW or CCW opening dampers.
 - c. Torque rating: 44 lb-inch (5 Nm).
 - d. Run time for 90 degree rotation: 90 seconds at 60 Hz.
13. The AUC shall have a mix of Universal Inputs (UI), Digital Inputs (DI), Analog Outputs (AO), and Digital Triac Outputs (DO), as well as a 2-wire, polarity insensitive, AUC communication bus providing Sensor, Actuator, and I/O expandability.
 - a. Analog outputs (AO) shall be capable of being configured as digital outputs (DO).
 - b. Input and Output wiring terminal strips shall be removable from the controller without disconnecting wiring.
 - c. Input and Output wiring terminals shall be designated with color coded labels.
 - d. Universal inputs shall be capable of being configured as binary inputs, resistive inputs, voltage inputs (0-10 VDC), or current inputs (4-20 mA).
14. The AUC shall provide "continuous" automated loop tuning with an Adaptive Integral Algorithm Control Loop.
15. The AUC platform shall have standard HVAC application programs that are modifiable to support both the traditional and specialized "sequence of operations" as outlined in Section 4.
 - a. Discharge air control and low limit.
 - b. Pressure-dependent dual duct without flow mixing.
 - c. Variable air volume with return flow tracking.
 - d. Economizer with differential enthalpy.
 - e. Minimum airflow coordinated with CO2.
 - f. Unit ventilator cycle (1, 2, 3) 2-pipe.
 - g. Unit ventilator cycle (1, 2, 3) 2-pipe with face/bypass.
 - h. Unit ventilator cycle (1, 2, 3) 4-pipe.
 - i. Unit ventilator cycle (1, 2, 3) 4-pipe with EOC valve.
 - j. VAV terminal unit.
 - k. VAV terminal unit fan speed control.
 - l. Series fan.
 - m. Parallel fan.
 - n. Regulated air volume (room pressurization/de-pressurization).
 - o. CV dual-duct.
 - p. Room CO2 control.
 - q. Room Humidity.
 - r. TOD occupancy sensor stand-by set points.

2.10 BACNET TOUCHSCREEN COMMUNICATING THERMOSTAT (BCT)

- A. BACnet Conformance
 1. Touchscreen communicating thermostats shall be approved by the BTL as meeting the BACnet Application Specific Controller requirements.
 2. Touchscreen Communicating Thermostats shall, at a minimum, support MS/TP BACnet LAN types. They shall communicate directly through this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device.
 3. Standard BACnet object types supported shall include, as a minimum, Analog Input,

Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File, and Program Object Types.

4. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

B. BCT hardware shall:

1. Include a 32 Bit processor
2. Include a backlit touchscreen for the user interface, buttons are not allowed.
3. Include Three (3) universal inputs with 12-bit resolution that can accept 3K and 10K Type II thermistors, 0-10VDC, 0- 5 VDC, 4-20mA, and dry contact signals. Inputs on controller may be either analog or digital.
4. Include built-in temperature sensor.
5. Include built-in humidity sensor.
6. Include Six (6) relay outputs on board.
7. Include Two (2) analog outputs with 12-bit resolution. Each auto-detecting for 0-10 V or 4-20 mA control signals.
8. Meet the requirements of Listed Underwriters Laboratory for Open Energy Management Equipment (PAZX) under the UL Standard for Safety 916.
9. Meet the requirements of EMC Directive (European CE Mark) EN 60950.
10. Meet the requirements for FCC Part 15, Class B.
11. Be powered by 24VAC power.

2.11 OTHER CONTROL SYSTEM HARDWARE

- A. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Vendor. Control damper frames shall be constructed of galvanized steel, formed into channels and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5 inches water gauge static pressure. Honeywell is basis of design.
- B. Control damper actuators shall be furnished by the Control System Vendor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators. Honeywell is basis of design.
- C. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials. Two-position valves shall be 'line' size. Proportional control valves shall be sized for a maximum pressure drop of 5.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2 inches (51 mm) shall be "screwed" configuration and 2-1/2 inches (63.5 mm) and larger valves shall be "flanged" configuration. All control valves, including terminal unit valves, less than 2 inches (51 mm) shall be globe valves. Electrically-actuated control valves shall include spring return type actuators sized for tight shut-off against system pressures (as specified above) and, when specified, shall be furnished with

integral switches for indication of valve position (open-closed). Pneumatic actuators for valves, when utilized, shall be sized for tight shut-off against system pressures (as specified above). Honeywell is basis of design.

- D. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "drive-open; drive-closed" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Actuators on valves needing 'fail-safe' operation shall have spring return to Normal position. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed. Honeywell is basis of design.
- E. All control valves 2-1/2 inches (63.5 mm) or larger shall have position indication. All hot water control valves shall be Normally-Open arrangement; all chilled water control valves shall be Normally-Closed arrangement. Honeywell is basis of design.
- F. Wall Mount Room Temperature sensors: Each room temperature sensor shall provide temperature indication to the digital controller, provide the capability for a software-limited occupant set point adjustment (warmer-cooler slider bar or switch) and limited operation override capability. Room Temperature Sensors shall be 20,000-ohm thermistor type with a temperature range of -40 to 140 degrees F (-38 to 60 degrees C). The sensor shall be complete with a decorative cover and suitable for mounting over a standard electrical utility box. These devices shall have an accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is basis of design.
- G. Duct-mounted and Outside Air Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of ± 0.2 degrees C. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F (-38 to 71 degrees C) The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 feet (2438 mm) long sensor element. These devices shall have accuracy of 0.5 degrees F (.024 degrees C) over the entire range. Honeywell is basis of design.
- H. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.
- I. Carbon Dioxide Sensors (CO₂): Sensors shall utilize Non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure. Honeywell is basis of design.
- J. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point. Honeywell is basis of design.

- K. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube. Honeywell is basis of design.
- L. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips. Honeywell is basis of design.
- M. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.
- N. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- O. Pipe and Duct Temperature sensing elements: 20,000-ohm thermistor temperature sensors with and accuracy of $\pm 1\%$ accuracy. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included. Honeywell is basis of design.
- P. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor. Honeywell model L482A, or approved equivalent.
- Q. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BMS via built-in interface card (MODBUS or BACnet). Honeywell SmartVFD is basis of design.
- R. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- S. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF."
- T. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.

- U. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation. Honeywell is basis of design.
- V. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.12 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Vendor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
 - 1. Trending.
 - 2. Scheduling.
 - 3. Electrical demand limiting.
 - 4. Duty Cycling.
 - 5. Downloading Memory to field devices.
 - 6. Real time 'live' Graphic Programs.
 - 7. Tree Navigation.
 - 8. Parameter change of properties.
 - 9. Set point adjustments.
 - 10. Alarm / event information.
 - 11. Configuration of operators.
 - 12. Execution of global commands.
 - 13. Add, delete, and modify graphics and displayed data.
- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
 - 1. Server Software, Database and Web Browser Graphical User Interface.
 - 2. 3 Year Software Maintenance license. Labor to implement not included.
 - 3. Embedded System Configuration Utilities for future modifications to the system and

- controllers.
- 4. Embedded Graphical Programming Tools.
- 5. Embedded Direct Digital Control software.
- 6. Embedded Application Software.
- F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non -Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
 - 1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 - 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.13 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
 - 1. Geographic View shall display a logical geographic hierarchy of the system including: cities, sites, buildings, building systems, floors, equipment and objects.
 - 2. Groups View shall display Scheduled Groups and custom reports.
 - 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:

1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:

- a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day 'Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system would be automatically downloaded with the 'Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.
 1. Schedules: Schedules shall comply with the LonWorks and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedule shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include: name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an 'individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the 'tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the 'tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
 6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the

Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:

1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with each alarm category, enabling the operator to easily sort through multiple events displayed.
3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A ' network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room

- temperature alarm).
 - d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
 - 1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to simultaneously graphically display multiple trends per graph.
 - 2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 - 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 - 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 - 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 - 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 - 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that are accessed from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
 - 1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
 - 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to

assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.14 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration and sequence of operation.
- C. Graphic Sequence: The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. GPL Capabilities: The following is a minimum definition of the capabilities of the Graphic Programming software:
 - 1. Function Block (FB): Shall be a collection of points, microblocks and wires which have been connected together for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 - 2. Logical I/O: Input/Output points shall interface with the control modules in order to read various signals and/or values or to transmit signal or values to controlled devices.
 - 3. Microblocks: Shall be software devices that are represented graphically and may be connected together to perform a specified sequence.
 - 4. Wires: Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 - 5. Reference Labels: Labels shall be similar to wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e. two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 - 6. Parameter: A parameter shall be a value that may be tied to the input of a microblock.
 - 7. Properties: Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields, and shall contain 'push buttons' for the purpose of selecting default parameter settings.
 - 8. Icon: An icon shall be graphic representation of a software program. Each graphic

- microblock has an icon associated with it that graphically describes its function.
9. Menu-bar Icon: Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
 10. Live Graphical Programs: The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

2.15 LONWORKS NETWORK MANAGEMENT

- A. Systems requiring the use of third-party LonWorks network management tools shall not be accepted.
- B. Network management shall include the following services: device identification, device installation, device configuration, device diagnostics, device maintenance and network variable binding.
- C. The Network configuration tool shall also provide diagnostics to identify devices on the network, to reset devices and to view health and status counters within devices.
- D. These tools shall provide the ability to "learn" an existing LonWorks network, regardless of what network management tool(s) were used to install the existing network, so that existing LonWorks devices and newly added devices are part of a single network management database.
- E. The network management database shall be resident in the Network Area Controller (NAC), ensuring that anyone with proper authorization has access to the network management database at all times. Systems employing network management databases that are not resident, at all times and within the control system shall not be accepted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.
- B. Line and low voltage electrical connections to control equipment shown specified or shown

on the control diagrams shall be furnished and installed by the Contractor in accordance with these specifications.

- C. Equipment furnished by the Mechanical Vendor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.4 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Vendor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.5 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Vendor shall load all system software and start-up the system. The Control System Vendor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Vendor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Vendor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Controls Vendor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.
- B. The Control System Vendor shall provide 48 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.7 WARRANTY PERIOD SERVICES

- A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Vendor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Vendor shall come with a 5 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage. Labor to implement upgrades in years two through five are not included in standard warranty.
- D. Maintenance of Control Hardware: The Control System Vendor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Vendor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.8 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Vendor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.9 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a

minimum:

1. As-built control drawings for all equipment.
2. As-built Network Communications Diagram.
3. General description and specifications for all components.
4. Completed Performance Verification sheets.
5. Completed Controller Checkout/Calibration Sheets.

3.10 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. Related Sections include the following:
 - 1. Division 230923 Section "Direct Digital Control System for HVAC" for control equipment and devices and for submittal requirements.

1.3 DEFINITIONS

- A. DDC: Direct digital control.

1.4 AIR-HANDLING-UNIT CONTROL SEQUENCES (HVAC UNITS)

- A. Start and Stop Supply and Return Fan(s):
 - 1. Initiate: Occupied Time Schedule:
 - a. Input Device: Time clock.
 - b. Output Device: Time clock to motor starter.
 - c. Action: Energize fan(s). Transducer shall monitor power draw on all supply and return fans.
 - d. Cycle two way hot water control valve or two way chilled water control valve to maintain setpoint. Temperature sensor shall be in supply ductwork for VAV systems or in space for constant volume systems. Provide CO monitors in similar location.
 - e. Motorized damper for outdoor air shall open to minimum position, return damper shall be open and spill damper shall be closed on fan start and outside air damper shall close when fan is off. Provide end switch on dampers. On the VAV units monitor the outdoor airflow rate and modulate the outdoor air damper to maintain outdoor air quantity at all supply rates.
 - 2. Initiate: Unoccupied Time Schedule:
 - a. Input Device: Room thermostat.
 - b. Output Device: Room thermostat to motor starter.

- c. Action: Energize fan(s) if temperature exceeds unoccupied setpoint. on cooling or below setpoint on heating.
- 3. Unoccupied Ventilation:
 - a. Input Device: Time clock and room thermostat.
 - b. Output Device: Room thermostat.
 - c. Action: Cycle fan(s) during unoccupied periods as thermostats call for heating or cooling Outdoor air damper and spill damper shall be closed and return damper shall be open..
- 4. Display: Supply-fan on-off indication.
- 5. Cooling and Heating:
 - a. Input Device: Discharge air sensor
 - b. Output Device: chilled and heating control valves.
 - c. Action: Modulate chilled water control valve in cooling mode and heating control valve in heating mode to maintain space temperature based on supply air temperature.
 - d. When outside air enthalpy is adequate and cooling is required outside air and spill air damper shall modulate open and return air damper shall modulate closed to maintain setpoint on units HVAC-1 to 4.
 - e. Discharge air sensor shall shutdown unit upon detection of low air temperature and provide alarm.
 - f. Provide condensate overflow alarm upon detection of condensate in drain pan. Shut down unit and provide alarm.
- B. Operator Station Display: Indicate the following on operator workstation display terminal:
 - 1. Occupied/unoccupied mode.
 - 2. Outdoor-air-temperature indication.
 - 3. Supply-fan and return fan on-off indication.
 - 4. Room temperature indication.
 - 5. Room temperature set point.
 - 6. Chilled water and hot water valve position.
 - 7. CO concentration

1.6 TERMINAL UNIT OPERATING SEQUENCE

A. VAV boxes

- 1. Occupancy:
 - a. Input Device: Timeclock.
 - b. Output Device: DDC system binary output.
 - c. Action: Report occupancy and enable occupied temperature set point or unoccupied setpoint.
- 2. Room Temperature:

- a. Input Device: Room thermostat. Room thermostat shall allow local adjustment by occupant.
 - b. Output Device: VAV box.
 - c. Action: Modulate airflow to the space to maintain temperature setpoint (occupied or unoccupied).
 - 1) Occupied Temperature: 75 deg F summer and 70 degrees winter (adjustable)
 - 2) Unoccupied Temperature: 80 degrees summer and 62 degrees winter (adjustable)
3. Hot Water Coil
- a. Input Device: Room thermostat and VAV position
 - b. Output Device: VAV box valve
 - c. Action: Modulate control valve to maintain temperature in the space
4. Display:
- a. Room/area served.
 - b. Room temperature indication.
 - c. Room temperature set point.
 - d. Room temperature set point, occupied.
 - e. Room temperature set point, occupied standby.
 - f. Room temperature set point, unoccupied.
 - g. Hot water coil valve position
5. Alarms:
- a. Room temperature 5% from set point
 - b. CO₂ concentration exceeds set point by 10%
 - c. Valve or damper failure (as sensed by end switch)
 - d. Motor failure alarms
 - e. Dirty filter

1.6 HEATING SYSTEM

A. Boilers:

- 1. Heating temperature:
 - a. Input Device: Outdoor air sensor
 - b. Output Device: Boilers
 - c. Action: Maintain discharge temperature as determined by outdoor air sensor.
- 2. Boiler Sequence:
 - a. Primary boiler shall cycle to maintain discharge temperature. If primary boiler can't maintain discharge temperature secondary boiler shall turn on and units shall cycle together

B. Secondary Pump:

1. Operation:
 - a. Input Device: Pressure sensor
 - b. Output Device: AFD
 - c. Action: Pump speed shall be determined by discharge pressure sensor to maintain preset discharge pressure. If primary pump can't maintain pressure secondary pump shall cycle on and pumps shall cycle together.

C. Primary Pump:

1. Operation:
 - a. Input Device: Boiler
 - b. Output Device: Motor starter
 - c. Action: Primary pump shall be in operation when boiler is in operation.

D. Operator Station Display: Indicate the following on operator workstation display terminal:

1. Outdoor air temperature
2. Discharge boiler temperature
3. Supply and return water temperatures and pressures
4. Primary pump on-off indication
5. Secondary pump speed.
6. Boiler on-off indication.
7. Failure alarms.

1.7 COOLING SYSTEM

A. Refrigeration Machine:

1. Chilled water temperature:
 - a. Input Device: Return water temperature
 - b. Output Device: Refrigeration machine
 - c. Action: Maintain discharge temperature as determined by return water temperature.
2. Refrigeration Machine Sequence:
 - a. Primary chiller shall cycle to maintain discharge temperature. If primary chiller can't maintain temperature secondary chiller shall turn on.

B. Chilled water Pump:

1. Operation:
 - a. Input Device: Pressure sensor
 - b. Output Device: AFD
 - c. Action: Pump speed shall be determined by discharge pressure sensor to maintain preset discharge pressure. Isolation valves shall be open to the primary pump and closed to the standby pump.

C. Condenser water Pump:

1. Operation:
 - a. Input Device: Chiller

- b. Output Device: Motor starter
 - c. Action: Condenser water pump shall be in operation when chiller is in operation. . Isolation valves shall be open to the primary pump and closed to the standby pump.
- D. Standby water Pump:
 - 1. Operation:
 - a. Input Device: Pumps
 - b. Output Device: AFD
 - c. Action: When the primary chilled water pump fails the automatic valves shall close to the primary pump and open to the standby pump. AFD shall modulate pump to maintain preset discharge temperature. When primary condenser water pump fails the valves shall close to the primary condenser water pump and open to the standby pump. The AFD shall stay in full speed position.
 - d. Alarm: Send alarm on failure of either pump. Should both primary pumps fail the chillers shall turn off.
- E. Operator Station Display: Indicate the following on operator workstation display terminal:
 - 1. Supply and return chilled water temperatures and pressures
 - 2. Supply and return condenser water temperatures and pressures
 - 3. Condenser water pump on-off indication
 - 4. Chilled water pump speed.
 - 5. Refrigeration machine on-off indication.
 - 6. Failure alarms.

1.8 UNIT HEATER CONTROL SEQUENCES

- A. Operation:
 - 1. Initiate: Thermostat:
 - 2. Output Device: Heater fan operation
 - 3. Action: Heater fan shall turn on when determined by remote thermostat

1.9 EXHAUST FANS

- A. Start and Stop Exhaust Fan(s):
 - 1. Initiate: Occupancy Sensor (for toilet exhaust fans):
 - a. Input Device: Local occupancy sensor.
 - b. Output Device: motor starter.
 - c. Action: Energize fan(s).
 - 2. Initiate: Temperature sensor (for IT closets):
 - a. Input Device: Temperature sensor

- b. Output Device: Motor starter
- c. Action: Energize fan

1.10 SPLIT SYSTEM AIR CONDITIONING UNIT.

- A. The unit shall operate on its independent thermostat. Air cooled condensing unit shall cycle based on cooling load requirements. These controls shall be provided by the air conditioning unit supplier. Provide a high temperature alarm and unit failure alarm to the DDC system

1.11 ENERGY METERING

- A. Provide water meters on incoming water service, and water feeds to condenser water, chilled water and hot water heating system. Monitor water use. All data shall be transmitted to the BMS system.
- B. Provide energy consumption meters on the heating system, condenser water system and chilled water system to monitor flow and temperature difference. Monitor flow and temperature difference. All data shall be transmitted to the BMS system.
- C. Provide interface to utility provided gas and electric meters to record whole building energy use.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled water piping.
 - 3. Condenser water piping.
 - 4. Makeup-water piping.
 - 5. Condensate-drain piping.
 - 6. Air-vent piping.
 - 7. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
 - 1. Hot-Water Heating Piping: 125 psig at 200 deg F
 - 2. Chilled water piping: 125 psig at 100 deg F.
 - 3. Condenser water piping: 125 psig at 150 deg F.
 - 4. Makeup-Water Piping: 80 psig at 150 deg F.
 - 5. Condensate-Drain Piping: 150 deg F.
 - 6. Air-Vent Piping: 200 deg F.
 - 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.4 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air control devices.
 - 3. Hydronic specialties.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Shop Drawings: Detail, at 1/4 inch scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- D. Welding certificates.
- E. Qualification Data: For Installer.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- H. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K .
- C. Wrought-Copper Fittings: ASME B16.22.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
 - 2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
- D. Copper or Bronze Pressure-Seal Fittings:
 - 1. Housing: Copper.
 - 2. O-Rings and Pipe Stops: EPDM.
 - 3. Tools: Manufacturer's special tools.
 - 4. Minimum 200-psig working-pressure rating at 250 deg F.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
 - 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F
- D. Dielectric Flanges:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Separate companion flanges and steel bolts and nuts shall have 150-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.
2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 VALVES

- A. Gate, Check, and Ball Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Gerand Engineering Co.
 - e. Griswold Controls.
 - f. Taco.
2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

2.6 AIR CONTROL DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amtrol, Inc.
 2. Armstrong Pumps, Inc.
 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 4. Taco.
- B. Manual Air Vents:
 1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: NPS 1/2
 5. Discharge Connection: NPS 1/8
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 deg F.
- C. Automatic Air Vents:
 1. Body: Bronze or cast iron.
 2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/4.
 6. CWP Rating: 150 psig
 7. Maximum Operating Temperature: 240 deg F

2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

B. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F .

C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hydronic piping, aboveground, NPS 2 and smaller, shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hydronic piping, aboveground, NPS 2 1/2" and larger, shall be the following:

1. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and welded joints.

C. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

E. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

F. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-

plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet ; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2 : Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch (10 mm).
 - 5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch.

6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 8. NPS 6: Maximum span, 17 feet ; minimum rod size, 1/2 inch.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 Maximum span, 5 feet ; minimum rod size, 1/4 inch.
 2. NPS 1 Maximum span, 6 feet ; minimum rod size, 1/4 inch.
 3. NPS 1-1/2 Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 6. NPS 3 : Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION - 232123 BASE-MOUNTED, CENTRIFUGAL HYDRONIC PUMPS

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Provide pumps and required system trim for heating, chilled water, condenserwater and dual temperature water systems including all related appurtenances for a complete and operating systems.

1.2 SECTION INCLUDES

- A. End Suction, Long Coupled Pump (Base Mounted)

1.3 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division 1 Specification Sections, apply to these Sections.
 - Section 230500 - Mechanical General Requirements
 - Section 230553 - Mechanical Identification
 - Section 230548 - Vibration Isolation
 - Section 230700 - Piping Insulation
 - Section 232113 - Hydronic Piping and Specialties
 - Section 230593 - Testing, Adjusting, and Balancing
 - Section 230519 - Meters and Gauges

1.4 REFERENCES

- A. HI - Hydraulic Institute.
- B. ANSI - American National Standards Institute.
- C. OSHA - Occupational Safety & Health Administration.
- D. ASHRAE – American Society of Heating, Refrigeration and Air-Conditioning Engineers.
- E. NEMA - National Electrical Manufacturers Association.
- F. UL - Underwriters Laboratories.
- G. ETL - Electrical Testing Laboratories.
- H. CSA - Canadian Standards Association.
- I. NEC - National Electric Codes.
- J. ISO - International Standards Organization.
- K. IEC - International Electrotechnical Commission.
- L. ASME – American Society of Mechanical Engineers.

1.5 SUBMITTAL

- A. Submit each item in this article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Submit manufacturer's installation instructions under provisions of General Conditions and Division 1.
 - Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts lists.
 - Under provisions of commissioning documentation, testing of pumps, as well as training of owner's operation and maintenance personnel may be required in cooperation with the commissioning consultant.
- C. Product Data including certified performance curves and rated capacities of selected model, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate pump's operating point on curves.
- D. Complete Package information Product Data including:
 - System summary sheet (where applicable)
 - Sequence of Operation
 - Shop drawing indicating dimensions, required clearances and location and size of each field connection
 - Power and control wiring diagram
 - System profile analysis including pump curves, system curve, and variable speed pump curves (where applicable)
 - Pump data sheets - Rated capacities of selected models and indication of pump's operating point on curves.
 - Submittals on furnished specialties and accessories
 - Submittals must be specific to this project. Generic submittals will not be accepted
- E. A detailed weighted average pump efficiency-Part Load Efficiency Value (PLEV)- Pump Rating Report shall be submitted for each pump. Pump PLEV shall be based on the standard load profile developed in AHRI 550/590-1998 also known as IPLV or Integrated Part Load Value. The pump PLEV Rating shall be expressed with load weighting $\text{pump PLEV} = 1 / (0.01/A + 0.42/B + 0.45/C + 0.12/D)$ & shall be based points on A: 100%, B:75%, C:50% and D:25%. Each Pump Efficiency ratings shown with flow matched to load percentage and Specified Control Head. Actual job specific load profile weighting may be substituted for standard IPLV weighting.
- F. Pump and motor must meet minimum Department of Energy requirements and have a PEICL value less than 1
- G. Specified Control Head shall be 30% TDH or calculated minimum control head specified within the equipment schedule
- H. Hanging and supporting requirements should follow the recommendations in the manufacturer's installation instructions
- I. Submittals that are "rejected" as being "non-compliant" will be re-reviewed once with all time for subsequent reviews back charged to the contractor in accordance with the engineer's current prevailing rate schedule. If a rate schedule for additional services is included, as part of the contract with the owner that rate schedule shall be used in lieu of the "current prevailing" rate schedule.

1.6 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.

- B. Ensure pump operation at specified system fluid temperatures without vapor binding and cavitation, is non-overloading in parallel or individual operation, and operates to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.
- C. Ensure pump pressure ratings are at least equal to system's maximum operating pressure at point where installed but not less than specified.
- D. Equipment manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment with a minimum of 20 years experience.
- E. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Materials damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- B. Store materials in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- C. Use all means necessary to protect equipment before, during, and after installation.
- D. All scratched, dented, and otherwise damaged units shall be repaired or replaced as directed by the Architect Engineer.

1.8 WARRANTY:

- A. Provide a minimum One (1) year warranty on materials and installation under provision of Section 01 78 36.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. The specifying engineer reserves the right to specify a primary supplier / lead spec manufacturer on all supplied schedule and specification documents. These primary suppliers have led their respective industry in research and development and their products have had proven track records in the field. These primary suppliers, in the opinion of this engineering firm, produce a superior product to the alternately listed manufacturers. The contractor may choose to supply equivalent equipment as manufactured by the alternately specified manufacturer based on the approval of the supplied alternate manufacturer's equipment is subject to approval of the submittals.
- B. Contractor shall furnish and install new end suction long coupled pumps for chilled water, condenser water and hot water heating systems as indicated on the drawings. Pumps shall be condenser water as manufactured by Bell & Gossett or approved equal. Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings. Pump substitutions shall be provided with connection sizes equal to those scheduled. Pump connections shall not be downsized. Pump substitutions shall not be provided at efficiencies less than those scheduled.

2.2 COMPONENTS

- A. The pumps shall be long coupled, base mounted, single stage, end suction, vertical split case design, in cast iron stainless steel fitted, specifically designed for quiet operation. Suitable standard operations at 225°F and 175 PSIG working pressure or optional operations at up to 250°F and 250 PSIG working pressures. Working pressures shall not be de-rated at temperatures up to 250F. The pump internals shall be capable of being serviced without disturbing piping connections, electrical motor connections or pump to motor alignment.
- B. The pumps shall be composed of three separable components a motor, bearing assembly, and pump end (wet end). The motor shaft shall be connected to the pump shaft via a replaceable flexible coupling.
- C. A bearing assembly shall support the shaft via two heavy-duty regreaseable ball bearings. Bearing assembly shall be replaceable without disturbing the system piping and shall have foot support at the coupling end. Pump bearings shall be regreaseable without removal of the bearings from the bearing assembly. Thermal expansion of the shaft toward the impeller shall be prevented via an inboard thrust bearing.
- D. The bearing assembly shall have a solid SAE1144 steel shaft. A stainless steel shaft sleeve shall be employed to completely cover the wetted area under the seal.
- E. Pump shall be equipped with an internally-flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Application of an internally flushed mechanical seal shall be adequate for seal flushing without requiring external flushing lines. Seal assembly shall have Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.
- F. Bearing assembly shaft shall connect to a stainless steel impeller. Impeller shall be both hydraulically and dynamically balanced to ANSI/HI 9.6.4-2016, balance grade G6.3 and secured by a stainless steel locking capscrew or nut.
- G. Pump should be designed to allow for true back pull-out allowing access to the pump's working components, without disturbing motor or piping, for ease of maintenance.
- H. A center drop-out type coupling, capable of absorbing torsional vibration, shall be employed between the pump and motor. Pumps for variable speed application shall be provided with a suitable coupling sleeve. Coupling shall allow for removal of pump's wetted end without disturbing pump volute or movement of the pump's motor and electrical connections. On variable speed applications the coupling sleeve should be constructed of an neoprene material to maximize performance life.
- I. An ANSI and OSHA rated coupling guard shall shield the coupling during operation. Coupling guard shall be dual rated ANSI B15.1 and OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling. No more than .25 inches of either rotating assembly shall be visible beyond the coupling guard.
- J. Pump volute shall be of a cast iron design for heating systems with integrally cast pedestal volute support, rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges. (Optional 250 PSIG working pressures are available and are 250# flange drilled.) Volute shall include gauge ports at nozzles, and vent and drain ports.
- K. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Pump and motors shall be factory aligned, and shall be realigned after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications and conform to standards outlined in EISA 2007.
- L. Base plate shall be of structural steel or fabricated steel channel configuration fully enclosed at sides and ends, with securely welded cross members and fully open grouting area (for field grouting). The minimum base plate stiffness shall conform to ANSI/HI 1.3.8.2.1-2019 for grouted Horizontal Baseplate Design standards.

- M. Pump shall be of a maintainable design and, for ease of maintenance, should use machine fit parts and not press fit components.
- N. The pump(s) vibration limits shall conform to Hydraulic Institute ANSI/HI 9.6.4-2016 for recommended acceptable unfiltered field vibration limits (as measured per ANSI/HI 9.6.4-2016 Figure 9.6.4.2.3.1) for pumps with rolling contact bearings.
- O. Pump manufacturer shall be ISO-9001 certified.
- P. Each pump shall be hydrostatically tested 1.5 times the maximum rated working pressure and name-plated before shipment.
- Q. Pump shall conform to ANSI/HI 9.6.3.1-2012 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

2.3 ACCESSORIES

- A. Where noted on the schedule provide one mechanical seal for each model type of primary pump.
- B. Where noted on schedule pumps shall be provided with internal volute wear rings, galvanized drip pan, or special spacer couplings.
- C. Where noted on schedule an EPR/Carbon-Tungsten Carbide seal (250° F maximum operating temperature), or EPR/Silicon Carbide-Silicon Carbide seal should be used in lieu of the Buna standard seal (225° F maximum operating temperature).
- D. Where noted on schedule a stuffing box design may be used in lieu of the traditional internally flushed mechanical seal design. Pump shall be flushed single seal or packing gland type seal arrangements.
- E. Where noted on schedule, pumping equipment may require a Hydraulic Performance Test per ANSI/HI-14.6-2011, witnessed or non-witnessed test.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. All components shall be installed in accordance with manufacturer's installation instructions.
- B. Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow.
- C. Furnish and install triple duty valves on the discharge side of all pumps and furnish and install a line size shut-off valve on the suction side of all pumps. Anywhere that 5 straight pipe diameters of pipe cannot be provided on the inlet side of a pump a suction diffuser shall be used to provide appropriate flow distribution into the eye of the pump's impeller.
- D. Provide temperature and pressure gauges where and as detailed or directed.
- E. On systems where pump seals require flushing water or cooling water for a heat exchanger kit, provide cooling water supply piping and connections as well as the return piping, if required. Piping should be of adequate size to pass required flow rate.
- F. Proper access space around a device should be left for servicing the component. No less than the minimum recommended by the manufacturer.
- G. Provide an adequate number of isolation valves for service and maintenance of the system and its components.
- H. Circulating pump shall have sufficient capacity to circulate the scheduled GPM against the scheduled external head (feet) with the horsepower and speed as scheduled and/or as denoted on the drawings. Motors shall be of electrical characteristics as scheduled, denoted and/or as indicated on the electrical plans and specifications. Pump characteristics shall be such that the head of the pump under varying conditions shall not exceed the rated horsepower of the drive motor.

- I. On systems where the final balancing procedure requires the triple duty valve to be throttled more than 25% to attain design flow (on a constant speed pumping system), and no future capacity has been built into the pump, the pump impeller must be trimmed to represent actual system head resistance. The pump provider and engineer of record, based on the balancing contractor's reports, shall determine the final impeller trim diameter.
- J. Install foot mounted and base mounted pumps on vibration isolation pad or house keeping pad, via anchor bolts. Set and level and grout in place.
- K. All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping. All piping shall be fitted to the pumps even though piping adjustments may be required after the pipe is installed.
- L. On components that require draining, contractor must provide piping to and discharging into appropriate drains.
- M. Provide drains for bases and seals, piped to and discharging into floor drains.
- N. Power wiring, as required, shall be the responsibility of the electrical contractor. All wiring shall be performed per manufacturer's instruction and applicable state, federal, and local codes.
- O. Control wiring for remote mounted switches and sensor / transmitters shall be the responsibility of this contractor. All wiring shall be performed per manufacturer's instructions and applicable state, federal, and local codes.

END OF SECTION

SECTION 232523 - GENERAL-DUTY VALVES FOR HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Bronze lift check valves.
 - 4. Bronze swing check valves.
 - 5. Bronze gate valves.
 - 6. Lubricated plug valves.
- B. Related Sections:
 - 1. Division 23 Section "Identification for hVAC Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 3. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.

2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.4 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig.
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

2.5 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Red-White Valve Corporation.

- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded[or solder joint].
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron[, bronze, or aluminum].

2.6 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Nordstrom Valves, Inc.
- 2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular or short
 - e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, or gate valves.
 - 2. Throttling Service: ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 5. For Grooved-End Copper Tubing: Valve ends may be grooved.

3.5 HYDRONIC VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: Two-piece, full port, brass or bronze with bronze trim.
 3. Bronze Swing Check Valves: Class 125, nonmetallic disc.
 4. Bronze Gate Valves: Class 125, NRS.

END OF SECTION 220523

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.
 - 7. Seismic-restraint devices.

- B. Related Sections:

- 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.

- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 5. Shop-Applied Coating Color: Black
 - 6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Maximum Thermal Conductivity:
 - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. Rubatex International, LLC
 - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - 1. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2. Ductmate Industries, Inc.
 - 3. Hilti Corp.
 - 4. Kinetics Noise Control.
 - 5. Loos & Co.; Cableware Division.
 - 6. Mason Industries.
 - 7. TOLCO; a brand of NIBCO INC.
 - 8. Unistrut Corporation; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

- D. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- D. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
 - 1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer's recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Test for leaks before applying external insulation.
 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 3. Give seven days' advance notice for testing.
- B. Duct System Cleanliness Tests:
 1. Visually inspect duct system to ensure that no visible contaminants are present.
 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- C. Duct system will be considered defective if it does not pass tests and inspections.

- D. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units
 - a. Pressure Class: Positive 1-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12
 - d. SMACNA Leakage Class for Round: 12

B. Return Ducts:

1. Ducts Connected to Air-Handling Units
 - a. Pressure Class: Positive or negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 12
 - d. SMACNA Leakage Class for Round and Flat Oval: 12

C. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel

D. Liner:

1. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
2. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.

E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:

- 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Backdraft dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Flange connectors.
6. Turning vanes.
7. Duct-mounted access doors.
8. Flexible connectors.
9. Flexible ducts.
10. Duct accessory hardware.

- B. Related Sections:

1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, including sleeves; and duct-mounted access doors and remote damper operators.

- e. Wiring Diagrams: For power, signal, and control wiring.
 - C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
 - D. Source quality-control reports.
 - E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
 - F. LEED Submittals:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1.
- 1.4 QUALITY ASSURANCE
- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
 - B. Comply with AMCA 500-D testing for damper rating.
- 1.5 EXTRA MATERIALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements,
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Duro Dyne Inc.
 - 5. Greenheck Fan Corporation.
 - 6. Lloyd Industries, Inc.
 - 7. Nailor Industries Inc.
 - 8. NCA Manufacturing, Inc.
 - 9. Pottorff; a division of PCI Industries, Inc.
 - 10. Ruskin Company.
 - 11. SEMCO Incorporated.
 - 12. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inches wg.
- E. Frame: 0.052-inch- thick, galvanized sheet steel, with welded corners
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.
- M. Accessories:
 - 1. Electric actuators.

2.3 MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements,
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. METALAIRE, Inc.
 - f. Nailor Industries Inc.
 - g. Pottorff; a division of PCI Industries, Inc.
 - h. Ruskin Company.
 - i. Trox USA Inc.
 - j. Vent Products Company, Inc.
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. U shaped.
 - b. Galvanized -steel channels, 0.064 inch thick.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple blades.
 - b. Opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel
7. Bearings:
 - a. Oil-impregnated bronze
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Vinyl
9. Jamb Seals: Cambered stainless steel
10. Tie Bars and Brackets: Galvanized steel

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements,

1. American Warming and Ventilating; a division of Mestek, Inc.

2. Arrow United Industries; a division of Mestek, Inc.
 3. CESCO Products; a division of Mestek, Inc.
 4. Duro Dyne Inc.
 5. Flexmaster U.S.A., Inc.
 6. Greenheck Fan Corporation.
 7. Lloyd Industries, Inc.
 8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
 9. McGill AirFlow LLC.
 10. METALAIRE, Inc.
 11. Metal Form Manufacturing, Inc.
 12. Nailor Industries Inc.
 13. NCA Manufacturing, Inc.
 14. Ruskin Company.
 15. Vent Products Company, Inc.
 16. Young Regulator Company.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
1. U shaped.
 2. Galvanized -steel channels, 0.064 inch thick.
 3. Mitered and welded corners.
- D. Blades:
1. Multiple blade with maximum blade width of 8 inches.
 2. Opposed-blade design.
 3. Galvanized steel.
 4. 0.064 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.
- E. Blade Axles: 1/2-inch- diameter; galvanized steel blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Oil-impregnated bronze
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.
- 2.5 FIRE DAMPERS
- A. Manufacturers: Subject to compliance with requirements,
1. Air Balance Inc.; a division of Mestek, Inc.

2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. McGill AirFlow LLC.
6. METALAIRE, Inc.
7. Nailor Industries Inc.
8. NCA Manufacturing, Inc.
9. PHL, Inc.
10. Pottorff; a division of PCI Industries, Inc.
11. Prefco; Perfect Air Control, Inc.
12. Ruskin Company.
13. Vent Products Company, Inc.
14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream, fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.6 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements,
1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIRE, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

2.8 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements,
 - 1. American Warming and Ventilating; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Ductmate Industries, Inc.
 - 4. Flexmaster U.S.A., Inc.
 - 5. Greenheck Fan Corporation.
 - 6. McGill AirFlow LLC.
 - 7. Nailor Industries Inc.
 - 8. Pottorff; a division of PCI Industries, Inc.
 - 9. Ventfabrics, Inc.
 - 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.

- d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
- e. Fabricate doors airtight and suitable for duct pressure class.
- 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
- 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements,
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements,
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- C. Flexible Duct Connectors:
 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.11 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 1. On both sides of duct coils.
 2. Upstream and downstream from duct filters.
 3. At outdoor-air intakes and mixed-air plenums.
 4. At drain pans and seals.
 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. At each change in direction and at maximum 50-foot spacing.
 8. Upstream and downstream from turning vanes.
 9. Control devices requiring inspection.
 10. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
 1. Head and Hand Access: 18 by 10 inches.
 2. Head and Shoulders Access: 21 by 14 inches.
 3. Body Access: 25 by 14 inches.
 4. Body plus Ladder Access: 25 by 17 inches.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- M. Connect flexible ducts to metal ducts with draw bands Install duct test holes where required for testing and balancing purposes.
- N. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233416 - CENTRIFUGAL HVAC FANS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes: For each product.
 - 1. Airfoil centrifugal fans.
 - 2. Backward-inclined centrifugal fans.
 - 3. Forward-curved centrifugal fans.
 - 4. Plenum fans.
 - 5. Plug fans.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include rated capacities, furnished specialties, and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
 - 6. Dampers, including housings, linkages, and operators.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - 5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
 2. Operating Limits: Classify according to AMCA 99.
- B. Unusual Service Conditions:
 1. Ambient Temperature: 70 degrees F.
 2. Altitude: 200 feet above sea level.
 3. High humidity.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Capacities and Characteristics:
 1. See Schedule on Drawings.

2.2 AIRFOIL CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck Fan Corporation.
 - 2. Loren Cook Company.
 - 3. Twin City
- B. Description:
 - 1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
 - 2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
 - 3. Factory-installed and -wired disconnect switch.
- C. Housings:
 - 1. Formed panels to make curved-scroll housings with shaped cutoff.
 - 2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 3. Horizontally split, bolted-flange housing.
 - 4. Spun inlet cone with flange.
 - 5. Outlet flange.
- D. Airfoil Wheels:
 - 1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange.
 - 2. Heavy backplate.
 - 3. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.
 - 4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with setscrews.
- E. Shafts:
 - 1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
 - 2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
 - 3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- F. Grease-Lubricated Shaft Bearings:
 - 1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
 - 2. Ball-Bearing Rating Life: ABMA 9, L10 at **50,000**hours.
- G. Grease-Lubricated Shaft Bearings:
 - 1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

2. **Ball-Bearing Rating Life: ABMA 9, L10 at 50,000 hours.**

H. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: **1.2**.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

I. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE62.1.
2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll on outdoor fans.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Discharge Dampers: Assembly with **opposed** blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
5. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
6. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing on outdoor fans.

2.3 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerovent; a Twin City Fan company.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Trane

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.

2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

D. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with setscrews.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 50,000 hours.

G. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 50,000 hours.

H. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.5
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

I. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in

ASHRAE62.1.

2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll on outdoor fans.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
5. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
6. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.4 FORWARD-CURVED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Loren Cook Company.
3. Twin City.
4. Trane.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

D. Forward-Curved Wheels:

1. Black-enameled or galvanized-steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with setscrews.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.
2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 50,000 hours.

G. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
2. Ball-Bearing Rating Life: ABMA 9, L10 at 50,000 hours.

H. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.
2. Service Factor Based on Fan Motor Size: 1.2.
3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
7. Motor Mount: Adjustable for belt tensioning.

I. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE62.1.
2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.
5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
8. Spark-Resistant Construction: AMCA99.
9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.5 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.
- D. Equipment Mounting: Install continuous-thread hanger rods and spring hangers of size required to support weight of fan unit.
 - 1. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction.
- F. Install units with clearances for service and maintenance.
- G. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.1 CONNECTIONS

- A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.2 FIELD QUALITYCONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
 - 10. Remove and replace malfunctioning units and retest as specified above.
- D. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416

SECTION 233600 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Shutoff, single-duct air terminal units.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
 - 4. Seismic-restraint devices.
- B. LEED Submittals:
 - 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

- C. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.
- D. Delegated-Design Submittal:
 - 1. Materials, fabrication, assembly, and spacing of hangers and supports.
 - 2. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.
- E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software setpoints.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Nailor Industries Inc.
 - 2. Price Industries.
 - 3. Titus.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: 0.034-inch (0.85-mm) steel.
 - 1. Casing Lining: Adhesive attached, 1-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84.
 - a. Inner lining shall be solid metal.
 - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections.
 - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE62.1.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 6-inch wg (1500-Pa) inlet static pressure.
 - 2. Damper Position: Normally open.
- E. Hydronic Coils: Coppertube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm), and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain valve.

2.2 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- C. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated intension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.
- D. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install hangers and braces designed to support the air terminal units and to restrain against seismic forces required by applicable building codes.

- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on air terminal units that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
 - 1. Identify position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Install heavy-duty sleeve anchors with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 - 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.4 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Section 233113 "Metal Ducts."
- D. Make connections to air terminal units with flexible connectors complying with requirements in Section 233300 "Air Duct Accessories."

3.5 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.7 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 233600

SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Adjustable bar registers and grilles.
- B. Related Sections:
 - 1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.
- C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.

E. Source quality-control reports.

F. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers

1. Manufacturers: Subject to compliance with requirements,
 - a. A-J Manufacturing Co., Inc.
 - b. Anemostat Products; a Mestek company.
 - c. Carnes.
 - d. Hart & Cooley Inc.
 - e. Krueger.
 - f. METALAIRE, Inc.
 - g. Nailor Industries Inc.
 - h. Price Industries.
 - i. Titus.
 - j. Tuttle & Bailey.
2. Design basis was Titus model OMNI.
3. Material: Steel
4. Finish: Baked enamel, white
5. Face Size: 24 by 24 inches.
6. Face Style: Flat Plate
7. Mounting: T-bar
8. Pattern: Fixed
9. Dampers: Radial opposed blade
10. Accessories:
 - a. Equalizing grid.
 - b. Sectorizing baffles.
 - c. Operating rod extension.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Register

1. Manufacturers: Subject to compliance with requirements,
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Dayus Register & Grille Inc.
 - d. Hart & Cooley Inc.

- e. Krueger.
 - f. METALAIRE, Inc.
 - g. Nailor Industries Inc.
 - h. Price Industries.
 - i. Titus.
 - j. Tuttle & Bailey.
2. Design basis is Titus model 300 for supply and 350 for returns.
3. Material: Steel
4. Finish: Baked enamel, white
5. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
6. Core Construction: Integral
7. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
8. Frame: 1 inch wide.
9. Mounting: Lay in.
10. Damper Type: Adjustable opposed blade
11. Accessories:
- a. Front and Rear-blade gang operator.
 - b. Filter

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, louvers and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, louvers and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels,

locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

- C. Install diffusers, registers, louvers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 234170 – ROOFTOP UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 GENERAL DESCRIPTION

- A. This Section includes the design, controls and installation requirements for packaged rooftop units.

1.3 QUALITY ASSURANCE

- A. Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.
- B. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- C. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
- D. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
- E. Unit Seasonal Energy Efficiency Ratio (SEER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
- F. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

1.4 SUBMITTALS

- A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided.
- B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be

provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Unit shall be shipped with doors bolted shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.
- B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- C. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation and Maintenance manual.

1.6 WARRANTY

- A. Provide a limited “parts only” warranty for a period of 24 months from the date of original equipment shipment from the factory. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer’s written instructions for installation, operation and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and air filters.

1.7 STARTUP REPAIR PROGRAM

- A. Provide startup repair for a period of 12 months from the date of original equipment shipment from the factory. Program shall cover labor for materials and workmanship that prove defective, within the specified warranty period, provided manufacturer’s written instructions for installation, operation and maintenance have been followed. Program excludes labor associated with routine maintenance, such as belt and air filter replacement.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Products shall be provided by the following manufacturers:
 - 1. AAON
 - 2. Substitute equipment shall include:
 - a. R-410A refrigerant
 - b. Direct drive supply fans
 - c. Double wall cabinet construction
 - d. Insulation with a minimum R-value of 13
 - e. Stainless steel drain pans
 - f. Hinged access doors with lockable handles

- g. Inverter driven variable speed compressor
- h. VFD controlled variable speed compressor
- i. All other provisions of the specifications must be satisfactorily addressed

2.2 ROOFTOP UNITS

A. General Description

1. Packaged rooftop unit shall include compressor, evaporator coil, filters, supply fan, dampers, air-cooled condenser coils, condenser fan, reheat coil, gas heater, and unit controls.
2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
5. Estimated sound power levels (dB) shall be shown on the unit ratings sheets.
6. Installation, Operation and Maintenance manual shall be supplied within the units.
7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

B. Construction

1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel, and prevents exterior condensation on the panel.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 210/240. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.

5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
6. Access to filters, dampers, cooling coil, reheat coil, heater, compressor, and electrical and controls components shall be through hinged access doors with quarter turn, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
8. Units shall include double sloped 304 stainless steel drain pans.
9. Unit shall be provided with through the base vertical discharge and return air openings. All openings through the unit shall have upturned flanges of at least 1/2 inch around the opening.
10. Unit shall include lifting lugs on the top of the unit.

C. Electrical

1. Unit shall have a 5kAIC SCCR.
2. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
3. Unit shall be provided with a factory installed and factory wired 115V, 12 amp GFI outlet disconnect switch in the unit control panel.
4. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
5. Unit shall be provided with remote stop/start terminals which require contact closure for unit operation. When these contacts are open the low voltage circuit is broken and the unit will not operate.

D. Supply Fans

1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
2. Blowers and motors shall be dynamically balanced.
3. Motor shall be a high efficiency electrically commutated motor.

E. Cooling Coils

1. Evaporator Coils
 - a. Coils shall be designed for use with R-410A refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
 - b. Coil shall be standard capacity.
 - c. Coils shall be helium hydrogen or helium leak tested.
 - d. Coils shall be furnished with factory installed electronic expansion valves.

F. Refrigeration System

1. Unit shall be factory charged with R-410A refrigerant.
2. Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.

3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
5. Each refrigeration circuit shall be equipped with electronic expansion valve type refrigerant flow control.
6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed liquid line filter driers.
7. Unit shall include a inverter driven variable speed scroll compressor on the refrigeration circuit which shall be capable of modulating refrigerant capacity.
8. Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
9. Refrigeration circuit shall be provided with an adjustable temperature sensor freeze stat which shuts down the cooling circuit when the evaporator coil tubing falls below the setpoint.

G. Condensers

1. Air-Cooled Condenser
 - a. Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
 - b. Coils shall be designed for use with R-410A refrigerant.
 - c. Condenser coils shall be multi-pass and fabricated from aluminum microchannel tubes.
 - d. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
 - e. Coils shall be hydrogen or helium leak tested.
 - f. Condenser fans shall be high efficiency electrically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.

H. Gas Heating

1. Stainless steel heat exchanger furnace shall carry a 25 year non-prorated warranty, from the date of original equipment shipment from the factory.
2. Gas furnace shall consist of stainless steel heat exchangers with multiple concavities, an induced draft blower and an electronic pressure switch to lockout the gas valve until the combustion chamber is purged and combustion airflow is established.

3. Furnace shall include a gas ignition system consisting of an electronic igniter to a pilot system, which will be continuous when the heater is operating, but will shut off the pilot when heating is not required.
 4. Unit shall include a single gas connection and have gas supply piping entrances in the unit base for through-the-curb gas piping and in the outside cabinet wall for across the roof gas piping.
 5. Modulating Natural Gas Furnace shall be equipped with modulating gas valves, adjustable speed combustion blowers, stainless steel tubular heat exchangers, and electronic controller. Combustion blowers and gas valves shall be capable of modulation. Electronic controller includes a factory wired, field installed supply air temperature sensor. Sensor shall be field installed in the supply air ductwork. Supply air temperature setpoint shall be adjustable on the electronic controller within the control compartment. Gas heater shall be capable of capacity turndown ratio as shown on the unit rating sheet.
- I. Filters
1. Unit shall include 4 inch thick, pleated panel filters with an ASHRAE efficiency MERV rating of 8, upstream of the cooling coil.
 2. Unit shall include a clogged filter switch.
- J. Outside Air/Economizer
1. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Unit shall include outside air opening bird screen, outside air hood with rain lip and barometric relief dampers.
 2. Damper assembly shall be controlled by spring return enthalpy activated fully modulating actuator.
- K. Controls
1. Factory Installed and Factory Provided Controller
 - a. Unit controller shall be capable of controlling all features and options of the unit. Controller shall be factory installed in the unit controls compartment and factory tested.
 - b. Controller shall be capable of standalone operation with unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling available without dependence on a building management system.
 - c. Controller shall have an onboard clock and calendar functions that allow for occupancy scheduling.
 - d. Controller shall include non-volatile memory to retain all programmed values without the use of a battery, in the event of a power failure.
 - e. Variable Air Volume Controller

- 1) Unit shall utilize a variable capacity compressor system and a variable speed supply fan system to modulate cooling and airflow as required to meet space temperature cooling loads and to save operating energy.
 - 2) Unit shall utilize a variable speed compressor system and a variable speed supply fan system to modulate cooling and airflow as required to meet space temperature cooling loads and to save operating energy. Supply fan speed shall modulate based on supply air duct static pressure. Cooling capacity shall modulate based on supply air temperature.
 - 3) With modulating hot gas reheat, unit shall modulate cooling and hot gas reheat as efficiently as possible, to meet space humidity loads and prevent supply air temperature swings and overcooling of the space.
 - 4) Unit shall modulate heating with constant airflow to meet space temperature heating loads. Modulating heating capacity shall modulate based on supply air temperature.
- f. Unit configuration, setpoint adjustment, sensor status viewing, unit alarm viewing, and occupancy scheduling shall be accomplished with connection to interface module with LCD screen and input keypad, interface module with touch screen, or with connection to PC with free configuration software. Controller shall be capable of connection with other factory installed and factory provided unit controllers with individual unit configuration, setpoint adjustment, sensor status viewing, and occupancy scheduling available from a single unit. Connection between unit controllers shall be with a modular cable. Controller shall be capable of communicating and integrating with a LonWorks or BACnet network. [Orion Controls System]

L. Accessories

1. Unit shall be provided with a safety shutdown terminal block for field installation of a smoke detector which shuts off the unit's control circuit.

2.3 Curbs

- A. Curbs shall to be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit.
- B. Knockdown curb (with duct support rails) shall be factory furnished for field assembly.
- C. Solid bottom curb shall be factory assembled and fully lined with curb rated 1 inch fiberglass insulation and include a wood nailer strip. (Curb shall be adjustable up to 3/4 inch per foot to allow for sloped roof applications.)

PART 3 - EXECUTION

3.1 Installation, Operation and Maintenance

- A. Installation, Operation and Maintenance manual shall be supplied with the unit.
- B. Install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.
- C. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

END OF SECTION 234170

SECTION 235216 - CONDENSING HOT WATER BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes packaged full condensing hot water boiler(s), and accessories for producing hydronic hot water with the following configurations, burners, and outputs:
 - 1. Factory packaged and assembled boiler.
 - 2. Integral natural gas and/or propane forced draft premix burner.

1.3 ACTION SUBMITTALS

- A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Design calculations and vibration isolation base details, signed and sealed by a qualified professional engineer.
 - a. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 - b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

- a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Source quality-control test reports.
- C. Field quality-control test reports.
- D. Warranty: Special warranty specified in this Section.
- E. Other Informational Submittals:
 1. ASME "A" Stamp Certification and Report: Submit "A" stamp certificate of authorization as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
 2. Startup service reports.
- F. LEED Submittals:
 1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.
- C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."
- D. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers."
- E. I=B=R Compliance: Boilers shall be tested and rated according to HI's "Rating Procedure for Heating Boilers" and "Testing Standard for Commercial Boilers," with I=B=R emblem on a nameplate affixed to boiler.

- F. CSA or UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.
- G. ASME CSD-1 Certification, in the form of completed data sheet.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace pressure vessel damaged by thermal shock that fail in materials or workmanship within specified warranty period.
 - A. Warranty Period for Heat Exchangers: 20 years from date of Substantial Completion when utilized in a closed loop hydronic heating system with a temperature differential of 120 °F or less. The boiler pressure vessel shall be guaranteed accordingly without a minimum flow rate or return water temperature requirement. The boiler shall not require the use of flow switches or other devices to ensure minimum flow.
 - B. The pressure vessel, tubes and tube sheets (heat exchanger) shall be guaranteed against flue gas corrosion and materials/workmanship for a period of 10 years. The condensate collection box shall be guaranteed for 20 years. The burner cylinder shall be warranted for a period of 5 years.
 - C. All parts not covered by the above warranties shall carry a 1 year warranty from startup, or 18 months from shipment, whichever occurs first. This shall include all electrical components and burner components.

PART 2 - PRODUCTS

2.1 CONDENSING BOILERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lochinvar
 - 2. Buderus.
 - 3. Ruud
- B. BOILER shall bear the ASME "H" stamp for 160 psi working pressure and shall be National Board listed. The BOILER shall have a fully welded, stainless steel, water tube heat exchanger. Multiple pressure vessels in a single enclosure are not acceptable. There shall be no banding material, bolts, gaskets or "O" rings in the pressure vessel construction. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. Pressure drop shall be no greater than 2.2 psi at 75GPM. The condensate collection basin shall be constructed of welded stainless steel. The complete heat exchanger assembly shall carry a ten (10) year limited warranty. Turndown ratio shall be 10:1 minimum.
- C. The BOILER shall be certified and listed by C.S.A. International under the latest edition of the

harmonized ANSI Z21.13 test standard for the U.S. and Canada. The BOILER shall comply with the energy efficiency requirements of the latest edition of ASHRAE 90.1 and the minimum efficiency requirements of the latest edition of the AHRI BTS-2000 Standard as defined by the Department of Energy in 10 CFR Part 431. The BOILER shall operate at a minimum of 97% Combustion and Thermal Efficiency at full fire as registered with AHRI. The BOILER shall be certified for indoor installation.

- D. The BOILER shall be constructed with a heavy gauge steel jacket assembly, primed and pre-painted on both sides. The combustion chamber shall be sealed and completely enclosed, independent of the outer jacket assembly, so that integrity of the outer jacket does not affect a proper seal. A burner/flame observation port shall be provided for observing the burner flame and combustion chamber. The burner shall be a premix design constructed of high temperature stainless steel with a woven Fecralloy outer covering to provide smooth operation at all modulating firing rates. The BOILER shall be supplied with a negative pressure regulation gas valve and be equipped with a pulse width modulation blower system to precisely control the fuel/air mixture to the burner. The BOILER shall operate in a safe condition with gas supply pressures as low as 4 inches of water column. The burner flame shall be ignited by direct spark ignition with flame monitoring via a flame sensor.
- E. The BOILER shall utilize a 24 VAC control circuit and components. The control system shall have a factory installed display for boiler set-up, boiler status, and boiler diagnostics. All components shall be easily accessed and serviceable from the front and top of the jacket. The BOILER shall be equipped with a temperature/pressure gauge; high limit temperature control with manual reset; ASME certified pressure relief valve set for 50 psi (standard); outlet water temperature sensor with a dual thermistor to verify accuracy; system supply water temperature sensor; outdoor air sensor, flue temperature sensor with dual thermistor to verify accuracy; low water cut off with manual reset, blocked drain switch and a condensate trap for the heat exchanger condensate drain.
- F. The BOILER shall feature the “SMART TOUCH™” control with CON-X-US which is standard and factory installed with an 7” liquid crystal touch screen display, password security, outdoor air reset, pump delay with freeze protection, pump exercise, ramp delay featuring six steps, domestic hot water prioritization with limiting capabilities and PC port connection. A secondary control that is field mounted outside or inside the appliance is not acceptable. The BOILER shall have alarm contacts for any failure, runtime contacts and data logging of runtime at given modulation rates, ignition attempts and ignition failures. The BOILER shall have a built-in “Cascade” to sequence and rotate while maintaining modulation of up to eight boilers of different Btu inputs without utilization of an external controller. The internal “Cascade” function shall be capable of lead-lag, efficiency optimization, front-end loading, and rotation of lead boiler every 24 hours. The control must include cascade redundancy to allow a member boiler to become the temporary leader if the original lead boiler shall loose communication with the members. The BOILER shall be capable of controlling an isolation valve (valve shall be offered by manufacturer) during heating operation and rotation of open valves in standby operation for full flow applications. The control must be equipped with standard BACnet MSTP and Modbus communication protocol with a minimum 55 readable points. The BOILER shall have an optional gateway device which will allow integration with LON or BACnet (IP) protocols.
- G. The “SMART TOUCH™” control shall include CON-X-US communication platform that will allow remote access via a smart phone or Tablet. This will allow the ability to monitor and manage multiple KNIGHT XL Boilers and send alerts via text or e-mail notifying of changes in system status. A user shall have the ability to check system status or re-program any boiler function remotely.
- H. The “SMART TOUCH™” control shall increase fan speed to boost flame signal when a weak flame signal is detected during normal operation. A 0 -10 VDC output signal shall control a variable speed boiler pump (pump to be offered by manufacturer) to keep a fixed delta t across the boiler regardless of the modulation rate. The BOILER shall have the capability to receive a 0 – 10 VDC input signal

from a variable speed system pump to anticipate changes in system heat load in order to prevent flow related issues and erratic temperature cycling.

- I. The BOILER shall be equipped with two terminal strips for electrical connection. A low voltage connection board with 44 connection points for safety and operating controls, i.e., Alarm Contacts, Runtime Contacts, Louver Proving Switch, Tank Thermostat, Domestic Hot Water Building Recirculation Pump Contacts, Domestic Hot Water Building Recirculation Temperature Sensor Contacts, Remote Enable/Disable, System Supply Temperature Sensor, Outdoor Temperature Sensor, Tank Temperature Sensor, Modbus Building Management System Signal and Cascade Control Circuit. A high voltage terminal strip shall be provided for Supply voltage. Supply voltage shall be 120 volt / 60 hertz / single phase on all models. The high voltage terminal strip plus integral relays are provided for independent pump control of the System pump, the Boiler pump and the Domestic Hot Water pump.
- J. The BOILER shall be installed and vented with a Direct Vent system with vertical roof top termination of both the exhaust vent and combustion air. The flue shall be Category IV approved material constructed of PVC, CPVC, Polypropylene or Stainless Steel. A separate pipe shall supply combustion air directly to the boiler from the outside. The boiler's total combined air intake length shall not exceed 150 equivalent feet. The boiler's total combined exhaust venting length shall not exceed 150 equivalent feet. The air inlet must terminate on the rooftop with the exhaust.
- K. The BOILER shall have an independent laboratory rating for Oxides of Nitrogen (NO_x) to meet the requirements of South Coast Air Quality Management District in Southern California and the requirements of Texas Commission on Environmental Quality. The manufacturer shall verify proper operation of the burner, all controls and the integrity of the heat exchanger by connection to water and venting for a factory fire test prior to shipping.
- L. The BOILER shall be suitable for use with polypropylene glycol up to a 50% concentration. The de-rate associated with the glycol will vary per glycol manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.
 - 1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.
- B. Examine mechanical spaces for suitable conditions where boilers will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

- A. Install boilers level on concrete base. Concrete materials and installation requirements are specified with concrete.

- B. Vibration Isolation: Elastomeric isolator pads with a minimum static deflection of 0.25 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install gas-fired boilers according to NFPA 54.
- D. Assemble casing panels per manufacturer's instructions.
- E. Assemble and install boiler trim.
- F. Install electrical devices furnished with boiler but not specified to be factory mounted.
- G. Install control wiring to field-mounted electrical devices.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to boiler to allow service and maintenance.
- C. Connect gas piping to boiler gas-train inlet with union. Piping size shall per installation instructions not size of gas train connection. Provide a reducer if required.

- D. Connect hot water supply-, return-, and drain tapplings with shutoff valve and union or flange at each connection.
- E. Install piping from safety valves to nearest floor drain to a safe point of discharge.
- F. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.
- G. Boiler Flue Venting:
 - 1. Install venting kit and combustion-air intake.
 - 2. Connect full size to boiler connections.
- H. Connect vents to full size of boiler inlet and outlet.
- I. Install flue gas condensate PVC drain piping to condensate neutralization assembly including loop trap seal.
- J. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- K. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.
 - b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature, steam pressure.
 - c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

- C. Remove and replace malfunctioning units and retest as specified above.
- D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.
- E. Performance Tests:
 - 1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.
 - 2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment in order to comply.
 - 3. Perform field performance tests to determine the capacity and efficiency of the boilers.
 - a. For dual-fuel boilers, perform tests for each fuel.
 - b. Test for full capacity.
 - c. Test for boiler efficiency at low fire 20, 40, 60, 80, and 100 percent of full capacity. Determine efficiency at each test point.
 - 4. Repeat tests until results comply with requirements indicated.
 - 5. Provide analysis equipment required to determine performance.
 - 6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.
 - 7. Notify Architect in advance of test dates.
 - 8. Document test results in a report and submit to Architect.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Cleveland Clinic maintenance personnel to adjust, operate, and maintain boilers. Video training sessions. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 235216

SECTION 236433 - MODULAR CHILLERS

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. Modular Chillers

1.2 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- C. Section 232113 - Hydronic Piping.
- D. Section 232123 - Hydronic Pumps.
- E. Section 236500 – Cooling Towers

1.3 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014.
- C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components 2016.
- D. ASME PTC 23 - Atmospheric Water Cooling Equipment 2003, Reaffirmed 2014.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2018.
- G. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) 1993 (Reapproved 2010).
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2018b.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015.
- J. ISO 9001 - Quality management systems -- Requirements 2015.
- K. NEMA MG 1 - Motors and Generators 2017.

1.4 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
- C. Shop Drawings: Indicate dimensions, sizes, and locations for mounting bolt holes.

- D. Manufacturer's Certificate: Certify that chiller performance, based on ASME PTC 23 meets or exceeds specified requirements.
- E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- F. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner 's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum twenty years of documented experience and ISO 9001 certification.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 5 years of experience and approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Factory assemble entire unit. For shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
- B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.8 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide a one year warranty to include coverage for defects in material and workmanship labor only.
- C. Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of five (5) years; or seven (7) if motor space heater is properly wired.

PART 2 - PRODUCTS

2.1 UNIT DESCRIPTION

- A. Chiller shall incorporate scroll compressors and consist of multiple refrigerant circuits. Each refrigerant circuit shall consist of an individual compressor, condenser, evaporator, thermal

expansion valve and control system. The multi-circuit chiller must be able to produce chilled water even in the event of a failure of one or more refrigerant circuits. All operating components for each module, including compressors, heat exchangers, piping, and controls shall be securely fastened to a unitized heavy gauge steel frame having an electro-statically applied powder, oven baked enamel finish. Steel frame work shall be completely factory assembled and base shall include forklift slots to eliminate the need for a pallet. Compressor motor contactors, control transformers, (one for each compressor circuit), transformer primary and secondary fuses are located in the control panel. Each chiller module has two (2) steps of control (100%, 50% and off) by cycling off the compressors. All electrical controls, contactors, and relays, for each module shall be mounted within that module and be of the low voltage type.

- B. Headers - each module shall include supply & return mains for both evaporator and condenser water. Grooved end connections are provided for interconnection to 6" standard piping with grooved couplings and end caps.

2.2 BASIC CONSTRUCTION

- A. The frame design shall consist of heavy gauge galvanized steel with 3 mil powder coat paint finish baked at 350° for resilience in transport and installation. The module must have a low center of gravity, detachable schedule 40 carbon steel pipe water headers two (2) for chilled water loop and two (2) for condenser loop and two each insulated with ¾" closed cell insulation, designed to connect to adjacent modules through the use of 300 psi rated grooved couplings, base with cutouts for forklift or pallet jack and the frame must be designed to fit through a standard 36" doorway.

2.3 EVAPORATORS AND CONDENSERS

- A. Each evaporator and condenser shall be dual-circuited, brazed plate heat exchangers constructed of 316 stainless steel; designed, tested, and UL stamped in accordance with ASME Section VIII pressure vessel code for 650 psig working refrigerant pressure on the evaporator and 650 psig working pressure on the condenser. Both the condenser and evaporator heat exchanger shall have a working pressure for the water circuits at least 285 psig.
- B. Both evaporator and condenser brazed plate heat exchangers shall have a waterside flush connection with ball valve on each module to permit back flushing or cleaning of heat exchangers without removing chiller headers or other in place components.

2.4 COMPRESSORS

- A. Unit shall contain multiple hermetic scroll compressors independently circuited and with internal isolation mounted with rubber-in-shear isolators. Each compressor system also includes high discharge pressure and low suction pressure manual reset safety cut-outs. The compressors are direct-drive, hermetic, 3600 rpm (@ 60 Hz) fixed compression, scroll compressors. Each

compressor has integral centrifugal oil pump, oil level sight-glass, oil charging valve, and an internal check valve on the scroll discharge port. Motor is suction gas-cooled, hermetically sealed, two-pole, squirrel cage induction type.

2.5 FACTORY INSULATED SURFACES

- A. All internal water piping and refrigeration piping (except discharge line), cooling header and load heat exchanger are factory insulated.

2.6 STARTER/CONTROL PANEL

- A. Starter/Control Panel: Module DDC Controls provides individual control as well as system integration. Simple two-conductor shielded daisy chain connection to allow communication between modules with minimal field wiring. NEMA Type 1 enclosure panel shall consist of control transformer, power distribution block, isolation relays, 16-bit microprocessor DDC control, status indicating lights showing , 1) compressor operation (on/off), 2) unit alarm status and 3) power on, relays for status and alarm and two toggle switches to disable each individual compressor during start-up or troubleshooting.

2.7 MASTER CONTROLLER SYSTEM

- A. System shall be fully compatible with the Building Automation System via native BACnet and LonWorks communication.
- B. Scheduling of the various compressors shall be performed by the Master microprocessor based controller. A compressor run time equalization sequence is provided to ensure even distribution of compressor run time. A load limit control shall be available to limit the number of compressors that can be energized at one time.
- C. The Master Controller shall monitor and report the following for each refrigeration circuit in each module:
 - 1. Discharge pressure and temperature faults.
 - 2. Suction pressure and temperature faults.
 - 3. Compressor fault.
 - 4. Low evaporator leaving chilled water temperature fault.
- D. The Master Controller shall monitor and report the following systems parameters for the chiller system:
 - 1. Chilled water entering and leaving temperature.
 - 2. Condenser water entering and leaving temperature
 - 3. Evaporator and condenser water flow availability.

- E. Any module failure condition shall cause a fault indication at the Master Controller and shut down of that compressor circuit with the transfer of the load requirements to the next available compressor circuit. In the case of a System fault the entire chiller will be shut down. When any fault occurs, the Master Controller shall record conditions at the time of the fault, and store the data for recall. This information shall be capable of recall through the keypad of the Master Controller and displayed on the 4 line by 40 character, back-lit LCD. A history of faults shall be maintained including date and time for each fault (up to the last 100 occurrences). Internal leaving chilled water reset control will insure that the parallel evaporators are operated above the freeze point for part load operation.

2.8 POWER CONNECTIONS

- A. Each module shall have its own electrical power panel mounted to the unit frame. Each module will be independently powered by a field installed fused disconnect switch (or equivalent module circuit breaker) supplied by others, so that any one module can be shut down for repair without interrupting the remaining chiller modules' operation. The power panel for each module shall contain:
 - 1. Main input terminal block
 - 2. Compressor motor contractors
 - 3. Motor overload protection per compressor
 - 4. Individual compressor motor fusing or breakers
 - 5. Local manual "ON" / "OFF" compressor switch to allow service or repair to individual modules and compressors without interrupting service of the entire chiller.
- B. Single point power connection to entire chiller bank is not acceptable due to need for power redundancy. The use of buss bars to power chillers is unacceptable without individual module disconnects.

2.9 WATER ISOLATION VALVES

- A. Water Isolation Valves and Flush Ports - Factory installed to provide isolation to the module for maintenance and cleaning of evaporator and condenser heat exchangers. This is accomplished without increasing unit or bank dimensions while adjacent modules continue normal operation.

2.10 STRAINERS

- A. Strainers shall be installed on cooling and condenser loop inlets of the chiller bank. Strainers must be field installed external to chiller for ease of service. Strainers located inside of headers, requiring disassembly for cleaning are not recommended.

2.11 SOUND ATTENUATION PANELS

- A. The Chiller shall be equipped with 18-gauge galvanized steel sound attenuation panels with 1” fiberglass insulation and 3 mill powder-coat paint finish for front, bank and top.
- B. The chiller bank end panels with the same construction as above will be furnished for field installation.

2.12 WATER TESTING

- A. The Manufacturer shall provide water bottles and certified sample testing for cooling, heating and source loops prior to commencement of equipment warranty.
- B. All water loops that come into contact with the brazed plate heat exchangers shall adhere to the below water quality parameters:

Property of Fluid	Recommended Level
Ammonia	Less than 2.0 mg/l
CaCO ₃ Alkalinity	30 – 500 mg/l
CaCO ₃ Hardness	30 – 500 mg/l
Chlorides	Less than 200 mg/l
Dissolved Solids	Less than 1000 mg/l
Iron	Less than 5.0 mg/l
Manganese	Less than 0.4 mg/l
Nitrate	Less than 100 mg/l
pH	7.0 – 9.0
Sulphate	Less than 200 mg/l

2.13 SAFETIES, CONTROLS AND OPERATION

- A. Chiller safety controls system shall be provided with the unit (minimum) as follows:
 - 1. Low evaporator refrigerant pressure.

2. Loss of flow through the evaporator
3. Loss of flow through the condenser.
4. High condenser refrigerant pressure
5. High compressor motor temperature-
6. Low leaving evaporator water temperature
7. Failure of chiller to start or chiller shutdown due to any of the above safety cutouts shall be enunciated by display of the appropriate diagnostic description at the unit control panel. This annunciation will be in plain English- Alphanumeric codes shall be unacceptable.

- B. The chiller system shall be furnished with a Master Controller shipped loose as described above
- C. Provide automatic chiller shutdown during periods when the load level decreases below the normal operating requirements of the chiller. Upon an increase in load, the chiller shall automatically restart.
- D. Provisions for connection to automatically enable the chiller from a remote energy management system.
- E. The control panel shall provide alphanumeric display showing all system parameters in the English language with numeric data in English units.
- F. Power Phase Monitor
 1. Provide power phase monitor shipped loose to be installed on the incoming power supply to the chillers
 2. Power Phase Monitor shall provide protection against low voltage, phase rotation, loss of phase, and phase imbalance

2.14 WARRANTY

- A. "Parts-Only" Warranty shall be twelve (12) months from date of unit start-up or eighteen (18) months from date of shipment, whichever comes first. Provide 4-year extended parts-only warranty for compressors is provided. (5 years total)

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight hour day.
- C. Install chiller on structural concrete pads as instructed by manufacturer.
- D. Connect condenser water and chilled water piping with flanged connections to chiller. Pitch condenser water and chilled water supply to chiller and condenser water and chilled water return away from chiller.
- E. Pipe pressure relief, bleed, and drain, to floor drain.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.

- B. Provide the services of the manufacturer's field representative to inspect chiller after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.
- C. Test for capacity under actual operating conditions in accordance with CTI ATC-105 and verify specified performance.

3.3 SYSTEM STARTUP

- A. Start-up chiller in presence of and instruct Owner 's operating personnel.

END OF SECTION

SECTION 236500 - COOLING TOWERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closed-circuit, forced-draft, counter-flow cooling towers.

1.2 RELATED REQUIREMENTS

- A. Section 230548 - Vibration and Seismic Controls for HVAC.
- B. Section 230593 - Testing, Adjusting, and Balancing for HVAC.
- C. Section 232113 - Hydronic Piping.
- D. Section 232123 - Hydronic Pumps.
- E. Section 236433 - Modular Water Chillers.
- F. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. ABMA std 9 - load ratings and fatigue life for ball bearings 2015.
- B. ABMA std 11 - load ratings and fatigue life for roller bearings 2014.
- C. ASME B31.5 - Refrigeration Piping and Heat Transfer Components 2016.
- D. ASME PTC 23 - Atmospheric Water Cooling Equipment 2003, Reaffirmed 2014.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2018.
- G. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus 2018.
- H. ASTM D2794 - Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact) 1993 (Reapproved 2010).
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2018b.
- J. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi 2015.
- K. CTI ATC-105 - Acceptance Test Code 2000.
- L. CTI STD-201 OM - Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment 2017.
- M. CTI STD-201 RS - Performance Rating of Evaporative Heat Rejection Equipment 2017.
- N. CTI STD-111 - Gear Speed Reducers for Application on Industrial Water Cooling Towers; 2009.
- O. ISO 9001 - Quality management systems -- Requirements 2015.
- P. NEMA MG 1 - Motors and Generators 2017.

1.4 SUBMITTALS

- A. See section 013000 - administrative requirements, for submittal procedures.
- B. Product Data: Provide rated capacities, dimensions, weights and point loadings, accessories, required clearances, electrical requirements and wiring diagrams, and location and size of field connections. Submit schematic indicating capacity controls.
- C. Shop Drawings: Indicate suggested structural steel supports including dimensions, sizes, and locations for mounting bolt holes.
- D. Manufacturer's Certificate: Certify that cooling tower performance, based on ASME PTC 23 meets or exceeds specified requirements and submit performance curve plotting leaving water temperature against wet bulb temperature.
- E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.
- F. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories.
- G. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner 's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for Owner 's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Fan Belts: One set, matched, for each unit.
 - 3. Extra Spray Nozzles: One nozzle kits for each cell.
 - 4. Extra Access Door Gaskets: One for each door.
 - 5. Extra Valve Seats: One for each make-up valve and control valve.

1.5 QUALITY ASSURANCE

- A. Manufacturer qualifications: company specializing in manufacturing the type of products specified in this section, with minimum twenty years of documented experience and iso 9001 certification.
- B. Installer qualifications: company specializing in performing the type of work specified in this section with minimum 5 years of experience and approved by manufacturer.

1.6 REGULATORY REQUIREMENTS

- A. Products requiring electrical connection: listed and classified by underwriters laboratories inc. as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Factory assemble entire unit. for shipping, disassemble into as large as practical sub-assemblies so that minimum amount of field work is required for re-assembly.
- B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.8 WARRANTY

- A. See section 017800 - closeout submittals, for additional warranty requirements.
- B. Provide a one year warranty to include coverage for defects in material and workmanship labor only.

- C. Fans, fan shafts, bearings, sheaves, gearboxes, drive shafts, couplings, and mechanical equipment support must be warranted against defects in materials and workmanship for a period of five (5) years; or seven (7) if motor space heater is properly wired.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis OF DESIGN: BALTIMORE AIRCOIL COMPANY
- B. Closed-circuit, forced-draft, counter-flow cooling towers:
 - 1. Baltimore Aircoil Company; Series VFL: www.baltimoreaircoil.com or approved equal.

2.2 MANUFACTURED UNITS

- A. Provide units for indoor or outdoor use, factory-assembled, sectional, vertical discharge, blow through design, with fan assemblies built into pan and casing.

2.3 COMPONENTS

A. Cold Water Basin:

- 1. Sloped with depressed section with drain/clean-out connection. Type 304 bolted stainless steel panels and structural members. Basins constructed of 301 stainless steel are not acceptable.

B. Casing Panels and Framework:

- 1. Casing panels: Galvanized steel protected by a thermosetting hybrid polymer. The polymer to consist of G-235 (Z700 metric) hot-dip galvanized steel prepared in a four-step (clean, pre-treat, rinse, and dry) process with an electrostatically applied, thermosetting, hybrid polymer fuse-bonded to the substrate during a thermally activated curing stage and monitored by a 23-step quality assurance program. Other coatings must be submitted to the engineer for pre-approval. Approved equals must have undergone testing, resulting in the following results as a minimum:
 - a. When X-scribed to the steel substrate, unit to withstand 6000 hours of 5 percent salt spray per ASTM B117 without blistering, chipping, or loss of adhesion.
 - b. When X-scribed to the steel substrate, unit to withstand 6000 hours of exposure to acidic (pH=4.0) and alkaline (pH=11.0) water solutions at 95 degrees F (35 degrees C) without signs of chemical attack.
 - c. Unit to withstand impact of 160 in-lbs per ASTM D2794 without fracture or delamination of the polymer layer.
 - d. Unit to withstand 6000 hours of ultraviolet radiation equivalent to 120,000 hours of noontime sun exposure without loss of functional properties.
 - e. Unit to withstand 200 thermal shock cycles between minus 25 degrees F and 180 degrees F (minus 32 degrees C and 82 degrees C) without loss of adhesion or other deterioration.
 - f. Unit to withstand 6000 hours of exposure to 60 psi (42,184 kg/m²) water jet without signs of wear or erosion.
 - g. Type 304 stainless steel may be supplied as an equal to eliminate the need for passivation, minimize maintenance requirements, and prolong equipment life.

- C. Casing panels and framework will be constructed of G235 galvanized steel.
- D. Fans: Forward curved centrifugal type mounted on steel shaft, with belt drive, bearings with ABMA STD 9 or ABMA STD 11 L-10 life at 80,000 hours, with extended grease fittings.
- E. Motors and Drives:
 - 1. Single speed (1800 rpm) mounted on adjustable steel base. Refer to Section 23 0513.
 - 2. Fan Drive System:
 - a. Belt Drive: Designed for minimum 150 percent motor nameplate power.
- F. Fan Guard: Welded steel rod and wire guard, hot dipped galvanized after fabrication.
- G. Heat Transfer Coils:
 - 1. Wet Coil:
 - a. Galvanized Steel: The coil shall be constructed of continuous serpentine all prime surface steel, be pneumatically tested at 375 psig (2,685 kPa), and be hot-dip galvanized after fabrication. The coil shall be designed for free drainage of fluid and shall be ASME B31.5 compliant. Maximum allowable working pressure shall be 300 psig (280 psig for coils supplied with a CRN).
- H. Distribution Section: Polyvinyl chloride piping header and branches with ABS plastic spray nozzles.
- I. Drift Eliminators: Three pass PVC, drift loss limited to 0.005 percent of total water circulated.
- J. Electronic water level control with NEMA 4 enclosure, solid state controls, stainless steel water level sensing electrodes. Stainless steel mounting hardware.
- K. Hardware: Galvanized steel nuts, bolts, washers, and tappers; assembled with phenolic epoxy coated, corrosion resistant washer head fasteners.
- L. Galvanized Steel Sheet Components: Hot-dipped galvanized, ASTM A653/A653M, with G235/Z700 coating, and finished with zinc chromated aluminum paint.

2.4 PERFORMANCE REQUIREMENTS

- A. This section is based on specific selections of equipment, and these selections relate to selection of related equipment, Section 232123 - Hydronic Pumps and Section 236433 - Modular Water Chillers. In substituting equipment, ensure that performance selection criteria matches that specified or that the selection of related equipment is acceptable or is revised to suit.

2.5 ACCESSORIES

- A. Electric Immersion Heaters: In pan suitable to maintain temperature of water in pan at 40 degrees F (4.4 degrees C) when outside temperature is 0 degrees F (-17.7 degrees C) or -20 degrees F (-28.9 degrees C) and wind velocity is 15 mph (25 kph); immersion thermostat and float control operate heaters on low temperature when the pan is filled. Heaters will be constructed of copper.
- B. Basin Sweeper Piping: The cold water basin of the cooling tower shall be equipped with PVC sump sweeper piping with plastic eductor nozzles.
- C. Electric Temperature Controller: In pan; with sensor to cycle fans. Coordinate with other disciplines.

- D. Time Delay Relay: Limits fan motor starts to not more than six per hour. Coordinate with other disciplines.
- E. Vibration Switch: Provide an electronic remote reset vibration switch with contact for BAS monitoring. Wiring shall be by the installing contractor. The electronic vibration cutout switch shall be set to trip at a point so as not to cause damage to the cooling tower. To ensure this, the trip point will be set in a frequency range of 2 to 1000 Hertz and a trip point of 0.45 in/sec (0.0114 m/sec).
- F. Access Packages: See submittal documents for access package requirements. Platforms and ladders must ship assembled from cooling tower manufacturer.
 - 1. Exterior Ladder with Handrails: An aluminum ladder with galvanized steel safety cage and safety gate shall be provided for access to the top of the unit. 1-1/4 inch (32 mm) galvanized steel pipe handrail shall be provided around the perimeter of the cooling tower cells. The handrails shall be provided with knee and toe rails and shall conform to OSHA requirements applicable at the time of shipment. Galvanized steel drift eliminators will be supplied to provide dependable walking surface.
- G. Intake Sound Attenuation: The unit shall be equipped with intake sound attenuators consisting of fiberglass acoustical baffles encased in steel to further reduce sound levels.
- H. Discharge Options: The unit shall be equipped with a tapered hood lined with sound absorbing fiberglass acoustical baffles to reduce sound levels from the top of the unit.
 - 1. (Alternate without sound attenuation) The unit shall be equipped with a tapered hood to increase discharge velocity or to raise the discharge to the top of an enclosure.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide the services of the manufacturer's field representative to supervise rigging, hoisting, and installation, allowing for minimum of one eight hour day per tower.
- C. Install tower on structural steel beams as instructed by manufacturer.
- D. Install tower on vibration isolators. Refer to Section 230548.
- E. Connect condenser water piping with flanged connections to tower. Pitch condenser water supply to tower and condenser water suction away from tower. Refer to Section 232113.
- F. Connect make-up water piping with flanged or union connections to tower. Pitch to tower. Refer to Section 221005.
- G. Connect overflow, bleed, and drain, to floor drain.

3.2 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide the services of the manufacturer's field representative to inspect tower after installation and submit report prior to start-up, verifying installation is in accordance with specifications and manufacturer's recommendations.
- C. Test for capacity under actual operating conditions in accordance with CTI ATC-105 and verify specified performance.

1. Refer to Section 230593.

3.3 SYSTEM STARTUP

- A. Start-up tower in presence of and instruct Owner 's operating personnel.

END OF SECTION

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Cabinet unit heaters with centrifugal fans and hot-water coils.
 - 2. Propeller unit heaters with hot-water coils.
 - 3. Wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CWP: Cold working pressure.
- C. PTFE: Polytetrafluoroethylene plastic.
- D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.
- B. LEED Submittals:
 - 1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required

clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of piping valves and specialties.
6. Location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

D. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

E. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
6. Perimeter moldings for exposed or partially exposed cabinets.

Addition And Alterations

- B. **Manufacturer Seismic Qualification Certification:** Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:
1. **Basis for Certification:** Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. **Dimensioned Outline Drawings of Equipment Unit:** Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. **Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.**
- C. **Field quality-control test reports.**

1.6 CLOSEOUT SUBMITTALS

- A. **Operation and Maintenance Data:** For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. **Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.**
1. **Cabinet Unit Heater Filters:** Furnish one spare filter(s) for each filter installed.

1.8 QUALITY ASSURANCE

- A. **Electrical Components, Devices, and Accessories:** Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. **ASHRAE Compliance:** Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. **ASHRAE/IESNA 90.1 Compliance:** Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 CABINET UNIT HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Modine Viking.
 - 2. Trane.
- B. Description: A factory-assembled and -tested unit complying with ARI440.
 - 1. Comply with UL2021.
- C. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
 - 1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch-thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
 - 2. Recessing Flanges: Steel, finished to match cabinet.
 - 3. Control Access Door: Key operated.
 - 4. Base: Minimum 0.0528-inch-thick steel, finished to match cabinet, 6 inches (150 mm) high with leveling bolts.
 - 5. False Back: Minimum 0.0428-inch- (1.1-mm-) thick steel, finished to match cabinet.
- D. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value(MERV)according to ASHRAE52.
 - pleated: 90 percent arrestance and 7 MERV.
- E. Hot-WaterCoil:Coppertube,withmechanicallybondedaluminumfinsspacednocloserthan 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.

F. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor.

Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC equipment."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.
4. Wrought-Copper Unions: ASMEB16.22.

G. Control devices and operational sequences are specified in Section 230993 "Sequence of Operations for HVAC Controls."

H. DDC Terminal Controller:

1. Heating Coil Operations:
 - a. Occupied Periods: Modulate control valve to provide heating if room temperature falls below thermostat set point.
 - b. Unoccupied Periods: Start fan and modulate control valve if room temperature falls below setback temperature.

I. Electrical Connection: Factory wire motors and controls for a single field connection.

J. Capacities and Characteristics:

1. See schedule on drawings

2.2 PROPELLER UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Modine Viking.
2. Trane.

B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

C.

- D. Cabinet: Removable panels for maintenance access to controls.
- E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory- assembled and - tested propeller unit heater before shipping.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE62.1.
- G. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.
- H. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE33.
- I. Hot-Water Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 325 deg F (163 deg C), with manual air vent. Test for leaks to 350 psig (2413 kPa) underwater.
- J. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fanventuri.
- K. Fan Motors: Comply with below.
 - 1. Motor Type: Permanently lubricated
- L. Control Devices:
 - 1. Unit-mounted thermostat.
- M. Capacities and Characteristics
 - 1. See schedule on drawing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."
- B. Install cabinet unit heaters to comply with NFPA 90A.
- C. Install propeller unit heaters level and plumb.
- D. Suspend cabinet unit heaters from structure with elastomeric hangers and seismic restraints. Vibration isolators and seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- E. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
- G. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in Section 232113 "Hydronic Piping Steam and Condensate Heating Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to cabinet unit heater or unit heater.
- D. Comply with safety requirements in UL1995.
- E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping."
- F. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of unit heater.

- G. Connect control wiring according to Section 230923 "DDC control system."

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

- A. Adjust initial temperature set points.
- B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION 238239

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 16.

1.02 SUMMARY

- A. The work under this Division shall consist of all labor, materials, equipment, and services necessary and required to complete all work as shown on the Drawings and in the Specifications (Contract Documents) and as inferable from the Drawings and Specifications.
- B. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 1:
 - 1. Submittals.
 - 2. Coordination drawings.
 - 3. Record Documents.
 - 4. Operation and Maintenance Manuals.
 - 5. Rough-ins.
 - 6. Electrical installations.
 - 7. Temporary light and power.
 - 8. Field testing.
 - 9. Quality control and acceptance testing.
 - 10. Selective demolition.
 - 11. Concrete equipment bases.
 - 12. Fire Stopping and Touchup painting.
 - 13. Lockout/tagout of overcurrent protective devices.
 - 15. Hazmat Disposal

- C. Related Sections: The following Sections contain requirements that relate to this Section and/or are governed by the requirements of this Section:

Raceways, Boxes and Cabinets

Wires and Cables

Wiring Devices

Electrical Identification

Grounding

Interior Lighting

Addressable Fire Alarm Systems

1.03 RELATED WORK NOT INCLUDED IN THIS DIVISION

- A. Raceways and conductors or connections to the Owner's equipment beyond the point indicated on the Electrical Drawings.
- B. Furnishing, setting, mounting or aligning of motors, motor driven equipment that is specified under other Divisions of these Specifications.
- C. Furnishing motor starters and control devices (except for those in the motor starter panel/Motor Control Centers, which are part of this division) or assembled and wired panels or cabinets containing these devices for heating, ventilating, air conditioning or other systems which are specified under other Sections, except as otherwise specified in this Section.
- D. Painting, except where specifically called for in other sections of this division (i.e.: identification) and except for factory applied prime or finish painting specified for equipment, fixtures, devices or materials furnished under this Section.

1.04 WORKMANSHIP

- A. All work performed shall be first class work in every respect. The work shall be performed by mechanics skilled in their respective trades, who shall at all times be under the supervision of competent persons.
- B. Work that is slipshod, poorly laid out, not perfectly aligned, or that is not consistent with the requirements generally accepted in the trade for "first class work" will not be acceptable.
- C. In addition to the materials specified elsewhere, furnish and install all other miscellaneous items necessary for the completion of the work to the extent that all systems be complete and operative.

- D. All work under this Section shall be performed in cooperation with the work performed under all other Sections of the Specifications on the Project in order to avoid interference's and to secure the proper installation of all work. Review the Drawings and Specifications covering the work to be performed under all Sections, so that the relation and extent of the work of this Section with respect to the work of all other Sections is understood.

1.05 REGULATIONS AND CERTIFICATES

- A. All work under this Section shall comply with the applicable requirements of the National Electrical Code, other codes, laws, regulations and standards of all local and State authorities. Where references are made to laws, codes, regulations and standards, these documents, including the latest revisions and amendments thereto in effect as of the date of Bid Opening, shall form part of these Specifications.
- B. Upon completion of the work, furnish Certificates of Approval from the local authorities having jurisdiction for approving materials, equipment installation and procedures under this Section and such other certificates pertaining to the electrical work as may be required by the authorities for the issuance of a permanent Certificate of Occupancy. Pay all expenses arising from the procurement of these certificates and included in the lump sum Contract Price.

1.06 BUILDING ACCESS

- A. The access into the building for Contractor's employees, equipment and materials furnished under this Contract shall be through openings and entrances designated by Owner. Refer to Division 1, Section 01500 - Temporary Facilities, for specific requirements relative to the use of building loading dock, staging areas and other existing facilities.

1.07 EXPEDITING THE WORK

- A. Cooperate with all other subcontractors on the project. This Division shall be responsible for prompt delivery of all materials and equipment and for the installation of all work under this Division, at a time and in a manner that will ensure that there will be no delay in the construction schedule. Including but not limited to coordination with the utility company.
- B. Verify all conditions on the job which may affect the installation of the work, and become familiar with applicable local and State regulations. Any discrepancies or interferences shall be reported immediately to the Owner. Additions to the Contract Price will not be allowed when they are due to the failure to carefully inspect existing conditions.
- C. Method of Procedure (MOP) will be required as outlined in Division 1 of these Specifications and for all work that will involve disruption of service to the building. Submit Method of Procedure to the Owner and Architect for approval. The MOP shall state proposed starting dates of each item of work, transitions, shutdowns, etc. with the expected duration of each. Revise the MOP to address the concerns of the Owner or as specifically directed by the Owner.

- D. Upon award of contract, provide a graphic schedule detailing the entire electrical installation. The schedule shall be prepared using Microsoft Project. Cooperate with the General contractor and other trades to integrate the electrical schedule with the overall project schedule. The schedule shall include the following:
 - 1. Indicate line items indicating each task including the work of all other trades.
 - 2. Identify all linked tasks.
 - 3. Indicate the critical path.
 - 4. Indicated percent complete, start, duration times and completion dates for each task.
 - 5. Group tasks into summary groups as applicable.
 - 6. Indicate milestones for completion dates and delivery dates.
 - 7. Indicate CINGULAR Wireless' established "quiet times" as non-working times.
- E. Update the project schedule for each project meeting or every two weeks which ever is more often.
- F. Provide updated "look ahead" schedules that indicate the work to be performed for the upcoming two-week period. This schedule will contain all the features of the basic project schedule but will be much more detailed than the basic project schedule.

1.08 PROTECTION OF THE WORK

- A. All work, materials and equipment, whether incorporated into the building or not, shall be protected from damage due to moisture, dirt, plaster, concrete or from carelessness.
- B. All material and equipment which is damaged, including installed work, shall be repaired or replaced to the satisfaction of the Owner, at no additional cost to the owner.
- C. After work is completed, all work, equipment, shall be cleaned of all construction dirt. All waste and debris resulting from the electrical installation shall be removed from the site and disposed of in a legal manner.

1.09 SUBMITTALS

- A. All shop drawings and manufacturer's literature shall conform to the requirements set forth in the General Conditions. The contractor shall verify the compliance of all shop drawings with the requirement of the contract documents. The contractor shall certify that the shop drawings comply with the requirements of the contract documents. Any deviation from the specified items shall be clearly marked and brought to the engineer's attention as deviations. Items that deviate from the specified that are not clearly highlighted (that manage pass through the approval) shall be changed after the installation when the deviation is discovered, at the cost of the contractor.
- B. Immediately after the Contract is awarded, submit, for approval, a complete list of materials, devices and equipment to be incorporated in the work. The list shall include manufacturers' names, catalog numbers, description of material, equipment, devices, etc. proposed to be utilized on this project only. The list shall clearly identify the proposed application of the materials and equipment. The list shall not preclude the necessity of submitting shop drawings for the items included herein.
- C. Shop drawings shall include descriptive data, manufacturer's ratings and application recommendations, cuts, diagrams, drawings, test reports, performance curves and such other information or samples as may be required by the Owner to judge compliance with the requirements of the Contract and suitability to the application. Items on the list shall be clearly identified as to proposed application. Approval of materials and equipment will be based on manufacturer's published ratings. Shop drawings shall clearly indicate the requirements for this specific project only.
- D. Each item shall be clearly identified as to proposed application. Where items of specified material and equipment are assembled to make up a larger apparatus, submit for approval the manufacturer's or fabricator's assembly shop drawings. Such drawings shall include dimensions and all essential details of arrangement, construction, assembly and connections. Wiring diagrams for special signal and control systems furnished under this Section shall also be submitted for approval. When directed by the Owner, submit in approved form for the record a Certificate of Compliance with a cited code or standard for the materials and equipment designated. Such certificates may be accepted in lieu of samples. Any materials, fixtures or equipment submitted for approval which are not in accordance with the Specifications requirements may be rejected. Any shop drawings marked "Revise and resubmit", "proceed with fabrication" or "Not Approved" shall be revised and resubmitted until accepted with "Approved".
- E. As part of the coordination work required, prepare installation drawings as necessary. It is intended that these drawings be used to coordinate the work of the various trades and to clarify details of proposed assembly, erection and installation.
- F. When indicated in these Specifications or on the Drawings, or when directed by the Owner, installation drawings shall be submitted for approval. Any installation drawing may be submitted to the Owner for comment and approval when an installation condition or problem arises which the Contractor wishes the Owner to review. All installation drawings submitted for review will be

considered and treated as shop drawings and the requirements pertaining to shop drawings shall govern.

- G. The following tabulation lists the major components for which shop drawings are required:
1. Conduit and fittings.
 2. Wire and cable.
 3. Equipment, panels, switchboards and circuit breakers.
 4. Splice and pull boxes.
 5. Cable Megger reports.
 6. Grounding system megger test reports.
 7. Written system description.
 8. Lighting Fixtures.
 9. Wiring Devices.
 10. Fire Alarm systems.
- H. Shop drawings for all devices shall be submitted within 30 calendar days from Award of Contract. If any equipment is not submitted within this time and/or in accordance with the requirements for shop drawings, and cannot be furnished in time to meet the construction schedule, provide temporary equipment that will perform the equivalent function, for the duration of the time until the specified equipment has arrived. Remove the temporary equipment and install the specified equipment at the Owner's convenience and at no additional cost to the Owner.
- I. Furnish to the Architect operating and maintenance instructions for each piece of equipment and each device. The instructions shall provide detailed description of the operation and maintenance of the equipment or device and shall include manufacturers' literature, detailed wiring diagrams, device internal wiring diagrams and descriptive literature. The instructions shall be furnished to the Architect 30 days prior to the completion of the building work. The instructions shall be submitted initially as a rough draft for approval. After the required corrections have been made, four sets in loose hardback covers shall be furnished to the Architect.
- J. Detail Drawings of fabrication and installation of supports and anchorage for electrical items.
- K. Coordination Drawings for electrical installation.

1. Prepare Coordination Drawings according to Division 1 Section 01300 - Submittals to a 1/4-inch-equals-1-foot scale or larger. Detail major elements, components, and systems of electrical equipment and materials in relation to each other and to other systems, installations, and building components. Indicate locations and space requirements for installation, access, and working clearance. Indicate where work requiring MOP approvals occur and show where sequence and coordination of installations are important to the efficient flow of the Work. Coordinate drawing preparation with effort specified in other Specification Sections. Include the following:
 - a. Provisions for scheduling, sequencing, moving and positioning large equipment in the building during construction.
 - b. Floor plans, elevations and details, including the following:
 - 1) Clearances to meet safety requirements and for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
 - 2) Equipment support details.
 - 3) Exterior wall, roof and foundation penetrations of cable and raceway; and their relation to other penetrations and installations.
 - 4) Fire-rated interior wall and floor penetrations by electrical installations.
 - 5) Sizes and locations of required concrete pads and bases.
 - c. Reflected ceiling plans to coordinate and integrate installing air outlets and inlets, light fixtures, alarm and communication systems components, sprinklers and other ceiling-mounted items.
 - d. Methods of Procedures as specified in Division 1 - Methods of Procedure
- L. Samples of color, lettering style and other graphic representation required for each identification product for Project.

1.10 RECORD DRAWINGS

- A. Maintain an accurate record of all work as actually installed. This record shall be kept current and shall be kept available at the site for inspection. Utilize the contract design drawings for marking up the work as installed. Upon completion of the work, and before final payment is authorized, AutoCAD® revision 14

drafted mylars of the as-built conditions with signed certification of accuracy shall be delivered to the Owner (this supersedes Supplementary and General Conditions). Provide the AutoCAD® “drawing” data files to the Owner.

1.11 GUARANTEE

- A. Guarantee all wiring free from unwanted grounds and short circuits.
- B. Guarantee all materials and workmanship free from defects for a period of one year starting from the date of acceptance by the Owner.
- C. Obtain from the various manufacturers or vendors standard guarantees or warranties for their particular equipment or components, and deliver them to the Owner.

1.12 FINAL INSPECTION

- A. Conduct a final inspection of all work installed under this Division of the Specification after the installation has been completed; the testing hereinafter specified has been performed; and test reports have been submitted to the Owner.
- B. During the conduct of the final inspection, have present a representative of the various manufacturers and a representatives of the manufacturers of other equipment as directed by the Owner.

1.13 TRAINING

- A. Provide a minimum of eight (4) hours training for the Owner’s on-site workforce for each type of equipment and/or system provided under this Division.
- B. The contractor shall provide two (2) VHS videotape copies of each training sessions to the Owner. Each session shall be provided on dedicated tapes. Tape labels shall be type written and dated.

1.14 QUALITY CONTROL AND ACCEPTANCE TESTING

- A. Provide Quality Control Performance Tests, and Acceptance Testing for all systems, devices and equipment installed or wired under this Division. Tests shall be performed to the satisfaction of the Owner and the Owner’s Representative.

1.15 SHUTDOWNS AND PREMIUM COSTS

- A. Should the contractor not be ready for the owner’s occupancy and shutdown and/or tie-ins be required when the owner’s equipment is on site the provisions of this paragraph will hold. Plan the installation of this work and connections to existing building systems and relocation of existing work to ensure minimum interference with building services.
- B. Submit for approval a schedule of necessary temporary shutdowns of the existing electrical services and shall secure such approval in writing before proceeding.

- C. All costs for performing specified overtime work and specified premium time work shall be at the contractor's expense.
- D. Electrical service, building services and systems shall not be interrupted during regular non-working hours. All work requiring the interruption of alarm systems or interruption or shutdown of electric power shall be performed during premium time. Provide temporary connections, if necessary, to maintain continuous electrical power for the operation of any area affected by the work of this Section.
- E. Once a system has been energized, any work requiring the interruption of alarm systems or interruption shutdown of an electrical panel shall be performed during premium time except as otherwise indicated. The installation of circuit breakers, connections to active circuit breakers and disconnecting from circuit breakers in active panelboards or switchboards shall be performed only during the shutdown of electric service to the panel.
- F. Any work under this Section which may cause interference with the Owner's operation shall be done in such a manner and at such time as is approved by the Owner and/or the Building Supervisor. Removal and alteration of electrical equipment, conduit and wiring and the installation of new work shall be performed with minimum interruption. Where the situation permits, make temporary connections as required to prevent electrical service interruptions.
- G. Approval for temporary shutdown of electrical services shall be secured from the Owner in writing a minimum of two weeks in advance. Provide temporary UPS systems for any critical load during shutdowns.
- H. Scheduled shutdowns shall be arranged to facilitate the phasing of the work. Complete as much preparatory work as can be done in advance of shutdown, so as to minimize the length of shutdowns. The shutdowns shall be arranged with the Owner.
- I. Provide sufficient personnel for all shutdowns to accomplish the required work within the time available.
- J. Should any work impair or limit the effectiveness of any existing system, provide adequate manpower to supervise any and all areas compromised by the work for the duration of the work. For example, if the work causes or requires the loss of fire alarm system coverage in part or full, provide certified dedicated fire warden personnel for each room and area lacking coverage, to detect and announce any potential fire or life safety hazard.

1.16 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

- B. Storage: Materials stored at the project site which become soiled with construction dirt, concrete or earth work shall be removed from the site and replaced with new. Do not install soiled material.
- C. Cleaning: Clean wipe the interior of all conduit, pullboxes and panel board backboxes, soiled by masonry trades, before proceeding with wiring.
- D. Generally, do not install damaged, broken or marred material or products; replace with new. On long delivery items that are damaged in shipping or storage, field repair these items and temporarily install them in the interim until replacement items have arrived. Replace the damaged items when the replacement item has arrived.

1.17 SEQUENCING AND SCHEDULING

- A. Coordinate installation with other building components and the work of other trades.
- B. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Sequence, coordinate and integrate installations of materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning or greater access prior to closing in the building.
- D. Coordinate connection of electrical services to equipment of other trades and Divisions.
- E. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.
- F. Coordinate delivery and setting of all equipment that require concrete pads, with Division 3.
- G. Prior to the commencement of the work of other Divisions, mark the area of all electrical distribution equipment and inform the other trades of required clearances. Designate the area equal to the footprint of the electrical equipment, from the top of the equipment to the structural ceiling above as dedicated electrical space. Inform all trades not to interlope this area. This applies to all distribution boards, switchgear, motor control centers (FBO) and panelboards.
- H. Arrange for chases, slots and openings in building structure during progress of construction to allow for electrical installations.
- I. Coordinate connecting electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

1.18 DRAWINGS AND SPECIFICATIONS

- A. The Drawings are to be considered schematic only and do not necessarily show the exact location and details of the work to be installed. It shall be the responsibility of the Contractor to provide the work in conformity with the requirements of these Specifications, the applicable codes, regulations and standards, and the best trade practices meeting with the approval of the Owner. If any departures from the Drawings are deemed necessary, details of such departures and the reasons therefore shall be submitted immediately to the Owner for approval. If any conflicts or discrepancies are found to exist on the Drawings, in the Specifications or between the Drawings and the Specifications, assume the most expensive option and include such costs in the Bid. It shall be understood that the Owner reserves the right to change the location of equipment and apparatus to a reasonable extent as building conditions may dictate, without extra cost to the Owner.
- B. Locations of lighting fixtures, outlets, panels, devices and other equipment are approximately correct, but are subject to such revision as may be found necessary or desirable at the time work is installed in consequence of increase or reduction in the number of outlets, to meet field conditions, to coordinate with modular requirements of ceilings, to simplify work, or for other legitimate causes.
- C. Architect's Drawings of the building shall be examined to ascertain whether any changes have been made since Electrical Drawings were completed. Particular caution shall be exercised with reference to location of panels, outlets, switches, etc. and precise and definite locations shall be approved by the Owner before proceeding with installation. It shall be distinctly understood that the Drawings show only general run of conduit and approximate location of outlets.
- D. Any significant changes in location of outlets, cabinets, etc., found necessary in order to meet field conditions, shall be brought to the immediate attention of the Owner and written approval must be obtained before such alterations are made.
- E. Locations of outlets and equipment not definitely located on the Drawings shall be obtained from the Architect in the field.
- F. Electrical Drawings show general arrangement of conduit, equipment and appurtenances and shall be followed as closely as actual building construction and work of other trades will permit. Verify dimensions in field and measure off building construction for locations of equipment and devices. Electrical work shall conform to requirements shown on each trade's Drawings. Architectural layout on Construction Drawings shall take precedence over Architectural layout on Electrical Drawings. Because of the small scale of Electrical Drawings, it is not possible to indicate every offset, fitting and accessory which may be required. Investigate structural and finish conditions affecting work and arrange electrical work accordingly, providing all accessories required to meet such conditions.
- G. Circuit "tags" in the form of arrows are used to indicate home runs of conduit to electrical panels. These tags show quantity of circuits in each home run, number of each circuit and panel designation. Circuit numbers shown are for reference only to indicate devices on a common circuit, not necessarily the exact circuit position to be utilized. Show actual circuit numbers on the finished record drawings and on the panel directory card.

- H. The Drawings generally do not indicate the quantity of wires or conduit for branch circuit wiring nor the conduit size for feeders. Provide the correct wire size and quantity of wires installed in conduit of proper size as required by the indicated circuiting, control wire diagrams, if any, specified voltage drop or maximum distance limitations and applicable requirements of the National Electrical Code. Show branch circuit and feeder wiring and conduit runs on the record drawings.

1.19 WRITTEN SYSTEM DESCRIPTION

- A. Submit a complete written description of the electrical distribution system as finally installed. Description shall be written in simple English providing a general understanding of the operation of the AC power distribution system.
- B. Refer to as-built drawings and shop drawings as well as manufacturers descriptive data for detailed information.

1.20 TEMPORARY POWER

- A. Arrange, obtain and pay for temporary utility service to the site during construction. Provide temporary lighting and receptacles for the use of all contractors during construction. Maintain the existing electrical service to accommodate temporary power to the building while waiting for final power. Remove as directed.
- B. All temporary circuits shall be provided with GFI protection in accordance with OSHA standards.
- C. Remove all temporary distribution at the completion of the project or as directed by the owner.

PART 2 - PRODUCTS

2.01 EQUIPMENT

- A. General: All equipment shall be the capacity and types specified and as shown in the Contract Documents, and shall be the listed manufacturers and model numbers unless otherwise noted.
- B. All equipment, materials, devices and accessories shall be in full compliance with all State, city and local codes and laws and shall comply with the NFPA, ANSI, NEMA, and shall be UL listed and labeled for the application.

2.02 MATERIAL

- A. Provide all materials required for a complete and proper installation.
- B. In addition to the materials specified elsewhere, all other miscellaneous items necessary for the completion of the work shall be furnished and installed by the Contractor to the extent that all systems be complete and operative.

- C. All material and equipment furnished under this Division shall be new and listed and/or labeled by the Underwriters' Laboratories, Inc. for the application, unless otherwise specified herein. Materials, material sizes and methods of construction not specified shall be at least equal to or better than the standards listed by the Underwriters' Laboratories, Inc. and/or requirements of the laws, regulations and codes mentioned hereinafter.

2.03 SUPPORTING DEVICES

- A. Channel and angle support systems, hangers, anchors, sleeves, brackets, fabricated items and fasteners are designed to provide secure support from the building structure for electrical components.
 - 1. Material: Steel, except as otherwise indicated, protected from corrosion with zinc coating or with treatment of equivalent corrosion resistance using approved alternative finish or inherent material characteristics.
 - 2. Material: Nonconductive structurally rated fiberglass for equipment and materials connected to any isolated ground plane.
 - 3. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel, except as otherwise indicated.
- B. Steel channel supports have 9/16-inch diameter holes at a maximum of 8 inches O.C., in at least 1 surface.
 - 1. Fittings and accessories mate and match with channels and are from the same manufacturer.
- C. Nonmetallic Channel and Angle Systems: Structural-grade, factory formed, fiber glass-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches O.C., in at least 1 surface.
 - 1. Fittings and accessories mate and match with channels or angles and are from the same manufacturer.
 - 2. Fitting and Accessory Material: Same as channels and angles, except metal items may be stainless steel.
- D. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets and spring steel clamps or "click"- type hangers.
- E. Sheet-Metal Sleeves: 0.0276-inch or heavier galvanized sheet steel, round tube, closed with welded longitudinal joint.
- F. Pipe Sleeves: ASTM A 53, Type E, Grade A, Schedule 40, galvanized steel, plain ends.

- G. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Plugs have number and size of conductor gripping holes as required to suit individual risers. Body constructed of malleable iron casting with hot-dip galvanized finish.
- H. Expansion Anchors: Carbon-steel wedge or sleeve type.
- I. Toggle Bolts: All-steel springhead type.
- J. Powder-Driven Anchors are not allowed.

2.04

ELECTRICAL IDENTIFICATION

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Raceway and Cable Labels: Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.
 - 1. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
 - 2. Color: Black legend on orange field.
 - 3. Legend: Indicates voltage.
- C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch wide.
- D. Underground Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:
 - 1. Size: Not less than 4 mils thick by 6 inches wide.
 - a. Compounded for permanent direct-burial service.
 - 2. Embedded continuous metallic strip or core.
 - a. Printed Legend: Indicates type of underground line.
- E. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

- G. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched for mechanical fasteners 1/16-inch minimum thick for signs up to 20 sq. in., 1/8 inch thick for larger sizes. Engraved legend in black letters on white face.
- H. Interior Warning and Caution Signs: Preprinted, aluminum, baked enamel finish signs, punched for fasteners, with colors, legend and size appropriate to the application.
- I. Exterior Warning and Caution Signs: Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- J. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.05 TOUCHUP PAINT

- A. For Equipment: Provided by equipment manufacturer and selected to match equipment finish.
- B. For Non-Equipment Surfaces: Matching type and color of undamaged, existing adjacent finish.
- C. For Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.06 LOCKOUT/TAGOUT OF BRANCH-CIRCUIT DEVICES

- A. Each overcurrent protective device, switch and/or means of disconnect shall be provided with the capability of being locked out in compliance with OSHA Standard 1910.147.
- B. Where factory furnished permanent lockout features are not available, each overcurrent protective device enclosure shall be provided with Stranco, Inc. Circuit Safe™ lockout system. Provide circuit safe unit with length to match the total length of the overcurrent protective devices, including the future devices. Coordinate the centerline separation of breakers and the distances from the enclosure center. Provide one pin holder and two of each type lockout pins for each enclosure. Provide mounting shims and offset brackets as required.

PART 3 - EXECUTION

3.01 GENERAL

- A. Inspection: Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence. Verify that the work of this Division may be completed in strict accordance with all pertinent codes and regulations, the approved shop drawings and the manufacturer's recommendations.
- B. Discrepancies: In the event of discrepancy, immediately notify the Owner. Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.
- C. Do not install work without approved shop drawings.
- D. Should the Contractor proceed without submittals and approvals of submittals, any costs incurred to correct problems that could have been corrected in the shop drawing or coordination drawings shall be the responsibility of the Contractor.
- E. All work performed shall be first class work in every respect. The work shall be performed by mechanics skilled in their respective trades, who shall at all times be under the supervision of competent persons.
- F. Work that is slipshod, poorly laid out, not perfectly aligned, or that is not consistent with the requirements generally accepted in the trade for "first class work" will not be acceptable.
- G. All work under this Section shall be performed in cooperation with the work performed under all other Sections of the Specifications on the Project in order to avoid interferences and to secure the proper installation of all work. Review the Drawings and Specifications covering the work to be performed under all Sections, so that the relation and extent of the work of this Section with respect to the work of all other Sections is understood.

3.02 INSTALLATION OF EQUIPMENT

- A. Locations: Install all equipment in the locations shown on the approved shop drawings, except where specifically otherwise approved on the job by the Owner. Do not install motor control centers and electrical equipment directly under the work of other trades (including new and existing work) even if such work is in the locations indicated on the contract documents or approved submittals. If such a condition occurs contact the Owner's representative for specific direction regarding the exact location of such equipment.
- B. Interferences: Avoid interference with structure, and with the work of other trades, preserving adequate headroom and clearing all doors and passageways to the approval of the Owner.
- C. Inspection: Check each piece of equipment in the system for defects, verifying that all parts are properly furnished and installed, that all items function properly, and that all adjustments have been made.
- D. Fabricate, test, assemble and install all material, equipment and systems in accordance with the requirements of the following:
 - 1. National Fire Protection Code – NFPA
 - 2. Occupational Safety and Health Administration (OSHA)
 - 3. American National Standards Institute (ANSI)
 - 4. Underwriters' Laboratories, Inc. (UL)
- E. Install components and equipment to provide the maximum possible headroom where mounting heights or other location criteria are not indicated.
- F. Install items level, plumb, and parallel and perpendicular to other building systems and components, except where otherwise indicated.
- G. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.
- H. Give right of way to raceways and piping systems installed at a required slope.
- I. Install motor control equipment, motor control centers and other equipment furnished under other Divisions for mounting and wiring by this Division in accordance with the Specification Sections of the Division that is furnishing the equipment.
- J. Anchor all floor mounted electrical equipment to the floor or equipment pad at each corner of each section of the equipment. Provide seismic bracing as specified elsewhere.

3.03 CLOSING-IN OF UNINSPECTED WORK

- A. General: Do not allow or cause any of the work of this Division to be covered up or enclosed until it has been inspected, tested and approved by the Owner's representative and by all other authorities having jurisdiction.
- B. Uncovering: Should any of the work of this Division be covered up or enclosed before it has been completely inspected, tested and approved, do all things necessary to uncover all such work. After the work has been completely inspected, tested and approved, provide all materials and labor necessary and make all repairs necessary to restore the work to its original and proper condition at no additional cost to the Owner.

3.04 COOPERATION WITH OTHER TRADES

- A. Do all things necessary to cooperate with other trades in order that all systems in the work may be installed in the best arrangements.
- B. Coordinate as required with all other trades to share space in common areas and to provide the maximum of access to each system.
- C. Accept delivery, set, mount and wire all motor control centers, starters, adjustable frequency drives and other HVAC control equipment specified and provided under Division 15.

3.05 CLEANING

- A. It is the intent of these Specifications that all work, including the inside of equipment, be left in a clean condition. All construction dirt shall be removed from material and equipment.

3.06 COMPLETENESS

- A. It is the intent of these Specifications to provide a complete system. All material and equipment shall be installed properly. All material and equipment shall be adjusted so that it is operating as designed, to the satisfaction of the Owner.

3.07 ELECTRICAL SUPPORTING METHODS

- A. Damp Locations and Outdoors: Hot-dip galvanized materials or nonmetallic, U-channel system components.
- B. Dry Locations: Steel materials.
- C. Support Clamps for PVC Raceways: Click-type clamp system.
- D. Conform to manufacturer's recommendations for selecting supports.
- E. Strength of Supports: Adequate to carry all present and future loads, times a safety factor of at least 4; 200 lb. minimum design load.

3.08 CUTTING AND PATCHING

- A. Cut, channel, chase and drill floors, walls, partitions, ceilings and other surfaces necessary for electrical installations. Perform cutting by skilled mechanics of the trades involved.
- B. Repair disturbed surfaces to match adjacent undisturbed surfaces.

3.09 TOUCHUP PAINTING

- A. Thoroughly clean damaged areas and provide primer, intermediate and finish coats to suit the degree of damage at each location.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.

3.10 TEMPORARY POWER FOR TOOLS AND EQUIPMENT

- A. The contractor shall provide ground fault circuit interrupters on each temporary power feed, including all extension cords.

3.11 DISPOSAL

- A. All materials removed under this contract shall be disposed of in a legal and approved manor. Items considered hazardous or that require manifested disposal shall be removed from equipment and/or devices separately contained and disposed of in such manor. Such items include but are not limited to ballasts (PCB or Not), fluorescent tubes (lamps), Mercury lamps and switches.

END OF SECTION 260100

SECTION 260519 - WIRES AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 16.

1.02 SUMMARY

- A. This Section includes building wires and cables and associated splices, connectors, and terminations for wiring systems rated 600 volts and less.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section - Firestopping.
 - 2. Section - Basic Electrical Requirements for supporting devices for supports and anchors for fastening cable directly to building finishes.
 - 3. Section - Basic Electrical Requirements for insulation color-coding and wire and cable markers.

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Field test reports indicating and interpreting test results relative to compliance with performance requirements of testing standard.

1.04 QUALITY ASSURANCE

- A. Testing Firm Qualifications: In addition to the requirements specified in Division 1 Section 01400 - Quality Control, an independent testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical Testing Association (NETA) and shall be an approved testing agency.
 - 1. Testing Firm's Field Supervisor Qualifications: A person currently certified by the NETA National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Comply with NFPA 70 "National Electrical Code" for components and installation.
- C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.

1.05 SEQUENCING AND SCHEDULING

- A. Coordination: Coordinate layout and installation of cable with other installations.
 1. Revise locations and elevations from those indicated as required to suit field conditions and as approved by the Owner's representative.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver wire and cable according to NEMA WC-26.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Wires and Cables
 - a. American Insulated Wire Corporation, Leviton Manufacturing Company
 - b. Brand-Rex Cable Systems, Brintec Corporation
 - c. Carol Cable Company, Inc.
 - d. Senator Wire & Cable Company
 - e. Southwire Company
 2. Connectors for Wires and Cables
 - a. Burndy
 - b. Electrical Products Division, 3M Company
 - c. O-Z/Gedney Unit, General Signal

2.02 BUILDING WIRES AND CABLES

- A. UL-listed Class B concentric round copper building wires and cables with conductor material, insulation type, cable construction, and rating as specified in Part 3 "Applications" Article.
- B. Rubber Insulation: Conform to NEMA WC 3.
- C. Thermoplastic Insulation: Conform to NEMA WC 5.
- D. Cross-Linked Polyethylene Insulation: Conform to NEMA WC 7.
- E. Ethylene Propylene Rubber Insulation (EPR): Conform to NEMA WC 8.

- F. Solid conductor for lighting and receptacle circuit conductors and all conductors 10 AWG and smaller; stranded conductor for larger than 10 AWG.

2.03 CONNECTORS AND SPLICES

- A. Provide UL-listed factory-fabricated compression style wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated. Select to comply with Project's installation requirements and as specified in Part 3 "Applications" Article.
- B. For conductors #10 AWG and smaller: Wire and cable connectors shall be solderless, mechanical, solid copper or copper alloy types. Connectors shall be Buchanan Electrical Products copper squeeze-on type with molded rubber or vinyl cap, Minnesota Mining and Manufacturing Company "Scotchlock" or Ideal Industries "Super-Nut" spring connectors with molded vinyl cap or as approved.
- C. Connectors and/or terminations for conductors #8 AWG and larger: UL Standard 486A Dual crimp long barrel compression lugs with two bolt holes, Suitable for 90°C, insulated with clear heat shrink molded covers over the entire barrel portion of the lug. Similar to "Hylugs" manufactured by Burndy to accommodate 1/2" bolts. Compression crimp shall be performed utilizing dies that impress a mark indicating the die used to crimp the connection. Die mark shall be visible through the clear heat shrink cover.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine raceways and building finishes to receive wires and cables for compliance with installation tolerances and other conditions. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Service Entrance: Type USE rated RHW-2, copper conductor rated 90°C insulation, in raceway.
- B. Feeders
 - 1. Cables 500MCM and smaller: Type THHN/THWN-2/XHHW-2/RHW-2, copper conductor, in raceway.
 - 2. Cables over 500MCM: Type THW, RHW, copper conductor, in raceway.
- C. Branch Circuits: Type THHN/THWN, copper conductor, in raceway.
- D. Lighting circuit drops to fixtures (limited to runs of no more than 5 feet where concealed): Type MC cable, copper conductor, 90°C insulation.

- E. Instrument cabling: Twisted shielded pair or triads with aluminum mylar shield and copper drain wire, Type XHHW or THHN insulation.
- F. Class 1 Control Circuits: Type THHN/THWN, copper conductor, in raceway.
- G. Class 2 Control Circuits: Type THHN/THWN, copper conductor, in raceway.
- H. Direct Current Circuits: Type EPR, copper conductor, in raceway.

3.03

INSTALLATION

- A. Install wires and cables as indicated, according to manufacturer's written instructions and the NECA "Standard of Installation." Install all wires and cabling concealed.
- B. Remove existing wire from raceway before pulling in new wire and cable.
- C. Pull conductors into raceway simultaneously where more than one is being installed in same raceway.
 - 1. Use pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basketweave wire/cable grips that will not damage cables or raceway.
- D. Where specifically allowed by the architect, Install exposed cable. Install parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.
- E. Conductor Splices: Keep to minimum.
 - 1. Splices are not permitted in feeders.
 - 2. Splices are permitted only where required to circuit specific devices on shared circuits.
 - 3. Install splices and tapes that possess equivalent or better mechanical strength and insulation ratings than conductors being spliced.
 - 4. Use only compression type splice and tap connectors that are compatible with conductor material.
- F. Wiring at Outlets: Install with at least 12 inches of slack conductor at each outlet.
- G. Connect outlets and components to wiring and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements

are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

- H. Provide each branch circuit with a dedicated ground conductor. Do not use multiconductor branch circuits, provide dedicated neutral conductors for each circuit requiring a neutral conductor.
- I. Connect each ground conductor to grounding bushings as it enters and/or exits boxes and enclosures.
- H. The drawings generally do not indicate the quantity of wires or conduit for branch circuit wiring nor the conduit size. Provide the correct wire size and quantity of wires installed in conduit of proper size as required by the indicated circuiting, control wire diagrams, if any, specified voltage drop or maximum distance limitations and applicable requirements of the national electrical code. Show branch circuit and feeder wiring and conduit runs on the record drawing.

3.04

FIELD QUALITY CONTROL

- A. Testing Firm: Provide the services of a qualified independent testing firm to perform specified field quality-control testing.
- B. Testing: Upon installation of wires and cables and before electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test stated in NETA Standard ATS, Section 7.3.1. Certify compliance with test parameters.
 - 2. Test all cables with 1000VDC megger test. Test branch circuit wiring for one minute. Test feeder wiring for 15 minutes with readings at one-minute intervals.
 - 3. Parallel feeders: Provide full load current tests for all parallel feeder conductors. Verify that current division between the parallel conductors does not vary more than 5%.
 - 4. Terminations: Provide infrared thermoscans of all terminations of conductors #8AWG and larger. Perform scans with conductors carrying the designed load.
- C. Correct malfunctioning products at site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.

END OF SECTION

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 26.

1.02 SUMMARY

- A. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 26 Section 26 0519 - Wires and Cables for requirements for grounding conductors.

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for grounding rods, connectors and connection materials, and grounding fittings.
- C. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- D. Field tests and observation reports certified by the testing organization and indicating and interpreting the test reports for compliance with performance requirements.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7, or a full member company of the International Electrical Testing Association (NETA).
 - 1. Testing Agency Field Supervision: Use persons currently certified by NETA or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Comply with NFPA 70.

- C. Comply with UL 467.
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy
 - 2. O-Z/Gedney Company
 - 3. Thomas & Betts, Electrical

2.02 GROUNDING AND BONDING PRODUCTS

- A. Governing Requirements: Where types, sizes, ratings, and quantities indicated are in excess of National Electrical Code (NEC) requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.

2.03 WIRE AND CABLE GROUNDING CONDUCTORS

- A. Comply with Division 26 Section 26 0519 - Wires and Cables. Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
 - 1. Material: Copper. Use only copper wire for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. Equipment Grounding Conductors: Insulated with green color insulation.
- C. Bare Copper Conductors: Conform to the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.04 MISCELLANEOUS CONDUCTORS

- A. Grounding Bus: Bare, annealed-copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, braided No. 30 AWG bare copper wire, terminated with copper ferrules.

- C. Bonding Straps: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.

2.05 CONNECTOR PRODUCTS

- A. Pressure Connectors: High-conductivity-plated units.
- B. Bolted Clamps: Heavy-duty type.
- C. Exothermic-Welded Connections: Provided in kit form and selected per manufacturer's written instructions for specific types, sizes, and combinations of conductors and connected items.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Equipment Grounding Conductors: Provide all branch circuits and feeders with ground conductors. Comply with NEC Article 250 for types, sizes, and quantities of equipment grounding conductors, except where specific types, larger sizes, or more conductors than required by NEC are indicated.
 - 1. Install equipment-grounding conductor with all circuit conductors.
 - 2. Busway Supply Circuits: Install separate equipment grounding conductor from the grounding bus in the switchgear to equipment grounding-bar terminal on busway.
 - 3. Non-metallic Raceways: Install Central office equipment grounding conductors in non-metallic raceways.
- B. Separately Derived Systems: Where NEC requires grounding, ground according to NEC Paragraph 250-26.
- C. Metal Poles Supporting Outdoor Lighting Fixtures: Ground pole to a grounding electrode in addition to separate equipment grounding conductor run with supply branch circuit.

3.02 INSTALLATION

- A. General: Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.
- B. Grounding Rods
 - 1. Drive until tops are 2 inches below finished floor or final grade, except as otherwise indicated.

2. Interconnect with grounding-electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make these connections without damaging copper coating or exposing steel.
- D. Grounding Conductors: Route along the shortest and straightest paths possible, except as otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Route and support so that conductors are not encircled by magnetic or conductive materials.
- E. Underground Grounding Conductors: Use bare copper wire. Bury at least 24 inches below grade.

3.03

CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use silver-plated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Provide antiox compounds at all bolted and compression connections.
 4. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 5. Cover crimp connections and barrels with clean heat shrink insulation.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, including those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use two hole long barrel dual crimp tongue lugs. Apply antiox compound and clear heatshrink cover over all visible copper areas. No. 10 AWG and smaller grounding conductors may be tapped with "C" or "H" style compression connectors.
- D. Metal Raceway Terminations: Where metallic raceways terminate Provide each conduit with a grounding bushing. Connect grounding bushings with grounding conductor. Bond conduits at both entrances and exits with grounding bushings and continuous grounding conductors, except as otherwise indicated.
- E. Metal Box Terminations: Provide bonding conductors from grounding bushings to ground bars and to back boxes. Provide brazed or welded posts in each back box to accommodate the lugs specified.. Bond electrically non-continuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.

- F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.
- G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code to make a visible indication that a connector has been adequately compressed on grounding conductor. Provide clear heat shrink insulating cover over the barrel section of the lug.
- H. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.04 FIELD QUALITY CONTROL

- A. Perform tests described below.
- B. Tests: Subject the completed grounding system to a megger test at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than 2 full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the 2-point method according to IEEE 81.
- C. Maximum grounding-to-resistance values are as follows:
 - 1. Equipment Rated 500 kVA and Less: 10 ohms.
 - 2. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - 3. Equipment Rated More than 1000 kVA: 3 ohms.
- D. Excessive Ground Resistance: Where resistance to ground exceeds specified values, notify Owner promptly and include recommendations to reduce ground resistance and to accomplish recommended work.
- E. Report: Prepare test reports, certified by the testing organization, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

3.05 ADJUSTING AND CLEANING

- A. Restore surface features, at areas disturbed by work of this Section.

END OF SECTION

SECTION 260533 - RACEWAYS, BOXES AND CABINETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 26.

1.02 SUMMARY

- A. Section includes raceways, fittings, boxes, enclosures and cabinets for electrical wiring. All raceways are to be installed concealed.
- B. Raceways include the following:
 - 1. Rigid metal conduit.
 - 2. Intermediate metal conduit.
 - 3. Electrical metallic tubing (EMT).
 - 4. PVC Conduit.
- C. Boxes, enclosures and cabinets include the following:
 - 1. Pull and junction boxes.
 - 2. Cabinets and hinged cover enclosures.
- D. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 26 Section 26 0500 - Basic Electrical Requirements for supporting devices and anchors for raceway and box supports.

1.03 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for surface raceway, wireway and fittings, floor boxes, hinged cover enclosures and cabinets.
- C. Shop drawings for nonstandard boxes, enclosures, and cabinets. Include layout drawings showing components and wiring.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
- C. Comply with NECA "Standard of Installation."
- D. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide Products by of one of the following:
 - 1. Metal Conduit and Tubing
 - a. Anamet, Inc., Anaconda Metal Hose
 - b. Triangle PWC, Inc.
 - c. Wheatland Tube Company
 - 2. Conduit Bodies and Fittings
 - a. Emerson Electric Company, Appleton Electric Company
 - b. Hubbell, Inc., Killark Electric Manufacturing Company
 - c. General Signal, O-Z/Gedney Unit
 - 3. Boxes, Enclosures and Cabinets
 - a. Butler Manufacturing Company, Walker Division
 - b. Cooper Industries, Midwest Electric
 - c. Hubbell Inc., Killark Electric Manufacturing Company
 - d. General Signal, O-Z/Gedney
 - e. Square D Company
 - f. Thomas & Betts Corporation
 - 4. PVC Conduit and Tubing
 - a. Carlon, Inc.

2.02 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: UL 6, ANSI C80.1.
- B. Intermediate Metal Conduit: UL 1242, ANSI C80.6.
- C. Electrical Metallic Tubing and Fittings: UL 797, ANSI C80.3 with compression-type fittings.
- D. Fittings: NEMA FB 1, compatible with conduit/tubing materials except that only threaded and compression type fittings are acceptable.

2.03 PULL AND JUNCTION BOXES

- A. Small Sheet Metal Boxes: NEMA OS 1.
- B. Cast Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.

2.04 CABINETS AND ENCLOSURES

- A. Hinged Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.
- B. Cabinets: NEMA 250, type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 WIRING METHODS

- A. Indoors: Use the following wiring methods:
 - 1. Damp or Wet Locations: Rigid steel conduit.
 - 2. Exposed: Electrical metallic tubing, except where exposed to physical damage.
 - 3. Concealed: Electrical metallic tubing, except where exposed to physical damage.
 - 5. Boxes and Enclosures: NEMA Type 1, except in damp or wet locations use NEMA Type 4, stainless steel.

6. Where subject to physical damage: Rigid or intermediate metal conduit.
 7. All other locations: Rigid or intermediate metal conduit.
- B. Outdoors: Use the following wiring methods:
1. Damp or Wet Locations: Rigid steel conduit.
 2. Exposed: Rigid steel conduit.
 3. Underground: Schedule 40 PVC Conduit
 4. Concealed Rigid steel conduit.
 5. Boxes and Enclosures: NEMA Type 4.
 6. Where subject to physical damage: Rigid or intermediate metal conduit.
 7. All other locations: Rigid or intermediate metal conduit.
- C. The following conditions are defined as subject to physical damage for this section:
1. Exposed below 10' above the finished floor where conduit travels up from the floor level or enters the bottom of a box. Except at typical floor lobbies.

3.03 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions. Unless otherwise noted all race way is to be installed concealed.
- B. Do not use EMT in areas where raceway will be exposed to physical damage. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install horizontal raceway runs above water and steam piping.
- D. Install raceways level and square and at proper elevations. Provide adequate headroom.
- E. Complete raceway installation before starting conductor installation.
- F. Support raceway as specified in Division 26 Section 26 0500 - Basic Electrical Requirements for supporting devices."
- G. Use temporary closures to prevent foreign matter from entering raceway.

- H. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- I. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
- J. Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, except as otherwise indicated. Unthreaded fittings shall not be used except for EMT.
- K. Run raceways concealed with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.
- L. Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical, and leave at least 1-inch concrete cover.
 - 1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - 2. Space raceways laterally to prevent voids in the concrete.
 - 3. Run conduit larger than 1-inch trade size parallel to or at right angles to main reinforcement. When at right angles to reinforcement, place conduit close to slab support.
 - 4. Transition nonmetallic tubing to Schedule 80 non-metallic conduit, rigid steel conduit, or IMC before rising above floor.
- M. Where in unfinished spaces or where specifically approved by the architect, install raceways exposed. Install parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
 - 1. Run parallel or banked raceways together, on common supports where practical.
 - 2. Make bends in parallel or banked runs from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
- N. Join raceways with fittings designed and approved for the purpose and make joints tight.
 - 1. Make raceway terminations tight. Use bonding bushings at connections subject to vibration. Use ground conductors through the bonding bushings.
 - 2. Use insulating bushings to protect conductors.
 - 3. Use compression fitting for non-threaded connections.

- O. Terminations: Terminate raceways with locknuts and grounding bushings, align the raceway to enter squarely, and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside the box. Provide grounding bushings for all raceway terminations
- P. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.
- Q. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb. tensile strength. Leave not less than 12 inches of slack at each end of the pull wire.
- R. Telephone and Signal System Raceways and underground raceways: In addition to the above requirements, install in maximum lengths of 150 feet and with a maximum of two 90° bends or equivalent. Install pull, junction boxes or hand holes where necessary to comply with these requirements.
- S. Install raceway sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:
 - 1. Where conduits enter or leave hazardous locations.
 - 2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces.
 - 3. Where otherwise required by the NEC.
- T. Stub-Up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs, and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.
- U. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- V. Do not install aluminum conduit embedded in or in contact with concrete.
- W. Set floor boxes level and adjust to floor surface.

- X. Install hinged cover enclosures and cabinets plumb. Support at each corner.
- Y. Provide grounding connections for all raceway, boxes, and components. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.
- Z. Install cast type boxes for all surface mounted devices, lighting etc. where boxes are surface mounted and mounted 10 foot above finished floor and below (including boxes under access floor).
- AA. Install electrical work that originates from different or diverse panelboards, load busses, services or derived systems (i.e: service switchboards or standby power) so that they are physically separated from each other. Distribution components that do not originate from the same load busses shall be run at extreme opposite ends of the facility. Where such can not be run at the extreme opposite ends of the facility, separate them to the extreme opposite ends of the room or space.

3.04 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer.

3.05 IDENTIFICATION

- A. Provide identification for the following:
 - 1 All accessible raceway 2 inches and larger.
 - 2. Fire alarm raceway.
 - 3. Security raceway.
 - 4. HVAC control.
 - 5. Emergency lighting raceways.
 - 6. Communication raceways.
 - 7. Junction, Pull and Splice boxes.
 - 8. Switchgear Control circuits.

- B. Use plastic sheet raceway markers extending 360° around conduits with a minimum length of 8 inches. Text shall be legible to the naked eye from the floor level below.
 - 1. Identify system voltage.
 - 2. Identify conduit function or system.
 - 3. Provide at minimum intervals of every 20' on center.
- C. Use plastic laminated labels to identify boxes. Text shall be legible to the naked eye from the floor level below.
 - 1. Identify system voltage.
 - 2. Identify function or system.
 - 3. Identify box name or designation.

3.06 CLEANING

- A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 26.

1.02 SUMMARY

- A. This Section includes identification of electrical materials, equipment, and installations.

1.03 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified.
- C. Schedule of identification nomenclature to be used for each identification signs and labels. Prior to fabrication submit schedule to the on-site work force representative, Building engineer and owner's design representative.
- D. Samples for each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with ANSI C2.

1.05 SEQUENCING AND SCHEDULING

- A. Coordinate installing electrical identification after completion of finishing where identification is applied to field-finished surfaces.
- B. Coordinate installing electrical identifying devices and markings prior to installing acoustical ceilings and similar finishes that conceal such items.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Stranco, Inc.
2. Ideal Industries, Inc.
3. Panduit Corporation
4. Ready Made Sign Company; Cornerstone Direct Corporation Division
5. Seton Name Plate Corporation
6. Standard Signs, Inc.

2.02 RACEWAY AND CABLE LABELS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Conform to ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway or cable size.
 1. Color: Black legend on orange field.
 2. Legend: Indicates Designation, voltage, rating, date of installation and service.
- C. Adhesive Labels: Preprinted, flexible, self-adhesive vinyl. Legend is overlaminated with a clear, weather- and chemical-resistant coating.
- D. Pre-tensioned, Wraparound Plastic Sleeves: Flexible, preprinted, color-coded, acrylic bands sized to suit the diameter of the line it identifies and arranged to stay in place by pre-tensioned gripping action when placed in position.
- E. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- F. Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.
- G. Aluminum, Wraparound Marker Bands: Bands cut from 0.014-inch thick aluminum sheet, with stamped or embossed legend, and fitted with slots or ears for permanently securing around wire or cable jacket or around groups of conductors.
- H. Plasticized Card-Stock Tags: Vinyl cloth with preprinted and field-printed legends. Orange background, except as otherwise indicated, with eyelet for fastener.
- I. Aluminum-Faced Card-Stock Tags: Weather-resistant, 18-point minimum card stock faced on both sides with embossable aluminum sheet, 0.002 inch thick,

laminated with moisture-resistant acrylic adhesive, and punched for the fastener. Preprinted legends suit each application.

- J. Brass Tags: Metal tags with stamped legend, punched for fastener. Dimensions: 2 by 2 inches by 0.05 inch.

2.03 ENGRAVED NAMEPLATES AND SIGNS

- A. Manufacturer's Standard Products: Where more than one type is listed for a specified application, selection is Installer's option, but provide single type for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.
- B. Engraving stock, melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 sq. in., 1/8 inch thick for larger sizes.
 - 1. Engraved Legend: Black letters on white face or white letters on red face where directed.
 - 2. Punched for mechanical fasteners.
- C. Baked-Enamel Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size as indicated or as otherwise required for the application. 1/4-inch grommets in corners for mounting.
- D. Exterior, Metal-Backed, Butyrate Signs: Weather-resistant, non-fading, preprinted, cellulose acetate butyrate signs with 0.0396-inch, galvanized steel backing, with colors, legend, and size appropriate to the application. 1/4-inch grommets in corners for mounting.
- E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

2.04 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties with the following features:
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength: 50 lb minimum.
 - 3. Temperature Range: Minus 40 to 185 degrees F.
 - 4. Color: As indicated where used for color-coding.
- B. Paint: Alkyd-urethane enamel over primer as recommended by enamel manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install identification devices according to manufacturer's written instructions.
- B. Install labels where indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- C. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations used in the Contract Documents or required by codes and standards. Use consistent designations throughout the Project.
- D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.
- E. Self-Adhesive Identification Products: Clean surfaces of dust, loose material, and oily films before applying.
- F. Identify feeders with "DANGER—120/208 (277/480 *as applicable*) VOLTS" in black letters 2 inches high, stenciled with paint at 10-foot intervals over a continuous, painted orange background. Identify the following:
 - 1. Entire floor area directly above conduits running beneath and within 12 inches of a basement or ground floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to conduits concealed within wall.
 - 3. All accessible surfaces of concrete envelope around conduits in vertical shafts, exposed in the building, or concealed above suspended ceilings.
 - 4. Entire surface of exposed conduits.
- G. Install painted identification as follows:
 - 1. Clean surfaces of dust, loose material, and oily films before painting.
 - 2. Prime Surfaces: For galvanized metal, use single-component, acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty, acrylic-resin block filler. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.
 - 3. Apply one intermediate and one finish coat of silicone alkyd enamel.
 - 4. Apply primer and finish materials according to manufacturer's instructions.

- H. Identify Raceways and Exposed Cables of Certain Systems with Color Banding: Band exposed and accessible raceways of the systems listed below for identification.
 - 1. Bands: Pre-tensioned, snap-around, colored plastic sleeves; colored adhesive tape; or a combination of both. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of 2-color markings in contact, side by side.
 - 2. Locate bands at changes in direction, at penetrations of walls and floors, at 20-foot maximum intervals in straight runs, and at 5 feet in congested areas.
 - 3. Colors: As follows:
 - a. Fire-Alarm System: Red.
 - b. Fire-Suppression Supervisory and Control System: Red and yellow.
 - c. Security System: Blue and yellow.
 - d. Mechanical and Electrical Supervisory System: Green and blue.
- I. Install Caution Signs for Enclosures: Use pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange field. Install on exterior of door or cover.
- J. Install Circuit Identification Labels on Boxes: Label externally as follows:
 - 1. Exposed Boxes: Pressure-sensitive, self-adhesive plastic label on cover.
 - 2. Concealed Boxes: Plasticized card-stock tags.
 - 3. Labeling Legend: Permanent, waterproof listing of panel and circuit number or equivalent.
- K. Color-Code Conductors: Secondary service, feeder and branch circuit conductors throughout the secondary electrical system.
 - 1. 208/120-V System: As follows:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - e. Ground: Green.
 - 2. Factory-apply color the entire length of the conductors.

- L. Power Circuit Identification: Use metal tags or aluminum wraparound marker bands for cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes and switchboard rooms.
 - 1. Legend: 1/4-inch steel letter and number stamping or embossing with legend corresponding to indicated circuit designations.
 - 2. Fasten tags with nylon cable ties; fasten bands using integral ears.
- M. Apply identification to conductors as follows:
 - 1. All Conductors: Indicate source and circuit numbers.
 - 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding for voltage and phase indication of secondary circuit.
 - 3. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- N. Apply warning, caution, and instruction signs and stencils as follows:
 - 1. Install warning, caution and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved, plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
 - 2. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- O. Install identification as follows:
 - 1. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of text with 1/2-inch high lettering on 1-1/2-inch high label; where 2 lines of text are required, use lettering 2 inches high. Use white lettering on black field. Apply labels for each unit of the following categories of equipment:
 - a. Control devices.
 - b. Transformers.
 - c. Power-generating units.
 - d. Pull and splice boxes.
 - e. Overcurrent Protective devices.
 - 2. Apply designation labels of engraved plastic laminate for disconnect switches, breakers, pilot lights, and similar items for power distribution

and control components above, except panelboards and alarm/signal components where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items controlled by each individual breaker.

END OF SECTION

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 1

1.02 SUMMARY

- A. This Section includes lighting and power panelboards and associated auxiliary equipment rated 600 V and less.
- B. Related Sections include the following:
 - 1. Division 16 Section 260500 - Basic Electrical Materials and Methods for general materials and installation methods.

1.03 SUBMITTALS

- A. Product Data: For each type of panelboard, accessory item, and component specified.
- B. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following:
 - 1. Enclosure type with details for types other than NEMA 250, Type 1.
 - 2. Bus configuration and current ratings.
 - 3. Short-circuit current rating of panelboard.
 - 4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
 - 5. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.
- C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

- F. Maintenance Data: For panelboard components to include in the maintenance manuals specified in Division 1. Include manufacturer's written instructions for testing circuit breakers.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: In addition to the requirements specified in Division 1 Section "Quality Control," an independent testing agency shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or shall be a full member company of the International Electrical Testing Association.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
- C. Comply with NFPA 70.
- D. Comply with NEMA PB 1.

1.05 EXTRA MATERIALS

- A. Keys: 6 spares of each type for panelboard cabinet lock.
- B. Circuit Safe One-way Lockout Pins: 3 spares for each panel board provided.
- C. Circuit Safe Two-way Lockout Pins: 3 spares for each panel board provided.
- D. Circuit Safe Hook Pins: 3 spares for each panel board provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the same manufacturer as the switchgear.

2.02 PANELBOARD FABRICATION

- A. Enclosures: Code gage steel with welded finished seams. Flush- or surface-mounted cabinets as indicated. NEMA PB 1, Type 1, unless otherwise indicated to meet environmental conditions at installed location.
 - 1. Outdoor Locations: NEMA 250, Type 3R.

2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

- B. Front: Hinged Front Cover: Entire front trim hinged to box with standard door within hinged trim cover. Secured one side to box with continuous piano hinge. Secure other side with flush catches and tumbler lock, all keyed alike. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated. Construct so that dead front covers are attached to and move with the front trim cover.
- C. Directory Frame: Metal, mounted inside each panelboard door.
- D. Bus: Hard drawn copper of 98 percent conductivity.
- E. Main and Neutral Lugs: To accommodate two hole long barrel dual crimp Compression lugs.
- F. Equipment Ground Bus: Hard drawn copper of 98 percent conductivity. Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box. Provide brazed ground lug on each backbox.
- G. Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the overcurrent protective device ampere ratings indicated for future installation of devices.
- H. Special Features: Include the following features for panelboards as indicated:
 - 1. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box.
 - 2. Split Bus: Vertical bus of indicated panelboards divided into 2 vertical sections with connections as indicated.
 - 3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and floor.
- I. Extra Gutter Space: Provide cabinets with double (minimum) the code required Gutter Space.

2.03 LOCKOUT/TAGOUT OF OVERCURRENT DEVICES

- A. Each Main and branch circuit overcurrent protective device shall be provided with the capability of being locked out in compliance with OSHA Standard 1910.147.
- B. Each lighting and branch circuit panelboard shall be provided with Stranco, Inc. Circuit Safe™ lockout system. Provide circuit safe unit with length to match the total length of the overcurrent protective devices, including the future devices. Coordinate the centerline separation of breakers and the distances from the panelboard center. Provide one pin holder and two of each type lockout pins for each panelboard. Provide mounting shims and offset brackets as required.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Hinged Front Cover: Entire front trim hinged to box with standard door within hinged trim cover. Secured one side to box with continuous piano hinge. Secure other side with flush catches and tumbler lock, all keyed alike. Front for surface-mounted panelboards shall be same dimensions as box. Fronts for flush panelboards shall overlap box, unless otherwise indicated. Construct so that dead front covers are attached to and move with the front trim cover.

2.05 DISTRIBUTION PANELBOARDS

- A. Doors: In panelboard hinged front, except omit in fusible-switch panelboard, unless otherwise indicated. Secure door with vault-type latch with tumbler lock, all keyed alike.
- B. Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers.

2.06 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.
 - 1. Characteristics: 100% rated. Frame size, trip rating, number of poles and auxiliary devices as indicated and interrupting capacity rating to meet available fault current in accordance with UL 67.
 - 2. Application Listing: Appropriate for application, including Type SWD for switching fluorescent lighting loads and Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Circuit Breakers, 100 A and Larger: Trip units interchangeable within frame size.
 - 4. Circuit Breakers, 200 A and Larger: True RMS sensing with field-adjustable long time, short-time, i^2t in/out and continuous current settings.
 - 5. Current-Limiting Trips: Let-through ratings less than NEMA FU 1, Class RK-5.
 - 6. Lugs: To accommodate compression lugs specified elsewhere in these specifications. Fully rated for 90°C and power-distribution connectors for number, size, and material of conductors indicated.
 - 7. Shunt Trip: Where indicated.

2.07 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: Arranged to permit testing of functions of solid-state trip devices without removal from panelboard.
- C. Lock-on devices for 1-pole circuit breaker handles.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install panelboards and accessory items according to NEMA PB 1.1.
- B. Mounting Heights: Top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly flush with wall finish. Secure panels using minimum size 3/8" bolts and vibration isolators.
- D. Circuit Directory: Typed directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installing.
- E. Install filler plates in unused spaces.
- F. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- G. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.
- H. Seismic Bracing: Provide seismic bracing in accordance with the manufacturer's recommendations and in compliance with the seismic zone requirements for the zone in which the equipment is located.

3.02 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.
 - 1. Indicate panel designation, voltage ratings and phase.
 - 2. Indicate source of power (feeder origin).
 - 3. Indicate location of panelboard.
 - 4. Indicate date of installation.
 - 5. Feeder origin shall include source switchgear or panelboard designation, floor number and floor location number or nearest column number.
- C. Breaker Nameplates: Label each breaker, regardless of size, in distribution panelboards and switchboards with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.
 - 1. Indicate breaker rating.
 - 2. Indicate breaker number: Breakers shall be numbered sequentially from top to bottom and left to right.
 - 3. Indicate load served, location of load and date of installation.

3.03 GROUNDING

- A. Make equipment grounding connections for panelboards as indicated and/or specified.
- B. Provide ground conductor to main electrical ground bus as indicated and/or specified.
- C. Provide each back box with brazed ground studs. Provide ground conductor to bond the back box to the feeder ground and the equipment ground bus in the panel.

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder and control circuits.
 - 2. Make continuity tests of each circuit.
- B. Testing Agency: Provide services of a qualified independent testing agency to perform specified testing.
- C. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: In addition to the requirements of division 16 “Acceptance testing”, Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Manually exercise all switches, circuit breakers and other operating mechanisms.
 - 3. Test all breakers rated 100 Amperes and larger. Provide the services of a NETA certified testing agency. Test all functions and ranges of all over current protective devices.
 - 4. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units, and retest.
 - 5. Submit Certified final test report to the owner’s representative for record.
- D. Balancing Loads: After Substantial Completion, but not more than 2 months after Final Acceptance, conduct load-balancing measurements and make circuit changes as follows:
 - 1. Perform measurements during period of normal working load as advised by Owner.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as required to meet this minimum requirement.
 5. Update panel directory to reflect changes.
- E. Infrared Scanning: After Substantial Completion, but not more than 2 months after Final Acceptance, perform an infrared scan of each panelboard. Remove fronts to make joints and connections accessible to a portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scanning of each panelboard 11 months after date of Substantial Completion.
 2. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.
 3. Record of Infrared Scanning: Prepare a certified report identifying panelboards checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.07 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 26.

1.02 SUMMARY

- A. This Section includes various types of receptacles, connectors, switches and finish plates.

1.03 SUBMITTALS

- A. Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data for each product specified.
- C. Samples of devices and device plates for color selection and evaluation of technical features.
- D. Operation and maintenance data for materials and products specified in this Section to include in the "Operating and Maintenance Manual" specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for devices and installation.
- B. Listing and Labeling: Provide products that are listed and labeled for their applications and installation conditions and for the environments in which installed.
 - 1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100.

1.05 COORDINATION

- A. Wiring Devices for Owner Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment. Verify type, configuration, etc. prior to providing devices. Include all such costs in bid submission.

1.06 EXTRA MATERIALS

- A. Furnish the following extra materials, packaged with protective covering for storage, and identified with labels describing contents. Deliver extra materials to the Owner.
 - 1. Receptacles: 1 for each 10, but not less than 1 of each type.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices
 - a. General Electric Company
 - b. Hubbell Inc.
 - c. Leviton Manufacturing Company, Inc.
 - d. Pass & Seymour/Legrand
 - 2. Wiring Devices for Hazardous (Classified) Locations
 - a. Crouse-Hinds Electrical Construction
 - b. Killark Electrical Manufacturing. Company
 - c. Pyle-National Company

2.02 WIRING DEVICES

- A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices."
- B. Enclosures: NEMA 1 equivalent, except as otherwise indicated.
 - 1. Color: As selected by the owners representative during shop drawing submissions except as otherwise indicated or required by Code
- C. Receptacles, Specification grade. Straight-Blade, Special Features: Comply with the basic requirements specified above for straight-blade receptacles of the class and type indicted, and with the following additional requirements:
 - 1. Ground-Fault Circuit Interrupter (GFCI) Receptacles: UL Standard 943, "Ground Fault Circuit Interrupters," feed-through type, with integral NEMA 5-20R duplex receptacle arranged to protect connected downstream receptacles on the same circuit. Design units for installation in a 2-3/4-inch deep outlet box without an adapter.
- D. Snap Switches: Specification grade. Quiet-type AC switches, NRTL listed and labeled as complying with UL Standard 20 "General Use Snap Switches," and

with Federal Specification W-S-896. Where indicated with pilot light provide illuminated handle switch where handle illuminates when load is activated.

- E. Receptacles: NEMA 5-20R Specification grade receptacle. NRTL listed and labeled as complying with UL Standard and with Federal Specifications. Where indicated as "WP" provide Red-Dot code keeper flip cover suitable for wet locations when in use.
- F. Wall Plates: Single and combination types that mate and match with corresponding wiring devices. Features include the following:
 - 1. Color: Matches wiring device except as otherwise indicated.
 - 2. Plate-Securing Screws: Metal with heads colored to match plate finish.
 - 3. Material for Finished Spaces: Steel with wrinkled finish, baked enamel, suitable for field painting, except as otherwise indicated.
 - 4. Material for Unfinished Spaces: Galvanized steel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- D. Protect devices and assemblies during painting.
- E. Do not connect switches in the neutral conductor. Install switches indicated by "S" with subletter to control the outlets indicated. However, if subletter is omitted, install switches to control lighting in the room or area. If there is only one switch indicated in the room, install the switch to control all lighting in the room even though they are not indicated by subletter. If two switches are shown in a room at the same location with no subletter, install each switch to control half the lamps in each fixture even though there is no subletter. For fixtures with 3 lamps one switch shall control the two outer lamps and the second shall control the inner lamp.
- F. Wall plates for devices in flush boxes, unless specified otherwise, shall be .040" thick beveled edge satin finish stainless steel plates, single or multi-gang as required by the outlet. Plates for FS or FD type boxes shall be zinc or cadmium plated sheet steel, specially designed to fit the type outlet box. Blank plates shall be furnished and installed on all empty, blanked or unused outlets.

- G. Install occupancy sensors on pendant-mounted boxes with seismic bracing to the ceiling slab. Install sensors so that the bottom of the sensor is below the bottom of the fixtures that it controls. Provide extension rings and covers to conceal and isolate the low voltage wiring and components.
- H. Provide UL listed wet location covers “while in use” for all switching and receptacles located outdoors.
- I. Softwired Switches and/or photocells shall be mounted in the spaces as indicated on the Reflected Ceiling Plans. Each low voltage wire shall be labeled clearly indicating which relay panel it connects to. Use only properly color coded, stranded #18 AWG (or larger) wire as indicated on the drawings. All relays and switches shall be tested after installation to confirm proper operation and the loads recorded on the directory card in each panel.
- J. The relay panels shall be mounted in electrical closets as indicated on the drawings. The numbered relays in the panel shall be wired to control the power to each load as indicated on the Panel Wiring Schedules included in the drawings. All power wiring will be identified with the circuit breaker number controlling the load. If multiple circuit breaker panels are feeding into a relay panel, wires shall clearly indicate the originating panel’s designation.
- K. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all system components.

3.02 IDENTIFICATION

- A. Comply with Division 16 Electrical Identification.
 - 1. Switches: Where 3 or more switches are ganged, and elsewhere where indicated, identify each switch with approved legend engraved on wall plate.
 - 2. Receptacles: Identify the panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.03 GROUNDING

- A. Isolated Ground Receptacles: Connect to isolated grounding conductor routed to designated isolated equipment ground terminal of electrical system.

3.04 FIELD QUALITY CONTROL

- A. Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.
- B. Test ground-fault circuit interrupter operation with both local and remote fault simulations according to manufacturer recommendations.

- C. Replace damaged or defective components.

3.05 CLEANING

- A. General: Internally clean devices, device outlet boxes and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 263213 –ENGINE GENERATOR AND ASSOCIATED WORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Owner's Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 26.

1.02 SUMMARY

- A. The work under this section shall consist of all labor, materials, equipment and services necessary and required for providing complete stand by Generator in an Outdoor weatherproof sound attenuating enclosure. Provide associated equipment and/or modifications as specified herein and/or on the drawings.
- B. This section also includes the provision of all circuitry, feeders and empty raceway systems.
- C. This section includes all interconnections, power and control circuitry.

1.03 EQUIPMENT

- A. The generator is a generator in an outdoor weather enclosure. Include the required modifications, installation, initial service, commissioning and on-site testing specified herein.
- B. Provide all rigging, transportation, storage, provisioning, commissioning, etc.. of the unit to accommodate the installation and work required under this contract.
- C. The generator is to include all other devices. Work associated with the installation shall be provided by this division
- D. Provide externally mounted control devices for operation of equipment, which have to be externally mounted apart from the internal controls.
- E. Provide internal modifications/devices for operation of equipment, which have to be internally mounted.

1.04 DEFINITIONS

- A. Standby Rating: Power output rating equal to the power the generator set delivers continuously under normally varying load factors for the duration of a power outage.

- B. Operational Bandwidth: The total variation from the lowest to the highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.
- C. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in hertz.

1.05 GENERATOR-SET PERFORMANCE

- A. The generator is a "quiet" unit Level 1 acoustical unit. The installation and all modifications shall maintain this criteria.

1.06 SUBMITTALS

- A. This division shall be responsible for the coordination and processing (the provision) of shop drawings and submittals.
- B. Product Data: For each component. Include data on features, components, ratings, and performance. Include dimensioned outline plan and elevation drawings of engine generator set and other system components.
- C. Shop Drawings: Show details of fabrication, piping, wiring, and installation of field-installed portions of system. Include general arrangement drawings showing locations of auxiliary components in relation to engine generator set and duct, piping, and wiring connections between generator set and auxiliary equipment. Show connections, mounting, and support provisions and access and workspace requirements.
- D. Wiring Diagrams: Show details of power and control connections and differentiating between factory-installed and field-installed wiring.
- E. Qualification Data: For firms and persons specified in the "Quality Assurance" Article.
- F. Adjustment for Site Ambient: Provide criteria used to adjust ANSI standard ratings to specified site operating ambient conditions.
- G. Field Test and Observation Reports: Indicate and interpret test results for compliance with performance requirements.
- H. Certified summary of prototype-unit test report.
- I. Certified Test Reports of Components and Accessories: For devices that are equivalent, but not identical, to those tested on prototype unit.
- J. Certified Summary of Performance Tests: Demonstrate compliance with specified requirement to meet critical performance criteria.

- K. Factory Test Reports: For units to be shipped for this Project showing evidence of compliance with specified requirements. Provide list of products and serial numbers for this Project's equipment for comparison during factory and field tests.
- L. Exhaust Emissions Test Report: To show compliance with applicable regulations.
- M. Sound measurement test report.
- N. Certification of Torsional Vibration Compatibility: Comply with NFPA 110.
- O. Field test report of tests specified in Part 3.
- P. Maintenance data for system and components to include in the maintenance manuals specified. Include the following:
 - 1. List of special tools recommended to be stored at the site for ready access.
 - 2. Detail operating instructions for both normal and abnormal conditions.

1.07

QUALITY ASSURANCE

- A. Qualifications: Engage a firm experienced in the specific equipment of types and capacities similar to those indicated for this Project and with a service center factory authorized and maintained by engine generator set manufacturer capable of providing training, parts, and emergency maintenance and repairs.
- B. Testing Agency Qualifications: Provide an independent testing agency with the experience and capability to conduct testing indicated. Provide factory authorized representatives for each piece of equipment involved in any test and during all tests.
- C. Source Limitations: Obtain engine generator set and auxiliary components from the manufacturer with responsibility for entire system. Provide a representative product built from components that have proven reliable and compatible with each other and are coordinated to operate as a unit as evidenced by records of prototype testing.
 - 1. Vendor (source) organization and maintenance organization of engine generator set shall be the same organization and meet the following qualifications:
 - a. The vendor shall be an authorized factory distributor of the engine generator set and shall have complete parts and full service capability with factory certified Craftsman available 24 hours per day, 7 days a week. The vendor shall have an existing operational service facility within two hour drive of the installation site. Delegation of this service responsibility will not be considered fulfillment of these specifications.
 - b. The vendor shall have an adequate experienced staff to support project management, technical support, maintenance and training requirements

of the engine generator set. The staff shall have 5 years minimum experience in the items previously listed.

- c. The vendor shall have been successfully engaged in the assembly, installation and service of engine generator set equipment for emergency power purposes for a period of no less than 10 years.

D. Comply with NFPA 70.

E. Comply with NFPA 110 requirement for a Level 1 emergency power supply system.

F. Engine Exhaust Emissions: Comply with applicable national, state and local government requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Transport/ ship the generator by dedicated carrier to the site, storage, modification shop. Include the costs of storing, shipping/rigging etc in the bid submission. . Deliver engine generator set and system components to their final locations in protective wrappings, containers, and other protection that will exclude dirt and moisture and prevent damage from construction operation. Remove protection only after equipment is safe from such hazards. Equipment shall be delivered, dismantled as required, to be directly rigged into its final mounting location.

B. Generator shall be delivered to the site and rigged into place. Inspect all equipment.

1.09 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Provide a warranty for all systems and components installed under this contract, signed by the Contractor and manufacturer, with single-source responsibility, authorized manufacturers representative for engine generator and auxiliary components, agreeing to repair or replace items that do not meet requirements or that deteriorate as defined in this Section within the specified warranty period. Include the cost for labor and material for the complete warranty period.

C. Warranty Period: 1 year from date of Substantial Completion/issuance of CO for the project.

1.10 MAINTENANCE SERVICE

A. Maintenance: Beginning at Substantial Completion, submit a proposal to the owner for 12 months full maintenance by skilled employees of the manufacturer's designated

service organization. Include monthly generator exercising with Owner's Representative to check for proper, starting, load transfer, and running under load. Schedule visits with Owner's Representative two weeks prior to exercising. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies as used in the manufacture and installation of original equipment.

1.11 EXTRA MATERIALS

- A. Provide extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver extra materials to Owner.
 - 1. Filters: 1 sets each of lubricating oil, fuel, and combustion air filters.
 - 2. Belts: 1 of each type.
 - 3. Hose: 1 of each type with clamp.

PART 2 - PRODUCTS

2.01 PRODUCTS

- A. Generator(s): Generac (or approved equal) 1000kw 3 Phase Outdoor stationary enclosed fuel oil fired generator with Level 1 acoustical enclosure. Complete with long run base mounted fuel tank with all required monitoring.
- B. Batteries: 12 volt sintered AGM lead acid storage batteries (in series as required) rated as recommended by the engine manufacturer for cyclic cranking of standby generating sets of this size shall be provided for the engine. Provide, inter-cell connections and cable connections with lugs and mounting supports shall be provided for each battery for mounting in the generator enclosure. Each battery shall have sufficient capacity to provide 120 seconds total cranking time without recharging. The batteries shall carry a two-year full replacement guarantee followed by a ten year prorated warranty. The battery manufacturer shall provide detailed battery sizing calculations for this project for review as a shop drawing.
- C. Engine Cooling System
 - 1. Cooling system coolant solution of 50% inhibited long life ethylene glycol and 50% water.
 - 2. Coolant hoses with flexible silicon impregnated assemblies with non-porous rubber inside surface and aging, ultraviolet and abrasion resistant fabric outer covering. The ratings shall be 50 psig maximum working pressure with 180°F coolant, and non-collapsible under vacuum. Hoses and belts shall not be painted.
 - 3. Provide a complete coolant recovery system designed to collect and contain any coolant lost due to overflow of over pressure release.
- D. Air Cleaner

1. Element dry type engine inlet air. At full load operation, the allowable air inlet restriction shall not exceed the recommendations of the engine manufacturer.

E. Engine Protective and Indicating Devices

1. Functional Description: When the mode-selector switch on the control and monitoring panel is in the automatic position, remote control contacts in one or more separate automatic-transfer switches initiate starting and stopping of the generator set. When the mode-selector switch is switched to the on position, the generator set manually starts. The off position of the same switch initiates generator set shutdown. When the generator set is running, specified system or equipment failures or derangements automatically shutdown the generator set, trips the generator circuit breaker (in the building) and initiate alarms. Operation of any remote emergency-stop switch(es) also shuts down the generator set and trips circuit breaker
2. Operating and safety indications, protective devices, basic system controls, and engine gages are grouped on a common control and monitoring panel mounted on the generator set. Mounting method isolates the control from generator set vibration.
 - a. Shunt Trip Device: For building load output circuit breaker (located in service room), connected to trip circuit breaker when generator set is shut down by protective devices.
3. The remote panel annunciator shall mimic that on the generator mounted control panel. It shall contain fault lights for those items listed elsewhere and in addition shall have individual indication lamps for the mode selector switch (auto, on, and off) positions, low main fuel tank level and engine running. The remote panel annunciator shall be provided with a dry form C (NO & NC) contact for fault.
4. Remote Emergency Stop Switches: Provide Flush wall mounted, prominently labeled and protected from accidental operation. Provide one at each generator room exit. Cutler Hammer E22J2N8. Provide Safety Technologies STI6605 or equivalent protective cover to prevent accidental operation.

F. Jacket Water Heater

1. Provide automatic thermostatically controlled tank-type heated jacket water circulating system is included for operation at 208 volts AC, single phase. The system shall be rated to maintain 90°F ambient. A lube oil pressure cutout switch shall shut down the heater during engine operation. Provide all circuiting for the jacket heater.

2.02 SOURCE QUALITY CONTROL

A. Testing

1. Include testing of the final modified unit.
2. Include engine generator set as modified, exhaust silencers, radiators, voltage regulator control panel annunciators and remote panel annunciator and all accessories required for operation of the generator.
3. The tests shall be witnessed by representatives of, the Owner, architect/engineer, mechanical contractor, and the electrical contractor. Provide fourteen days advance notice of the witness factory tests.
4. The vendor shall submit to the architect/engineer for approval a detailed procedure of the proposed test three weeks prior to the scheduled factory tests.
5. All equipment shall be ready for operation prior to start of the witnessed tests.
6. The engine generator set shall then be operated at full rated load for at least two hours. During the full load tests, readings shall be recorded of the values listed below. The readings shall be made at 30-minute intervals, starting at the beginning of the test and including the values at the end of the cool-down period.
 - a. Ambient temperature, barometric pressure and humidity.
 - b. Generator kilowatt load.
 - c. Generator currents in all three phases.
 - d. Generator voltage across all three phases L-L and L-N.
 - e. Generator frequency.
 - f. Engine coolant temperature.
 - g. Engine lube oil pressure.
 - h. Engine lube oil temperature.
 - i. Engine fuel consumption.
7. During the full load tests, measurements shall be made at the exhaust silencer to ensure that the specified maximum sound level is not exceeded.
8. Provide demonstration of the following compliance to specified performance requirements:
 - a. Single step load pick-up.
 - b. Transient and steady state governing.
 - c. Transient and steady state voltage performance.
 - d. Safety shutdown devices.

9. If the equipment fails to meet specification requirements during the witnessed tests, the vendor shall correct the cause of the failure and repeat the tests to the satisfaction of prior to shipment at the expense of the manufacturer.
10. Four legible certified copies of the test results shall be provided to the architect/engineer. The test results shall include a log of all readings taken during the test run.

2.03 ACCESSORIES

- A. Provide the replacement fill of lubricating oil and 50% inhibited ethylene glycol solution coolant in the cooling loop.
- B. Start circuitry shall be compatible with the existing generator start circuitry. Provide all appurtenances to start generator set in the same fashion as the existing.
- C. Identify system components.
- F. Provide EPO Stations. Stations shall be Push/Pull maintained switches with mushroom type actuators with double throw multi-pole contact blocks mounted in a FD style back box with over all clear lexan flip cover. Provide legend plate indicating "GENERATOR #X EMERGENCY SHUTDOWN"...."PULL TO RESET". Switch is push on maintained and pull off maintained with a minimum of 2 double throw contacts. Similar to Square D ZB2BX4 with series ZB2 BZ105 base contact block. Circuit One pole to the associated generator shutdown circuit. Provide clear lexan flip cove is similar to the covers often provided for fire alarm pull stations except there is no audible alarm nor "fire" legend

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise installation, connection and on-site testing of units and to report results in writing.
- B. Supervised Adjusting and Pre-testing: Under supervision of factory-authorized service representative, pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation is according to specifications.
- C. On-Site Tests: Under supervision of factory authorized service representative, conduct the following tests:
 1. Load Tests: provide a complete full load and step load test of the equipment. Test all specified responses indicated ion part 2. Record all teats and issue certified test reports. Perform all tests again to the satisfaction of the Engineer Conduct all tests as specified in "Source Quality Control" in this section.

2. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
3. System Integrity Tests: Methodically verify proper installation, connection and integrity of each element of engine generator system before and during system operation. Check for air, exhaust and fluid leaks.
4. Exhaust System Back-Pressure Test: Use a manometer with a scale exceeding 40" of water. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
5. Exhaust Emissions Test: Conform to applicable government test criteria.

3.02 DEMONSTRATION

- A. Training: Engage a factory-authorized service representative to demonstrate adjustment, operation, and maintenance of system and to train Owner's maintenance personnel as specified below:
 1. Conduct a minimum of 2 hours of training.
 2. Schedule training with at least 7 days advance notice.

3.03 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. Six copies of the operation and service instructions shall be provided by the generator manufacturer in illustrated and bound form.
- B. All equipment provided in this Specification shall be guaranteed against defects in material or workmanship for a period of one (1) year from date of initial operation/acceptance.

3.04 INSTALLATION

- A. Provide the installation, final assembly and alignment of all components of the unit. The manufacturer shall provide everything necessary for the assembly and complete installation of the unit, and evacuate, test, charge and adjust the unit for satisfactory operation.
- B. Check the entire system and all controls and, in conjunction with the contractor, make all necessary tests to ensure proper operation of the unit and verify compliance with installation and performance specifications. A test log shall be submitted to the Architect/Engineer containing hourly test data for the machine for the duration of the test.
- C. Provide all control circuitry required.

- D. Provide a circuiting required for alarm points and engine generator control and shutdown. Including the shunt trip of the in building generator power breaker when the generator shuts down on response to a protective or emergency device.
- E. Provide EPO control circuiting and ancillary devices. Provide EPOs on the generator and at the main electric room.
- F. Provide all nuts, bolts, and gaskets required to connect all mating flanges. Nuts, bolts, and washers shall be stainless steel or case-hardened rated at 1100°F. All other materials and appurtenances, structural steel supports, anchors, and guides required to complete the installation, as specified and as indicated on the drawings, shall be furnished.
- G. In addition to the controls indicated on the drawings and herein, provide all control and circuitry for the following associated systems:
 - 1. Remote generator control panels.
 - 2. Mimic panels.
 - 8. All wiring for engine control indication alarm and monitoring shall be connected to terminal blocks in an accessible terminal cabinet located on the engine.

3.05 CLEANING

- A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch-up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

END OF SECTION

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes interior lighting fixtures, lamps, ballasts, emergency lighting units, and accessories.

1.03 DEFINITIONS

- A. Emergency Lighting Unit: A fixture with integral AC/DC inverter fed from normal AC power, and a switch leg for lighting control.
- B. Fixture: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply. Internal battery-powered exit signs and emergency lighting units also include a battery and the means for controlling and recharging the battery. Emergency lighting units include ones with and without integral lamp heads.
- C. Average Life: The time after which 50 percent fails and 50 percent survive under normal conditions.

1.04 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data describing fixtures, lamps, ballasts, and emergency lighting units. Arrange Product Data for fixtures in order of fixture designation. Include data on features and accessories and the following:
 - 1. Outline drawings indicating dimensions and principal features of fixtures.
 - 2. Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for fixtures and lamps.
 - 3. Battery and charger data for emergency lighting units.
- C. Shop Drawings detailing nonstandard fixtures and indicating dimensions, weights, method of field assembly, components, features and accessories.

- D. Wiring diagrams detailing wiring for control system showing both factory-installed and field-installed wiring for specific system of this Project, and differentiating between factory-installed and field-installed wiring.
- E. Coordination Drawings showing fixtures mounted on ceiling. Indicate coordination with other equipment installed in vicinity.
- F. Maintenance data for fixtures to include in the operation and maintenance manual specified in Division 1.

1.05 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.
- B. Listing and Labeling: Provide fixtures, emergency lighting units, and accessory components specified in this Section that are listed and labeled for their indicated use and installation conditions on Project.
 - 1. Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed in combustible construction that are specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.
 - 2. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 3. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Fixtures for Hazardous Locations: Conform to UL 844. Provide units that have Factory Mutual Engineering and Research Corporation (FM) certification for indicated class and division of hazard.
- D. Coordinate fixtures, mounting hardware, and trim with ceiling system and other items, including work of other trades, required to be mounted on ceiling or in ceiling space.

1.06 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Provide a written warranty executed by the manufacturer agreeing to replace fixture components that fail within the specified warranty period. Such warranty shall include the placements as MOP items performed at the owner's convenience and during premium time.

- C. Special Warranty Period: Manufacturer's standard but not less than 1 years after date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last 9 years.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Lamps: 10 lamps for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least once of each type.
 - 5. Mellinan Sleeves: Furnish at least one standard case.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, fixtures that may be incorporated into the Work include, but are not limited to, the products specified in the Interior Lighting Fixture Schedule.

2.02 FIXTURES AND FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs, sharp corners, and edges.
- B. Sheet Metal Components: Steel, except as indicated. Form and support to prevent warping and sagging.
- C. Doors, Frames and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers and other pieces to prevent accidental falling during relamping and when secured in operating position.
- D. Reflecting Surfaces: All fixtures shall be provided with a specular reflector designed to increase fixture efficiency to provide 80% the lighting level with half the lamps. Minimum reflectance as follows, except as otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.

3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metalized Film: 90 percent.
- E. Lenses, Diffusers, Covers and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass, except as otherwise indicated.
 1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat and UV radiation.
 2. Lens Thickness: 0.125 inch minimum; except where greater thickness is indicated.
- F. Fixture Support Components: Comply with Division 16 Section "Basic Electrical Materials and Methods."
 1. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.
 2. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.
 3. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
 4. Hook Hanger: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.
 5. Recessed Fluorescent Fixtures: Support independent from the suspended ceiling with cable or chains at each corner of the fixture. Adjust supports to remove all fixture weight from the suspended ceiling structure.
- G. Fluorescent Fixtures: Conform to UL 1570.
- H. Fluorescent Ballasts: Electronic integrated circuit, solid-state, full-light-output, energy-efficient type compatible with lamps and lamp combinations to which connected. Prescolite Intellect ballasts including the P120-23RS and P277-23RS ballasts are not acceptable.
 1. Certification by Electrical Testing Laboratory (ETL).
 2. Labeling by Certified Ballast Manufacturers Association (CBM).
 3. Type: Class P, high power factor, except as otherwise indicated.
 4. Sound Rating: "A" rating, except as otherwise indicated.
 5. Voltage: Match connected circuits.
 6. Lamp Flicker: Less than 1 percent.
 7. Minimum Power Factor: 90 percent.

8. Total Harmonic Distortion (THD) of Ballast Current: Less than 10 percent.
 9. Conform to FCC Regulations Part 15, Subpart J for electromagnetic interference.
 10. Conform to IEEE C62.41, Category A, for resistance to voltage surges for normal and common modes.
 11. Multilamp Ballasts: Use multiple single lamp ballasts for multilamp fixtures where possible.
 12. Lamp-ballast connection method does not reduce normal rated life of lamps.
 13. Low-Temperature Fluorescent Ballasts: Comply with above requirements, except ballast may be Class P electromagnetic type. Starting temperature is minus 20 degrees C or colder.
 14. Dimming Ballasts: Electronic type providing smooth dimming over a minimum range from 100 to 5 percent light output. Listed for use with specific fluorescent dimming system provided. Dimming systems are specified in Division 16 Section 16915 - Lighting Control Equipment. Fluorescent wall dimmers are specified in Division 16 Section 16140 - Wiring Devices.
- J. Electromagnetic Interference (EMI) Filters: Integral to fixture assembly. Provide one filter for each ballast. Suppress EMI as required by MIL-STD-461.
- K. High-Intensity-Discharge (HID) Fixtures: Conform to UL 1572.
- L. HID Ballasts: Conform to UL 1029 and ANSI C82.4. Include the following features, except as otherwise indicated.
1. Constant wattage autotransfer (CWA) or regulating high-power-factor type, unless otherwise indicated.
 2. Operating Voltage: Match system voltage.
 3. Single-Lamp Ballasts: Minimum starting temperature of minus 30 degrees C.
 4. Normal Ambient Operating Temperature: 40 degrees C.
 5. Open circuit operation will not reduce average life.
 6. High Pressure Sodium (HPS) Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 degrees C.

7. Encapsulation: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise.
- M. Instant Restrike Device: Solid-state, potted module, mounted inside HPS fixture and compatible with HPS lamps, ballasts and sockets up to 150 W.
 1. Restrike Range: 105 to 130 VAC.
 2. Maximum Voltage: 250 V peak or 150 VAC RMS.
- N. Auxiliary, Instant-On, Quartz System: Automatically switches quartz lamp when fixture is initially energized and when momentary power outages occur. Turns quartz lamp off automatically when HID lamp reaches approximately 60 percent light output.
- O. Incandescent Fixtures: Conform to UL 1571.
- P. Exit Signs: Conform to UL 924 and the following:
 1. Sign Colors: Green letters on a background.
 2. Minimum Height of Letters: 6" high letters with a uniform $\frac{3}{4}$ " stroke. Visible "dots" from LED sources are not acceptable.
 3. Arrows: Include as indicated.
 4. Illuminated faces: As indicated.
 5. Lamps for AC Operation: Light-emitting diodes (LED), 70,000 hours minimum rated life.
 6. Integral automatic high/low trickle charger in a self-contained power pack. Sealed, maintenance-free, nickel-cadmium type with special warranty.

2.03 LAMPS

- A. Comply with ANSI C78 series that is applicable to each type of lamp.
- B. Fluorescent Color Temperature and Minimum Color-Rendering Index (CRI): 4100 K and 85 CRI, except as otherwise indicated.
- C. Non-compact Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid start circuits.

2.04 FINISHES

- A. Manufacturer's standard, except as otherwise indicated, applied over corrosion-resistant treatment or primer, free of streaks, runs, holidays, stains, blisters, and similar defects.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Set units plumb, square and level with ceiling and walls, and secure according to manufacturer's written instructions and approved Shop Drawings. Support fixtures according to requirements of Division 16 Section "Basic Electrical Materials and Methods."
- B. Support for Suspended Fixtures: Seismically brace pendants and rods over 48 inches long to limit swinging. Provide unistrut braces every 10' on center along rows of fixtures mounted on common unistrut channels else brace each fixture independently. Support stem-mounted, single-unit, suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
 - 1. Install support clips for recessed fixtures, securely fastened to ceiling grid members, at or near each fixture corner.
 - 2. Fixtures Smaller than Ceiling Grid: Install a minimum of 4 rods or wires for each fixture. Do not support fixtures by ceiling acoustical panels.
 - 3. Fixtures of Sizes Less than Ceiling Grid: Center in acoustical panel. Support fixtures independently with at least two 3/4-inch metal channels spanning and secured to the structure above.
- C. Support for Suspended Fixtures: Seismically brace pendants and rods over 48 inches long to limit swinging. Provide Unistrut braces every 10' on center along rows of fixtures mounted on common Unistrut channels else brace each fixture independently. Support stem-mounted, single-unit, suspended fluorescent fixtures with two-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
- D. Lamping: Where specific lamp designations are not indicated, lamp units according to manufacturer's instructions.

3.02 CONNECTIONS

- A. Ground lighting units. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Circuit Emergency inverter ballasts with unswitched AC source to provide power failure sensing allowing the ballast to automatically switch over to the DC source and illuminate the fixture upon AC power failure. Provide AC switch leg to each inverter ballast as well to accommodate standard switching functions as designated on the contract drawings. DC power to the inverter ballast shall be

constant DC power source. Switching to DC source shall be accomplished at each inverter ballast. Do not connect a switched DC power source to the inverter ballast.

3.03 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replaced damaged fixtures and components.
- B. Give advance notice of dates and times for field tests.
- C. Provide instruments to make and record test results.
- D. Tests: Verify normal operation of each fixture after fixtures have been installed and circuits have been energized with normal power source. Interrupt electrical energy to demonstrate proper operation of emergency lighting installation. Include the following information in tests of emergency lighting equipment:
 - 1. Normal transfer to battery source and retransfer to normal.
 - 2. Low supply voltage transfer.
- E. Replace or repair malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.
- F. Report results of tests.
- G. Replace fixtures that show evidence of corrosion during Project warranty period.

3.04 ADJUSTING AND CLEANING

- A. Clean fixtures after installation. Use methods and materials recommended by manufacturer.
- B. Adjust amiable fixtures to provide required light intensities.

END OF SECTION

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 26.

1.2 SUMMARY

- A. Section Includes:
 - 1. Exterior luminaires with lamps/modules, and drivers.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color-rendering index.
- C. LER: Luminaire efficacy rating.
- D. Luminaire: Complete lighting fixture, including ballast housing if provided.
- E. Pole: Luminaire support structure, including tower used for large area illumination.
- F. Standard: Same definition as "Pole" above.

1.4 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
 - 2. Details of attaching luminaires and accessories.
 - 3. Details of installation and construction.
 - 4. Luminaire materials.

5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
 6. Voltage drop calculations.
 - a. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 7. Photoelectric relays.
 8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
 9. Materials, dimensions, and finishes of poles.
 10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
 11. Anchor bolts for poles.
 12. Pole foundations.
 13. LED lamps/modules and drivers.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
 3. Design calculations, certified by a qualified professional engineer, indicating strength of foundations and soil conditions on which they are based.
 4. Wiring Diagrams: For power, signal, and control wiring.
- C. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals. Provide data in electronic and hard-copy formats.
- F. Warranty: Sample of special warranty specified in this section
- G. Coordination Drawings: Provide coordination drawings by coordination with Civil and other trades.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency acceptable to the authority having jurisdiction, and marked for intended location and application.
- C. Comply with IEEE C2, "National Electrical Safety Code."
- D. Comply with NFPA 70.
- E. LED fixtures shall comply with the following:
 - 1. UL Standard 8750 "Light Emitting Diode Equipment for Use in Lighting Products".
 - 2. IES Standard LM-79 "Electrical and Photometric Measurements of Solid-State Lighting Products".
 - 3. IES Standard LM-80 "Measuring Lumen Maintenance of LED Light Sources".
 - 4. IES Standard TM-21 "Projecting Long term Lumen Maintenance of LED Light Sources".
 - 5. ANSI C78.377 "Specifications for the Chromaticity of Solid State Lighting Products" with LEDs binned within a maximum three-step MacAdam Ellipse to ensure color consistency amongst luminaires of the same type.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B 660.
- B. Store poles on decay-resistant-treated skids at least twelve (12) inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Glass and Plastic Lenses, Covers, and Other Optical Parts: One (1) for every one hundred (100) of each type and rating installed. Furnish at least one (2) of each type.
 - 2. Globes and Guards: One (1) for every twenty (20) of each type and rating installed. Furnish at least one (2) of each type.

3. LED Lamps/Modules: One (1) for every one hundred (100) (2) of each type and rating installed. Furnish at least one (1) of each type.
4. LED Drivers: One (1) for every one hundred (100) (2) of each type and rating installed. Furnish at least one (1) of each type.

1.8 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
 1. Warranty Period for Luminaires: Five (5) years from date of Substantial Completion.
 2. Warranty Period for Metal Corrosion: Five (5) years from date of Substantial Completion.
 3. Warranty Period for Color Retention: Five (5) years from date of Substantial Completion.
 4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three (3) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one (1) of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. : Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.

- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85%.
 - 2. Specular Surfaces: 83%.
 - 3. Diffusing Specular Surfaces: 75%.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Coordinate color with architect to match UMB standards factory-assembled and -tested luminaire before shipping. Where indicated, match the finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected by UMB from manufacturer's full range.

N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color (other than Polson fixtures): As determined by the architect

O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
 - a. "USES ONLY" and include specific lamp type.
 - b. Lamp/Module code configuration and nominal wattage for luminaires.
 - c. Driver type (dim, non-dim) for luminaires.
 - d. CCT and CRI for all luminaires.

2.3 LED Lighting Products:

A. Acceptable Manufacturers:

1. Luminaires:
 - a. Refer to the Luminaires Schedule on the drawings.
2. Drivers:
 - a. Cree.
 - b. EldoLED.
 - c. Philips/Advance.
 - d. Thomas Research Products.
 - e. Or as supplied by the luminaire manufacturer, in compliance with these Specifications.
3. Dimmable Drivers:
 - a. Cree.

- b. EldoLED.
- c. Philips/Advance.
- d. Thomas Research Products.
- e. Or as supplied by the luminaire manufacturer, in compliance with these Specifications.

B. Luminaires:

- 1. Refer to Luminaire Schedule for specified parameters such as correlated color temperature (CCT) value(s), lumen output, efficiency, etc.
- 2. Products shall be fabricated to be Reduction of Hazardous Substances (RoHS) - compliant.
- 3. Must maintain their warranted life while operating within the manufacturers' specified environmental parameters.
- 4. The lumen value specification listed in the Luminaire Schedule is a delivered lumen value specification. Products supplied shall deliver not less than the lumen value specified.
- 5. The lumen maintenance specification of any assembled LED based chip, array, module, driver, and luminaire combination shall be a minimum of L70, at 50,000 hours, as tested and measured in compliance with IES documents LM-79 and LM-80.
- 6. Except as otherwise stated in the Luminaire Schedule, the light source shall provide a minimum CRI of >85.
- 7. Operating temperature rating shall be between -40°C (-40°F) and 50°C (120°F).

C. Drivers: Listed and so labeled per UL 8750 and UL 1310, and shall meet or exceed the following general specification criteria:

- 1. Designed and tested to be compatible with the luminaire light source operating current, voltage, and output power requirements.
- 2. Inaudible above 27 dBA ambient sound level.
- 3. Designed, fabricated, and tested to operate at an input voltage of 120 – 480VAC, ±10%, at 60 Hz, with no perceptible change in light source output.
- 4. Contribute less than 20% total harmonic distortion, operating at full rated load, and shall not exceed the maximum allowable THD requirements allowed per standard ANSI C82.11.
- 5. Provided with integral short circuit, open circuit, and overload protection.
- 6. Have an operating power factor ≥ 0.9 .
- 7. Limit conducted and radiated interference in compliance with FCC 47 CFR Part 18.
- 8. Housed in a UL compliant and listed enclosure, suitable for remote installation where required, as defined in NFPA 70 – the National Electrical Code.
- 9. Starting temperature -40°C (-40°F).
- 10. Power supplies Class I or II output.

11. Surge Protection: The system must survive 250 repetitive strikes of "C Low" wave forms at 1-minute intervals with less than 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ANSI C62.41.2-2002, Scenario 1 Location Category C.

D. Dimmable Drivers - In addition to the general specification criteria specified above:

1. Have an operating power factor of ≥ 0.9 at full load, and not less than 0.8 at dimmed level.
2. Provide smooth, flicker-free, dimmable light output from 100% to less than 1%.
3. 0-10VDC "sinking" type dimming control protocol per enforced version of IEC Standard 60929, unless otherwise noted or required.

2.4 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at one and one half (1.5) fc to three (3) fc and off at four and one half (4.5) fc to ten (10) fc with fifteen (15) second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.5 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

- B. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
3. Anchor-Bolt Template: Plywood or steel.

- C. Hand hole: Oval-shaped, with minimum clear opening of two and one half (2-1/2) inches by five (5) inches, with cover secured by stainless-steel captive screws.

- D. Concrete Pole Foundations: By general contractor; Cast in place, with anchor bolts to match pole-base flange.

- E. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

2.6 STEEL POLES

- A. Poles: Comply with ASTM A 500, as specified by catalog number on the lighting fixture schedule with access handhole in pole wall.
 - 1. Shape: see schedule
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 - 1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with stainless steel bolts.
 - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
 - 3. Match pole material and finish.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Steps: Fixed steel, with nonslip treads, positioned for fifteen (15) inch vertical spacing, alternating on opposite sides of pole; first step at elevation ten (10) feet above finished grade.
- E. Grounding and Bonding Lugs: Welded one half (1/2) inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- F. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a five (5.0) safety factor.
- G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- H. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- I. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair

- paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 3. Exterior Surfaces: Manufacturer's standard finish consisting of one (1) or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected by Architect from manufacturer's full range.

2.7 ALUMINUM POLES

- A. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.
 1. Shape: Dual Round, straight .
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- C. Grounding and Bonding Lugs: Welded one half (1/2) inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- D. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, than bolted together with stainless-steel bolts.
 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 2. Finish: Same as luminaire.
- E. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - a. Color: As selected by Architect.

2.8 POLE ACCESSORIES

- A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: Sixty (60) inches
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: Ten (10) feet
 - 3. Trees: Fifteen (15) feet from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 2. Install base covers unless otherwise indicated.
 - 3. Use a short piece of one half (1/2) inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
 - 4. Orient hinged side of pole base facing the street.
- E. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top four (4) inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base.

Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top four (4) inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 03 Section "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

- A. Steel Conduits: Comply with Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 % overlap. Aluminum shall not be used.

3.6 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
 - 1. Install grounding electrode for each pole unless otherwise indicated.
 - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.7 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
 - 1. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
 - a. IESNA LM-64, "Photometric Measurements of Parking Areas."
 - b. IESNA LM-72, "Directional Positioning of Photometric Data."
- D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.

END OF SECTION 265600

SECTION 283111 – FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Agreement, including General Conditions and Division 1 Specification Sections, apply to this and other Sections of Division 16.

1.02 SUMMARY

- A. This section includes a complete fire alarm system.
- B. A fire alarm system at this building is being upgraded and expanded. The scope under this contract includes:
 - The removal of specific equipment.
 - The upgrade of the FACP.
 - The upgrade of certain devices.
 - The re-integration of existing to remain devices.
 - Additional equipment and devices.
- C. The work under this specification section is the responsibility of the Electrical contract including work indicated as by the fire alarm system installing contractor.
- D. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section “Wire and Conduit”.
 - 2. Section “Acceptance Testing”.

1.03 DEFINITION

- A. FACP: Fire Alarm Control Panel.
- B. FAA: Fire Alarm Annunciator.
- C. FAGA: Fire Alarm Graphic Annunciator.
- D. ADA: Americans with disabilities Act of 1990 and 2008.
- E. ICC/ANSI A117.1 2009

1.04 SYSTEM DESCRIPTION

- A. General: Hybrid conventionally zoned hard wired and Analogue addressable detection. All work under this contract shall be Non-coded, Analogue addressable, microprocessor-based fire-detection and alarm system with manual and automatic alarm initiation, analog addressable smoke detectors, and automatic alarm verification for alarms initiated by certain smoke detector zones

as indicated. System is also listed and compatible with automatic suppression agent release. Hardwired zones shall be included as spares.

The existing system is serviced, maintained and warranted by Red Hawk, Contact: John Cirocco (914)418-9420 johncirocco@adt.com. maintain all existing warranties for the system.

- B. Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.
- C. Alarm Indication: By actuation of audiovisual indicating appliances using strobes and tone generating speaker-horns.
- D. Visual Alarm Indication: By xenon-strobe-type units.
- E. System connections for alarm-initiating and alarm-indicating circuits. Class A wiring.
- F. The requirements of the Contract Documents, including the General and Supplementary General Condition and Division 1 - General Requirements shall apply to the work of this section.
- G. At the time of bid, all exceptions taken to these Specifications, all variances from these Specification and all substitutions of operating capabilities or equipment called for in these Specification shall be listed in writing and forwarded to the Engineer. Any such exception, variances or substitutions which were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment.
- H. The entire system shall be installed with aesthetics in mind. All control panels and remote annunciators installed shall be flush mounted with no exposed conduit or cable trays.

1.2 WORK INCLUDED

- A. The work covered by this Section of the Specification shall include all labor, equipment, materials and services to furnish and install a complete fire alarm system of the addressable, non-coded type. It shall be complete with all necessary hardware, software and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer. The system shall consist of, but not be limited to, the following:
 - 1. Fire Alarm Control Panel and related remote data gathering panels.
 - 2. Remote Annunciators with flush backbox.
 - 3. Addressable manual fire alarm stations.
 - 4. Addressable analog area smoke detectors.
 - 5. Addressable analog duct smoke detectors.
 - 6. Addressable analog heat detectors.
 - 7. Magnetic door\card access release override control.
 - 8. Audible notification appliances - horns.
 - 9. Visual notification appliances - strobes.

10. Central station alarm connection control.
11. Air handling systems shutdown control.
12. Magnetic door holder release.
13. Dry pipe sprinkler release valve/deluge valve control.
14. Pre-Action Sprinkler System.
15. Sprinkler supervisory switches and tamper switch supervision.
16. Battery standby.

1.3 APPLICABLE CODES AND STANDARDS

- A. All equipment shall be UL listed for its intended use and conform to the latest UL Standards.
- B. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:
 - UL 864/UOJZ, APOU Control Units for Fire Protective Signaling Systems.
 - UL 268 Smoke Detectors for Fire Protective Signaling Systems.
 - UL 268A Smoke Detectors for Duct Applications.
 - UL 217 Smoke Detectors Single Station.
 - UL 521 Heat Detectors for Fire Protective Signaling Systems.
 - UL 228 Door Holders for Fire Protective Signaling Systems.
 - UL 464 Audible Signaling Appliances.
 - UL 1638 Visual Signaling Appliances.
 - UL 38 Manually Activated Signaling Boxes.
 - UL 346 Waterflow Indicators for Fire Protective Signaling Systems.
 - UL 1971 Standard for Signaling Devices for the Hearing Impaired
 - UL 1481 Power Supplies for Fire Protective Signaling Systems.
 - UL 1711 Amplifiers for Fire Protective Signaling Systems.
 - UUKL The Fire Alarm system shall be UUKL for Smoke Control.
- C. This installation shall comply with:
 1. Americans with Disabilities Act (ADA)
 2. National Electric Code, Article 760.
 3. National Fire Protection Association Standards: NFPA72
 4. Local and State Building Codes and the Local Authorities Having Jurisdiction.
 5. International Standards Organization (ISO): ISO-9001

1.4 RELATED DOCUMENTS

- A. Secure permits and approvals prior to installation.
- B. Prior to commencement and after completion of work notify Authorities Having Jurisdiction.
- C. Submit letter of approval for installation before requesting acceptance of system.

1.5 RELATED WORK

- A. The Contractor shall coordinate work in this Section with all related trades. Work and/or equipment provided in other Sections and related to the fire alarm system shall include, but not be limited to:

1. Sprinkler waterflow and supervisory switches shall be furnished and installed by the fire protection contractor, but wired and connected by the electrical contractor. Modification of existing sprinkler devices to accommodate monitoring by the new fire alarm system shall be the responsibility of the fire alarm system installing contractor.
2. Duct smoke detectors shall be furnished, wired and connected by the electrical contractor. The HVAC contractor shall furnish necessary duct opening to install the duct smoke detectors.
3. New air handling and smoke exhaust system fan control circuits and status contacts to be furnished by the HVAC control equipment.
4. Elevator recall control circuits to be provided by the elevator control equipment. Modifications to the existing elevator controls to accommodate ANSI A17.1 shunt trip activation shall be provided by the elevator controls contractor. Any shunt trip circuit breakers and related wiring required for ANSI A17.1 compliance shall be provided by the electrical contractor (see power riser for more details).
5. Dry pipe/deluge sprinkler system release valve control circuits and supervision contacts shall be provided by the dry pipe/deluge sprinkler system control equipment.
5. Kitchen hood extinguishing systems status monitoring.
6. Emergency generator status monitoring
 - a. Running indication
 - b. Fail to start indication
7. Conduit: Section 16110.
8. Wire and Cables: Section 16120.
9. Installing dedicated outgoing RJ-31X telephone lines (2) shall be the responsibility of the Installing **Electrical Contractor**. Establishment and/or the reconnection to the existing central station monitoring account shall be the responsibility of the fire alarm equipment vendor.

1.6 SUBMITTALS

- A. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer's part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.
- B. Provide description of operation of the system (Sequence of Operation), similar to that provided in Part 2 of this Section of the Specifications, to include any and all exceptions, variances or substitutions listed at the time of bid. Any such exceptions, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. The sequence of operation shall be project specific, and shall provide individual sequences for every type of alarm, supervisory, or trouble condition which may occur as part of normal or off-normal system use.

- C. Provide manufacturer's ORIGINAL printed product data, catalog cuts and description of any special installation procedures. Photocopied and/or illegible product data sheets shall not be acceptable. All product datasheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.
- D. Provide manufacturer's installation instruction manual for specified system.
- E. Provide samples of various items when requested.
- F. Provide copy of state License to perform such work.
- G. Provide copies of NICET Level II Fire Alarm certifications for the two (2) technicians assigned to this project.
- H. Provide shop drawings as follows:
 - 1. Coversheet with project name, address and drawing index.
 - 2. General notes drawing with peripheral device backbox size information, part numbers, device mounting height information, and the names, addresses, point of contact, and telephone numbers of all contract project team members.
 - 3. Device riser diagram, which individually depicts all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed point descriptor above each addressable device. Shall include a specific, discrete point address that shall correspond to addresses depicted on the device layout floor plans. Drawing shall provide wire specifications, and wire tags shown on all conductors depicted on the riser diagram. All circuits shall have designations that shall correspond with those require on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.
 - 4. Control panel termination drawing(s). Shall depict internal component placement and all internal and field termination points. Drawing shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data gathering panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service and location of the control enclosure. End-of-line resistors (and values) shall be depicted.
 - 5. See section 3.4 DOCUMENTATION AND TRAINING for other documents relating to this section.
 - 6. Device typical wiring diagram drawing(s) shall be provided which depict all system components, and their respective field wiring termination points. Wire type, gauge, and jacket shall also be indicated. When an addressable module is used in multiple configurations for monitoring or controlling various types of equipment, different device typical diagrams shall be provided. End-of-line resistors (and values) shall be depicted.
 - 7. Device layout floor plans shall be created for every area served by the fire alarm system. CAD Files (AutoCAD – latest edition) shall be provided by the consulting engineer for the fire alarm system equipment vendor in the preparation of the floor plans. Floor plans shall indicate accurate locations for all control and peripheral devices. Drawings shall be NO LESS THAN 1/8-INCH SCALE. All addressable devices shall be depicted with a discrete address that corresponds with that indicated on the Riser Diagram. All notification appliances shall also be provided with a circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8" scale

- requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner. End-of-line resistors (and values) shall be depicted.
8. Contained in the title block of each drawing shall be symbol legends with device counts, wire tag legends, circuit schedules for all addressable and notification appliance circuits, the project name/address, and a drawing description which corresponds to that indicated in the drawing index on the coversheet drawing. A section of each drawing title block shall be reserved for revision numbers and notes. The initial submission shall be Revision 0, with Revision A, B, or C as project modifications require.
 - I. Battery calculations shall be provided on a per power supply/charger basis. These calculations shall clearly indicated the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements (which reflect a 20% DEGRADE, for 24 Hour supervisory, 5 minute alarm operation). Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws. Failure to provide these calculations shall be grounds for the complete rejection of the submittal package.
 - J. Table of contents, product data sheets, sequences of operation, battery calculations, installation instructions, licenses, NICET certifications and B-Size (blackline) reduced shop drawings shall be provided by the fire alarm vendor as part of a single, spiral bound submittal book. The submittal book shall have laminated covers indicating the project address, project number, system type, and contractor. The book shall consist of labeled dividers, and shall not exceed 9 ½" in width, and 11 ½" in height. No less than three (3) sets of submittal booklets shall be provided to the consulting engineer for review and comment. Additional copies may be required at no additional cost to the project.
 - K. Scale drawing sets shall be submitted along with the submittal booklets. These drawings may be either D-Size or E-Size Blue-line drawings and of a sufficient resolution to be completely read. Sets shall be bound and folded so as to not take up more than 100 square inches of space. No less than three (3) sets of scale drawing sets shall be provided to the consulting engineer for review and comment. Additional copies may be required at no additional cost to the project.
 - L. Submit color graphics of all computer based display pages for device annunciation and monitoring.
- 1.7 WARRANTY
- A. Maintain the existing warrantee(s) for the system. In addition all work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for an additional period of at least one (1) year from the date of acceptance or approval by AHJ. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

PART II - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/Vendor

- A. The catalog numbers used are those of Edwards EST-4. All new devices must be compatible with the existing system and maintain the existing warranties. The current system warrantee/vendor is Red Hawk Fire & Security in Hawthorne, NY. Contact John Cirocco (914-418-9420, johncirocco@adt.com)
- B. If equipment of another manufacturer is to be submitted for approval as equal, the contractor shall, at the time of bid, list all exceptions taken to these Specifications, all variances from these Specifications and all substitutions of operating capabilities or equipment called for in these Specifications and forward said list to the Engineer. Any such exceptions, variances or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination of compliance with these Specifications shall rest with the Engineer, who, at his discretion, may require proof of performance.
- C. Alternate product submissions made without proof of no less than three (3) factory authorized and certified manufacturer's distributors residing within 50 miles of the project job site shall be rejected. These distributors must not only provide installation support but must have a service organization capable of 24-hour emergency call service and **MUST HAVE BEEN CONTRACTED AND DELIVERED NO LESS THAN FIVE (5) ACCEPTED PROJECTS USING THE SUBMITTED PRODUCT OVER THE PAST YEAR.**
- D. Alternate product submissions based upon use of a product line considered proprietary in its distribution, design, application software, or ongoing maintenance and repair shall not be acceptable. Proof of a product's non-proprietary nature shall be the burden of the contractor at the time of Bid and shall be in the form of written documentation. The determination of a product's compliance to this requirement shall be exclusively that of the Consulting Engineer.
- F. All products used shall be of a single manufacturer. Submission of notification appliances, auxiliary relays, or documentation from other than a single manufacturer shall not be acceptable and will be grounds for immediate disapproval without comment.

2.2 CIRCUITING GUIDELINES

- A. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class B operation.
- B. Where it is necessary to interface conventional initiating devices provide intelligent input modules to supervise Class B zone wiring.
- C. Each of the following types of devices or equipment shall be provided with supervised circuits as shown on the drawings but shall be typically as follows:

1. Sprinkler Valve Supervisory Switches: Provide one (1) supervisory module circuit for each sprinkler valve supervisory switch.
 2. When waterflow and tamper switches exist at the same location, provide one (1) dual input addressable module. When odd numbers of devices exist at a single location, provide additional single input addressable modules.
- D. Each of the following types of alarm notification appliances shall be circuited as shown on the drawings but shall be typically as follows:
1. Audible Signals: Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.)
 2. Visual Signals Provide sufficient spare capacity to assure that the addition of three (3) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.)
- E. Each of the following types of remote equipment associated with the fire alarm system shall be provided with a form 'C' control relay contact as shown on the drawings, but shall be typically as follows:
1. HVAC Fan Systems: Provide one (1) shutdown control relay contact for each HVAC fan system.
 2. HVAC Supply Fans: Provide one (1) shutdown control relay contact for each HVAC supply fan.
 3. HVAC Return Fans: Provide one (1) shutdown control relay contact for each HVAC return fan.
- F. Provide a dedicated 24VDC circuit to feed all auxiliary relays required for inductive loads. Circuits shall be supervised via an end-of-line relay and addressable input module. Auxiliary relays shall not derive their power from the starter or load being controlled.
- G. Each control or data gathering panel shall have a dedicated 20Amp-120VAC feed. This feed shall come from an emergency or lighting circuit breaker panel, and shall have a locked circuit breaker. Earth grounds shall also terminate to the same circuit breaker panel from each respective control panel.

2.3 FIRE ALARM SYSTEM SEQUENCE OF OPERATION

- A. The system shall identify any off normal condition and log each condition into the system database as an event.
1. The system shall automatically display on the control panel Liquid Crystal Display the first event of the highest priority by type. The priorities and types shall be alarm, supervisory, trouble, and monitor.
 2. The system shall have a Queue operation, and shall not require event acknowledgment by the system operator. The system shall have a labeled color coded indicator for each type of

- event; alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.
3. For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42 character custom user description.
 4. The user shall be able to review each event by simply selecting scrolling keys (up-down) for each event type.
 5. New alarm, supervisory, or trouble events shall sound a silencing audible signal at the control panel.
- B. Operation of any alarm initiating device shall automatically:
1. Update the control/display as described above (A.1.)
 2. Sound all audible appliances in a Temporal-3 Pattern. ALL AUDIBLE APPLIANCES SHALL BE SYNCHRONIZED WITH EACH OTHER WHEN TWO OR MORE HORNS CAN BE HEARD. Audible devices shall have the ability to be silenced.
 3. Activate all strobe appliances throughout the facility. ALL STROBE APPLIANCES SHALL BE SYNCHRONIZED WITH EACH OTHER IN ANY LOCATION WITH TWO OR MORE DEVICES IN A COMMON FIELD OF VIEW. Visual devices shall be non-silenced unless the system is successfully reset.
 4. Operate control relay contacts to shutdown all HVAC units serving the floor of alarm initiation.
 5. Operate control relay contacts to return all elevators that serve the floor of alarm initiation to the ground floor. If the alarm originates from the ground floor, operate control circuits contacts to return all elevators to the floor above or to a level as directed by the local fire department.
 6. Operate control relay contacts to release all magnetically held smoke doors throughout the building.
 7. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.
 8. Transmit an alarm condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).
- C. Elevator smoke and heat detector sequences shall comply with the ANSI A17.1 requirements for main/alternate floor recalls, and shunt trip activations.
- D. Activation of a sprinkler supervisory initiating device shall:
1. Update the control/display as described above (A.1.)
 2. Transmit a supervisory condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).

3. Visually annunciate the individual point of alarm on all remote annunciator panels. The visual indication shall remain on until the alarm condition is reset to normal.
- E. The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm control panel. Any opens, grounds or disarrangement of system wiring and shorts across alarm signaling wiring shall automatically:
1. Update the control/display as described above (A.1.)
 2. Transmit a trouble condition, via the integral central station communicator, to central station/Local Fire Department (as required by the AHJ).
 3. Visually and audibly annunciate a general trouble condition, on the remote annunciator panels. The visual indication shall remain on until the trouble condition is repaired.
- F. Purge / Smoke Control

The panel shall be UUKL listed specifically for smoke control operation to allow the smoke purge control to be housed in the FACP cabinet (if approved by the Local Authority). The smoke control switches shall be located behind a locked glass door.

2.4 SUPPORT FOR INSTALLER AND OWNER MAINTENANCE

- A. Provide a coded one-man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.
- B. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.
- C. Provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.
- D. Allow the user to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the user with a measure of contamination of a device upon which cleaning decisions can confidently be made.
- E. Allow the user to report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.
- F. Allow the user to disable/enable devices, zones, actions, timers and sequences. Protect the disable function with a password.
- G. Allow the user to activate/restore outputs, actions, sequences, and simulate detector smoke levels.
- H. Allow the service user to enter time and date, reconfigure an external port for download programming, initiate auto programming and change passwords. Protect these functions with a password.

- I. THE END-USER SHALL RETAIN COMPLETE OWNERSHIP TO THE PROGRAMMING DATABASE RUNNING IN THE SYSTEM. The fire alarm equipment vendor shall provide useable hard and soft copies of the software database to the End-User at the end of the warranty period. The database provided shall be useable by any authorized and certified distributor of the product line, and shall include all applicable passwords necessary for total and unrestricted use and modification of the database. The Consulting Engineer shall define the extent of hardcopy database documentation to be provided.

2.5 UL LISTED AND APPROVED EQUIPMENT

- A. Fire Command Station/ Fire Alarm Control Panel Requirements: The fire alarm control panel or panels and all system devices including speaker-strobes or Horn Strobes, strobes, pull stations, smoke and heat detectors, etc. shall be Edwards's type EST4 series. All under one label "**UL listed and approved**" for the use of fire alarm systems in this area of the United States of America. The operating controls shall be located behind locked door with viewing window. All modules shall be labeled, and all zone locations shall be identified.
- B. Main Central Processor, model 4-CPU: The main controller 4-CPU shall be supervised, site programmable, and of modular design supporting up to 125 detectors and 125 remote modules per addressable Signaling line Circuit (SLC). The CPU shall support up to 10 SLC's per network node for a total system capacity of 2500 Intelligent Addressable points. The system shall be designed with peer-to-peer IPV6 networking capability for enhanced survivability, with support for up to 40 nodes, each with up to 2500 points and an overall capacity of 100,000 points. The system shall include 8 Giga bytes of onboard memory which is used to store all system functionality and job specific data. All site specific and operating data shall survive a complete power failure intact. Passwords shall protect any changes to system operations. The system shall include a hot backup file, containing the entire systems database programming, for use in the unlikely event that the systems programs becomes corrupt. The system shall support a single standalone node or multiple nodes communicating on a TCP/IP, IPV6 network that supports mesh configuration. The network shall support physical media connections via fiber, twisted pair or CAT 5 in any combination. The Network shall support data transmission of panel-to-panel data, voice audio and firefighter telephone data on a single twisted pair or single fiber optic cable. The Network shall be configured as Class A or Class B or Class X configuration per the project plans. Networks restricted to Class N wiring shall not be permitted. Network shall support a back-to-back pass-through mode that shall maintain network connectivity on power down or catastrophic failure of a single panel. The network shall support twisted pair links to 5,000 ft., CAT 5 links to 3,280 ft., and fiber links to 130,994 ft. The network shall support hard copy report printing to a system printer connected to any panel in the network, systems that require reports be run from the panel that has a printer connection shall not be considered equal. The systems LCD display shall provide color graphics display of maintenance and sensitivity reports. The system shall support multiple languages/dialects and Unicode character set. The Control panel and network shall not use easily removable devices, such as SD cards or external storage devices for storage of system critical information including programming and project files. Communications outside the life safety network shall meet the requirements of FIPS Publication 197. Security-relevant information, such as: failed login attempts, failed unauthorized accesses, and user modification shall be logged to panel history. Unsuccessful authentication attempts shall not leak information regarding the presence of the system or users. Credentials shall only be transmitted that are encrypted. The system shall provide for multiple users, roles shall be provided for users to ensure proper access by user for the role they perform on the system. All passwords shall use a cypher algorithm for security purposes to protect any sensitive information. No passwords shall be

visible as plain text within the database or entire system. Sensitive information shall not be logged to history or displayed on service tools (e.g. passwords, PINs etc.). The system shall support configuration of multiple IP connections to external services including, central stations, email servers, web interfaces, reports, and third party integration. Email messages shall support multiple languages in native characters that match the languages supported in the panel. Email messages shall support symbolic and color alarm event highlighting. The system shall support logging of up to 20,000 chronological events using FIFO. It shall be possible to freeze or store the most recent 10,000 events separately from the FIFO log. It shall be supported to download all applications and firmware from the configuration computer at a single location on the fire network. The system shall support upload of a project file from any location on the fire network.

- C. Main Graphic Touch Screen Display, model 4-LCDLE: The system shall provide a user interface that displays system events on a color touch screen display in a text format. The display must be capable of supporting a minimum of two languages including but not limited to English, Spanish, Portuguese or French. The display design shall be simplified for emergency users so that main common controls are provided as switches/buttons that provide positive feedback of operation, common control buttons shall not be part of the touch screen display area. The Common Control Switches and LEDs provided through tactile buttons with indicators shall be; Reset switch and LED, Alarm Silence switch and LED, Panel Silence switch and LED, Acknowledge switch and LED. In addition the following LEDs shall be provided as discrete indicators, Alarm Indicator, CPU Fail Indicator, Trouble Indicator and Power Indicator. It must be possible to add additional common controls as required through the use of modular display units. The user interface must provide a color touchscreen LCD display with minimum resolution of VGA 640 x 480. The display shall provide a minimum of seven events displayed concurrently and support >200,000 colors. Hands free operations shall be provided for viewing the first eight highest priority events. Events of different priorities shall be automatically placed in easy to access queues. It shall be possible to view specific event types separately. Having to scroll through a mixed list of event types is not acceptable. The total number of active events by type must be displayed. Visual indication must be provided of any event type which has not been acknowledged or viewed. It must be possible to customize the designation of all user interface LEDs and Switches for local language requirements. The color LCD display must support scripts & ideograph style font types. It shall be possible to have a custom message for each device in addition to zone messages. Custom device messages must support a minimum of 42 characters each.
- D. Control Display Module(s), model 4-24L Series: The Life Safety system shall support up to 576 tactile switches and 576 indicators incorporating annunciation of Alarm, Supervisory, Trouble and Monitor operations. Annunciation must be through the use of LED display strips, complete with a means to custom label each LED/Switch position as to its function. The labels must support the ability to allow visual custom grouping of LEDs and switches. Where applicable, control of remote smoke control devices must be made available at the control center. Switches with LEDs must provide positive feedback to the operator of remote equipment status. All individual indicator LEDs shall be configurable for color including Red, Yellow, Blue, Green or White to facilitate identification from a distance and maximize display location usage. Where voice audio is required, a means of paging individual zones must be available. The status of each paging zone must be annunciated. It must be possible to selectively page into specific zones. It shall be possible to manipulate the evacuation of the building from the main control center. It must be possible for the emergency operator to put specific zones into evacuation manually. When being serviced or when it is necessary to disable switches, the system shall not 'remember' if a disabled switch is pressed. Switches must be rubber to provide tactile feedback as well as a visual indication when a switch is activated.

- E. Common Relay Module, model 4-COMREL: The system shall support dedicated common alarm, trouble and supervisory relays.
- F. Network Controller, model 4-NET: The system shall support communicating on a TCP/IP, IPv6 network that supports multiple network topologies including any mix of ring, bus, star and mesh. The network shall support physical media connections via fiber, twisted pair or CAT5 in any combination. The Network shall support data transmission of panel-to-panel data, voice audio and firefighters' telephone data on a single twisted pair or single optical fiber. The Network shall be configured as Class A, Class B, or Class X (see project plans). Networks restricted to Class N wiring shall not be acceptable. Network shall support a back-to-back pass through mode that maintains network connectivity on power down for servicing or catastrophic failure of a single panel. For retrofit of existing installations the system shall support reuse of existing network wiring that meets the minimum wiring specification of the specified SFP controller, is electrically sound and is acceptable to the Authority Having Jurisdiction.
- G. Network Controller Adder, model 4-NET-AD: Network Adder, model 4-NET-AD: The panel network shall communicate on a TCP/IP based, multicast IPv6 network that supports mesh configuration. The network shall support physical media connections via fiber, twisted pair or CAT5 in any combination. The network shall support data transmission of panel-to-panel data, voice audio, and fire fighter telephone data on a single twisted pair or single fiber optic cable. The Network shall be configured as Class A or Class B or Class X configuration. Networks restricted to Class N wiring shall not be acceptable. The network shall support a back-to-back pass-through degraded- mode for any media type to any media type that shall maintain network connectivity on power down or catastrophic failure of a single panel. Communications outside the life safety network shall meet the requirements of FIPS publication 197. Security relevant information, such as failed login attempts, failed unauthorized accesses, and user modification shall be logged to panel history. Unsuccessful authentication attempts shall not leak information regarding the presence of the system or users. Credentials shall only be transmitted that are encrypted. The system shall provide for multiple users, roles shall be provided for users to ensure proper access by user for the role they perform on the system. All passwords shall use a Cypher Algorithm. Passwords must use a hash. No password or authentication shall be exposed in any format in the system database viewable as plain text. Sensitive information shall not be logged to history or displayed on service tools (e.g. passwords, PINs etc.).
- H. Ground Isolated USB Connections, model 4-USBHUB: The system shall provide USB connections for external peripheral devices including printers. Where a system printer is required the printer shall communicate to the system via USB, be supervised and support ground isolation. The event and status printer shall be a nine-pin, impact, dot matrix printer with a minimum print speed of 232 characters per second. Print parameters shall be set up with a menu drive program in the printer. The printer shall be capable of serial or USB communications protocol. The communications speed for RS-232 communications protocol shall be adjustable from 300 to 9600 Baud. The connection to the printer from the panel shall be supervised. The printer shall list the time, date, type and user defined message for each event printed. Alarm messages shall have a special character printed at the beginning of the message to allow easier location of alarm events on the print out. Where required, Audible notification appliances shall be coded using a microprocessor based Positive, Successive, Non Interfering (PSNI) coder module. The coder shall have a capacity for 1,000,000 unique codes and be capable of storing pending codes without a loss of an active code or interference from a new code. The coder shall output four rounds of two, three, or four digit code sequences. The coder shall provide both 1 KHz audio tone output as well as a dry relay contact output. The coder shall output a continuous, temporal, or 60/90 BPM March

time output as required at the end of the PSNI code sequence. In the event of a failure of the microprocessor, the coder shall automatically output a temporal code.

- I. Signaling Line Circuit (SLC) Controller Module, Model 3-SSDC1/3-SDDC1: Up to 125 detectors and 125 modules; 250 addressable devices in total, shall be supported over a single pair of wires by each Signaling Line Circuit (SLC) Controller circuit. Loop distances of 11,000 feet (3300m) shall be possible. Class B, Class A and Class X wiring shall be supported and selected based on the contract drawings. The SLC Controller Module shall use an advanced communication format that provide exceptional response using a "BROADCAST POLL" where the loop controller checks the entire device circuit for any changes of state. Should one or more devices report a change the SLC Controller shall use "DIRECT ADDRESS SEARCH" to find reporting device(s). Devices that have entered the alarm state or become active shall be located nearly instantaneously. The unique use of "BROADCAST POLLING" combined with "DIRECT ADDRESS SEARCH" ensures that only new information is transmitted allowing a reduced baud rate with fast response time. To enhance survivability of the system the SLC Controller shall support a standalone mode for Addressable devices. Two catastrophic failure modes are supported. If the main panel CPU fails, the loop controller will continue to poll its devices. If an alarm is detected it will be sent on the local rail communication bus and received by other local rail modules. A common alarm condition throughout the panel will result. If the SLC controller fails, and a device (smoke or module) detects an alarm, specialized circuitry will make the node aware of the alarm condition. The panel's main CPU will communicate the alarm condition to the rest of the network. Every time the SLC Controller Module communicates with a detector a green LED on the detector shall flash. Normal green LED activity is not disturbing to building occupants, but can be quickly spotted by a maintenance technician. A red LED on the detector turns on only in the alarm condition. The Controller shall also supervise the device wiring, physical location of each device and the programmed device characteristics. This characteristic is accomplished by "MAPPING" the SLC circuit and committing the map to memory. Upon power up the loop controller will scan device serial numbers and map their physical location sequence on the loop, including "T" taps. After mapping is complete the controller automatically addresses each detector and module through downloading over the loop. There shall be no switches or dials to set. Each device is assigned a unique soft address generated by the site specific program. The controller then compares the "Actual" physical device data to the "Expected" site specific program data. If any correlations are different, the loop controller issues a trouble to the CPU identifying the devices which do not match and posting a map fault. A graphical map of the loop can be uploaded depicting each device's location on the loop, including branches (T-Taps) and all of the physical attributes associated with the device. The SLC controller shall have the ability to locate ground faults by specific module, speeding up the troubleshooting process. The SLC controller shall include electronic addressing and mapping eliminating duplicate addresses, which are very difficult to locate. During maintenance, should groups of detector heads be removed for service and returned into the wrong smoke detector base (location), the SLC Controller Module will automatically detect the problem. If the attributes of the switched devices are the same, the system will automatically download the correct soft addresses and algorithms to the devices (maintaining location supervision). If the attributes are not the same the systems will send a map fault indication to the system's main CPU and post a trouble indicating the specific devices in fault. The SLC Loop controller shall also monitor the addressable devices for maintenance and trouble conditions. Each smoke detector contains intelligence to adjust with environmental changes. This expands the amount of time required between cleaning while maintaining a constant alarm threshold. As the detector begins to exhaust the environmental compensation, and reaches the 80% level, the controller shall indicate a maintenance alert or dirty condition to the system's main CPU and indicate the specific device requiring cleaning. If cleaning is not performed the detector will continue to operate until all of its environmental compensation is

utilized. At this point a dirty trouble indication shall be sent to the panels main CPU and post a trouble condition. If maintenance is still not performed the detector will automatically remove itself from service once the programmed threshold window has been breached (preventing a false alarm). When a detector includes carbon monoxide (CO) detection, the detector monitors its CO life remaining for the CO sensor element and provides this information automatically to the panel display. A unique CO maintenance signal is automatically generated by the panel when there is 8% (several months) of CO life remaining. Should the CO sensor not be replaced after the maintenance signal is reported, an "End of Life" trouble automatically posts on the panel when the CO sensor detection capability is exhausted. Remote test capability permits devices to be put in alarm, pre-alarm, supervisory, monitor, or security alarm, or trouble from the panel menu or controls. This facilitates testing of smoke and heat detectors as well as monitor and security devices. Fast test is also provided for CO detectors allowing these devices to be tested quickly in the field. The system shall have a UL Listed Detector Sensitivity test feature, which will be a function of the smoke detectors and performed automatically every 4 hours. The system shall support 100% of all remote devices in alarm and provide support for a 100% compliment of detector isolator bases. All panel modules shall be supervised for placement and return trouble if damaged or removed.

- J. Modular Digital Alarm Communicator Transmitter, model 3-MODCOM: The panel shall have an interface module for remote site monitoring. The control panel shall include built-in (part of the fire alarm control panel) Digital Alarm Communicator Transmitter (DACT)) module to transmit smoke, supervisory, waterflow, trouble, CO Alarm (if included), pump running, and pump trouble events to a Central monitoring Station (CMS) company. The DACT shall support dual telephones lines, Contact I.D. communications, and configured for dual tone multi-frequency (DTMF) or pulse modes. It shall be possible to delay AC power failure reports, auto test call, and be site programmable. The DACT shall be capable of transmitting every individual condition to the central station via Contact I.D. format. Selection of Contact I.D. format SHALL be of the discretion of the engineer and building owner but shall be an available option. Contractors who choose a separate dialer must meet all of the above options and are responsible for all necessary added connections such as power (with FCO/FDS), conduit, wire, addressable interface modules etc.
- K. Optional, IP with Cellular Interface Model DMP Model DUALCOMNF-L*: The DUALCOMNF-L*(LV for Verizon Cat M1 LTE or LA for AT&T Cat M1 LTE) is used in conjunction with the 3-MODCOM for applications where Plain Old Telephone (POTs) lines are not available or where Managed Facility Voice Network (MFVN) analog lines do not provide a stable interface. The DUALCOMNF shall capture the contact ID string from the 3-MODCOM and transmit the signal over IP to a UL-Listed central station. This connection captures Contact ID messages from the panel that are based on the SIA communication standard DC-05-1999.09-DCS. Messages are then formatted into a Serial 3 message and sent to an SCS-1R Receiver or SCS-VR Receiver. It shall include a red housing and be powered by regulated 24Vdc from the control panel. The Communicator shall be capable of supporting Network communication using existing Ethernet data networks, satellite communication, fiber optic networks, local area networks, wide area networks. The communicator shall also support LTE cellular communication using retail data networks. The communicator shall be configured as a dual path system with primary network communication, a single path system with network communication or a single path system with cellular communication based on local Authority Having Jurisdiction (AHJ) and NFPA 72.
- L. Network alphanumeric annunciators, Model 4-ANN Series: The Life Safety system shall incorporate annunciation of Alarm, Supervisory, Trouble and Monitor operations. Annunciation

must be through the use of both LED display strips complete with a means to custom label each LED as to its function. LED color shall be selectable at configuration time. Where applicable control switches must be provided. Switches with LEDs must provide positive feedback to the operator of remote equipment status. A color touchscreen LCD display with basic common control LEDs and switches shall be provided. Optionally a second color touchscreen display may be added to support audio and telephone operations. The Common Control Switches and LEDs provided as minimum will be: Reset switch and LED, Alarm Silence switch and LED, Panel Silence switch and LED, Drill switch and LED. It must be possible to add additional common controls as required through the use of modular display / control units. The LCD must provide the emergency user, hands free viewing of the first highest priority event. System events must automatically be placed in queues. It shall be possible to view specific event types separately. The total number of active events by type must be displayed. It must be possible to customize the designations of all user interface LEDs and switches for local language requirements. It must be possible to route system event messages to specific annunciator locations. It must be possible for the annunciator to contain a paging microphone and fire fighter telephone.

- M. Lobby Mount Cabinet Enclosure (4-CAB Series): The cabinets shall be 14 gauge rolled steel and available in various sizes based on the configuration and available in a Bronze or Red finish. Wallboxes have a black baked enamel finish. Lobby enclosure doors feature a modern contoured door design and integral viewing windows. They come with bronze or red baked enamel finishes. The door designs and colors ensure that there is a match to system annunciators and battery cabinets for a consistent look throughout the facility. Doors may be mounted as remote annunciators without the need to have large CAB enclosures behind. This allows larger equipment to be mounted remotely, minimizing wall penetrations in lobbies and public spaces, and removing the need to home-run all field wiring. The EST4 lobby enclosures backboxes, doors and chassis units are ordered and shipped separately for easy staging on project sites. With a variety of sizes available, customized installations offer the flexibility to support up to two color LCD touch screens, and LED and switch modules offering configurations of 576 5 color LED indicators, as well as 576 control switches along with microphone and firefighters' telephone options.
- N. Power Supplies: The power supply shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 45 minutes.
- O. Auxiliary power supplies shall be a high efficiency switch mode type with line monitoring to automatically switch to batteries for power failure or brown out conditions. The automatic battery charger shall have low battery discharge protection. The power supply shall provide internal power and 24 Vdc at 7.0A continuous for notification appliance circuits. The power supply shall be capable of providing 7A to output circuits for a maximum period of 100 ms. All outputs shall be power limited. The battery shall be sized to support the system for 24 hours of supervisory and trouble signal current plus general alarm for 45 minutes.
- P. Firefighters Smoke Control System – FSCS: The FSCS shall be utilized for control of both Smoke Control and Post Fire Smoke Purge. Smoke control shall include Atrium, Stair, and Elevator Shaft Smoke Control as well as zoned smoke control per the project plans. Post Fire Smoke Purge shall include post fire smoke evacuation and control. The FSCS shall be integral to the Fire Command Station or Fire Alarm Control Panel. It shall include switch/LED modules that

provide three position (on/off/auto and open/closed/auto) switches and 4 LED's (normal, on, off, fault or normal, open, closed, fault) per each smoke control system. The FSCS shall be UL864 and UUKL listed and designed per the Building Code Chapter 9. The FSCS shall include 3 position switches for each smoke control system. Each switch shall include On/Off/Auto positions for control of smoke control fan systems and Open/Closed/Auto positions for Smoke Control Dampers systems. The FSCS shall include the following indicators for each smoke control system as required per section 909 of the NYC Building Code: Fans, Dampers, or other operating equipment in their normal status – White Indicator. Fans, Dampers, or other operating equipment in their off or closed position – Red Indicator. Fans, Dampers, or other operating equipment in their on or open Status – Green Indicator. Fans, Dampers, or other operating equipment in Fault - Yellow Indicator. Smoke Control switch and LED modules shall include a printable portion next to each switch and LED set for a custom descriptor of each smoke control system. The printable portion shall include text and graphical icons indicating the function of the smoke control system. Verification All Dampers that are part of the smoke control system shall include verification per section 909 of the Building code and NFPA 92A. Verification shall mean end switches (true open and true closed) for each smoke control damper. All fans used for smoke control shall include verification per section 909 of the Building code and NFPA 92A. Verification shall mean duct pressure, airflow, or equivalent sensors. The white normal indicator shall give the FSCS operator a clear indication that the smoke control equipment is operating properly. Dampers that are not open or not closed (mid point) shall extinguish the white indicator. When a smoke control fan is indexed to start manually or from the fire alarm system all dampers shall open. When fan is indexed to stop, all dampers shall close unless indicated differently on the project plans. Fire detection systems providing control input or output signals to mechanical smoke control systems or elements thereof shall comply with the requirements of Chapter 9 and NFPA 72.

- Q. The FSCS shall include manual post fire smoke purge per the Building Code. Manual smoke purge shall be integral to the FSCS or located on Led/Switch modules directly adjacent to the smoke control controls and indicators. Controls for smoke purge shall only be available after activation of a built in FDNY/NYC approved 2642 key. A 2-position On/Off switch shall be included by floor or area for manual evacuation of smoke. Each 2-position switch shall include a green indicator that displays when the purge fan is on and a yellow trouble indicator. The Purge Fan shall be interlocked with the Purge Dampers and shall not start until there is confirmation that the damper is open (true open). A graphic diagram indicating the portions of the building served by each post fire smoke purge system shall be included.
- i. 1 - All Purge Dampers shall be monitored for open status (true status – i.e. sail switch with Fire Alarm Monitor Module). LEDs shall be provided in the FSCS for each purge damper to indicate that a Damper is open.
 - ii. 2. - All Fans will not be affected upon system reset. Restarting the fans may be accomplished by turning them back on in an individual sequential fashion or through individual manual switches at the FSCS controls to eliminate the possibility of all fans turning on simultaneously.
 - iii. Under normal circumstances, smoke exhaust fans, respective fire-smoke dampers, motorized dampers shall be closed unless noted otherwise on the project plans.

2.6 COMPONENTS

- A. Intelligent Detectors — General: The System Intelligent Detectors shall be UL268 7th edition (May 2020 UL requirements) approved meeting the new test fires created by UL to target reducing nuisance alarms. They shall be capable of full digital communications using both broadcast and polling protocol. Detectors shall be multi-criteria optical sensing with a full array of detection options including Smoke, Heat, and Carbon Monoxide (CO). Model variations shall be available including Smoke and Heat, Smoke and CO, fixed or fixed and rate of rise Heat, Heat and CO, as well as a three chamber multi criteria multi sensor with Smoke, Heat and CO. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Signal patterns that are not typical of fires shall be eliminated by digital filters. Devices not capable of combining different fire parameters or employing digital filters shall not be acceptable. Each intelligent device shall have a microprocessor with non-volatile memory to support its functionality and serviceability. Each device shall store as required its functionality for the following data: device serial number, device address, device type, personality code, date of manufacture, hours in use, time and date of last alarm, amount of environmental compensation left/used, last maintenance date, job/project number, current detector sensitivity values, diagnostic information (trouble codes) and algorithms required to process sensor data and perform communications with the loop controller. Each device shall be capable of electronic addressing, either automatically or application programmed assigned, to support physical/electrical mapping and supervision by location. Setting a device's address by physical means shall not be necessary. Each detector shall contain an integral microprocessor which shall determine if the device is normal, in alarm, or has an internal trouble. The microprocessor's non-volatile memory shall permanently store the detector's serial number, device type and system address. It shall be possible to address each intelligent device without the use of switches. Devices requiring switches for addressing shall not be considered as equal. Memory shall automatically be updated with the hours of operation, last maintenance date, number of alarms and troubles, time of last alarm, and analog signal patterns for each sensing element just before the last alarm. Each detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector. Each addressable detector on the Signaling Line Circuit (SLC) shall transmit information regarding its location with respect to other intelligent devices on the signaling line circuit to the control panel, creating an "As-Built" circuit map. The circuit mapping function shall provide location supervision of all intelligent devices on the signaling line circuit. An intelligent detector's programmed system response functions shall be associated with the detector's actual *location* on the signaling line circuit and *not with the detector's address*. After system commissioning, detectors improperly installed in the wrong location shall function according to the mapped programmed response for its *location* on the circuit, not its detector's address. A status indicator shall be provided on each detector. Flashing green shall indicate normal operation; flashing RED shall indicate the alarm state. The indicator shall be visible from any direction. The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced, without the need for reprogramming. System shall display an off-normal condition until the proper detector type is installed or a change in the device type profile has been made. The detector shall also store pre-alarm and alternate pre-alarm sensitivity settings. Pre alarm sensitivity values shall be configurable in 5% increments of the alarm and alternate alarm sensitivity settings respectively. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to

both 24-hour long term and 4-hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the “learned” base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour. The intelligent analog detectors shall be suitable for mounting on a variety of detector mounting bases; including, 3 ½ octagon or 4 inch square standard base, relay base, Isolator base, or Temporal 3 sounder base or Temporal 3 520 Hz sounder base. Intelligent Detectors shall clearly indicate from the outside of the device what type of sensor or sensors is within the device with letter description. An “O” designation shall indicate Optical Smoke, an “H” shall indicate a Heat detection device and a “C” shall indicate a Carbon Monoxide device. A combination of letters shall indicate an intelligent multi sensor detector.

- B. Multi Criteria Optical Smoke Detector, SIGA-OSD: Provide intelligent optical smoke detector, SIGA-OSD. The optical detector shall be an intelligent device that gathers analog information from multiple optical sensors converting the data into a digital signal. It shall use dual optical wavelengths combined with multiple detection angles to differentiate particles that are not representative of actual smoke. Particle data is input into digital filters which feed a series of ratios removing signal patterns. An integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGA-PRO Signature Program/Service Tool. The Optical detector shall be rated for ceiling installation at a minimum of 30 ft (9.1m) centers and be suitable for wall mount applications. The Optical smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 4,000 ft/min. (0-20.32 m/sec) without requiring specific duct detector housings or supply tubes. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from .5% to 4.36%. The Optical detector shall be suitable for operation in the following environment: Temperature: 32°F to 120°F (0°C to 49°C), Humidity: 0-93% RH, non-condensing, Elevation: no limit. Multi Criteria Optical Smoke detectors that have a fixed or limited life expectancy shall not be acceptable.
- C. Multi Sensor / Multi Criteria Optical Smoke Detector with built in Heat sensor or built-in Heat Sensor and Carbon Monoxide (CO) Sensor, SIGA-OSHD or SIGA-OSHCD: Provide intelligent optical smoke detector, SIGA-OSHD or SIGA-OSHCD. The Optical Smoke and heat multi sensor shall meet all of the above requirements for optical smoke detection and in addition include a low mass thermistor that shall act as fixed temperature 130 to 140 °F (54 to 60 °C) heat sensors and at a temperature rate-of-rise alarm point of 15°F per minute. The smoke/heat/CO sensor shall in addition include a Carbon Monoxide sensor. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from .5% to 4.36%. The Optical detector shall be suitable for operation in the following environment: Temperature: 32°F to 100°F (0°C to 38°C), Humidity: 0-93% RH, non-condensing, Elevation: no limit. Smoke and heat conditions shall be fully separated by the control panel and include the ability to program each sensor independently or combined. The smoke, heat and CO sensors shall have the ability to separate alarms (heat/smoke combined) and CO signals. Separated signals shall be fully programmable by the control panel.

- D. Fixed Temperature/Rate of Rise Heat Detector and Combination Heat and CO Detector, models SIGA-HRD and SIGA-HCD: Provide intelligent combination fixed temperature/rate-of-rise heat detectors SIGA-HRD. The heat detector shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall include a low mass thermistor that shall act as fixed temperature 130 to 140 °F (54 to 60 °C) heat sensors and at a temperature rate-of-rise alarm point of 15°F per minute. The heat detector shall be rated for ceiling installation at a minimum of 50 ft (15.24m) centers and be suitable for wall mount applications. Where shown on the project plans, include SIGA-HCD combination Heat and Carbon Monoxide (CO) detector. The combination Heat and CO device shall report separately to the control panel where a heat detection condition is considered a fire alarm and a CO condition is a supervisory alarm with separate and unique evacuation sequence.
- E. Sleeping Room Optical Smoke and CO Detection: Provide combination intelligent addressable Optical smoke and Carbon Monoxide (CO) detectors Edwards model SIGA-OSCD with 82 dB (per UL464) audible base SIGA-AB4GT-LF for installation inside each sleeping room and as indicated on the project plans. The "sleeping room" smoke and CO detection devices shall be fully addressable with a built in sounder. The detector shall be arranged so that a fire alarm condition shall sound the internal horn at a Low Frequency 520 Hz Temporal 3 pattern and a Carbon monoxide condition shall sound the internal horn at a Temporal 4 pattern per NFPA 720. All sounders within the dwelling shall sound together in tandem at the same temporal rate. The fire alarm control panel shall be UL-Listed UL2017 for general purpose signaling. The CO detector shall also be UL2075 listed and provide the control panel with an "end of life" signal for the CO element. The Optical detector shall utilize a light scattering type optical smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. Systems using central intelligence for alarm decisions shall not be acceptable. A smoke alarm or CO alarm from the sleeping room detector shall not cause automatic building evacuation; rather indicate the alarm condition at the main fire alarm panel and at designated remote displays. The CO detector shall report as a separate signal to the fire alarm control panel and be treated as a Supervisory signal. Rooms that include more than one detector (i.e. a single living space with two or more smoke/co detectors) shall be arranged so that all detectors within the space shall activate their built-in sounder bases in a common alarm fashion (if one detector alarms, the sounders from all detectors shall sound in the space) at the appropriate Temporal rate (Temporal 3 or Temporal 4). The detector shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGA-HDT Signature Program/Service Tool. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from .5% to 4.36%. Sleeping rooms designated handicapped accessible, shall include a wall mounted strobe light meeting ADA code that is activated by the building alarm AND by the in-room addressable smoke detector. The fire alarm vendor shall provide control module(s) arranged so that rooms addressable smoke detectors can activate the strobe in the associated guest room independent of building strobe devices.
- F. Addressable Carbon Monoxide (CO) Detector, model SIGA-COD with sounder base. Provide intelligent addressable Carbon Monoxide Alarms as required the building code. The CO activation shall be programmable type as follows: Alarm, Supervisory Latching, Supervisory

Non-Latching, Monitor Latching, or Monitory Non-Latching. The electro-chemical CO sensor shall generate a CO alarm in compliance with UL-2034 requirements. The sensor shall have a nominal six but control panel dependent up to ten-year life. When the sensor approaches the end of its useful life, it shall transmit a maintenance condition to the control panel, indicating the CO sensor board replacement is required. Only when the sensor is no longer operational shall a trouble condition be sent to the control panel. Sensors that transmit a common trouble indication for both sensor end-of-life and other causes of detector trouble shall not be considered as equal. Performing a "sensitivity" check from the panel shall report the approximate number months of CO sensor life remaining.

- G. Standard Detector Mounting Bases, SIGA-SB / SIGA-SB4: Provide standard detector mounting bases SIGA-SB suitable for mounting on North American 1-gang, 3½" or 4" octagon box and 4" square box. The base shall, contain no electronics, support all Signature Series detector types and have the following minimum requirements: Removal of the respective detector shall not affect communications with other detectors, Terminal connections shall be made on the room side of the base, bases that must be removed to gain access to the terminals shall not be acceptable. The base shall be capable of supporting one (1) Signature Series SIGA-LED Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.
- H. Audible Detector Mounting Base, SIGA-AB4GT. Where shown on the project plans include detector audible/sounder base model SIGA-AB4GT. The sounder base shall be capable of two tones, Temporal 3 for a fire condition and Temporal 4 for a Carbon monoxide condition. The tones shall be fully programmable and also synchronize the sound with other sounder bases. The system shall be UL2017 listed for dual signaling for this purpose.
- I. Low Frequency Audible Detector Mounting Base, SIGA-AB4G-LF. Provide low frequency 520hz audible detector mounting bases suitable for mounting on 4" square x 2-1/8" (54 mm) deep box. The audible base shall produce tone sound within the frequency range of 520 Hz ±10% square wave tone. The operation of the audible base shall be controlled by its respective detector processor or under program control as required by the application. The base shall support all Signature Series detector types and be capable of single or group operation. The audible base shall emit a temporal 3 alarm tone and/or temporal 4 tone. The audible bases shall be UL268 and UL464 Listed as a system, and nominal sound level shall be 87dBA in anechoic chamber and 80 dBA in reverberant room, listed. All low frequency sounder bases audible temporal 3 tones shall be synchronized throughout the facility.
- J. Duct Detector Housing, SIGA-SD: Provide model SIGA-SD Low profile intelligent addressable DUCT smoke detector as indicated on the project plans. Provide for variations in duct air velocity between 100 and 4,000 feet per minute and include a wide sensitivity range of .79 to 2.46%/ft. Obscuration. Include one Form-C shut down relay rated 2.0 amps @ 30 Vdc and also include slave high contact relays if required. Provide an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten feet. The addressable DUCT housing shall be suitable for extreme environments, including a temperature range of -20 to 158 degrees F (-29 to 70 degrees Celsius) and offer a harsh environment gasket option. Provide Remote Alarm LED Indicators SIGA-LED and/or remote test station model SD-TRK as indicated on the project plans.
- K. Intelligent Modules — General: It shall be possible to address each Intelligent Signature Series module without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2

diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:

Temperature: 32°F to 120°F (0°C to 49°C), Humidity: 0-93% RH, non-condensing.

- L. Single Input Module, SIGA-CT1 (Waterflow Detectors, Tamper Switches etc.): Provide intelligent single input modules SIGA-CT1. The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The single input module shall support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).
- M. Dual Input Module, SIGA-CT2: Provide intelligent dual input modules SIGA-CT2. The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The module shall be suitable for mounting on North American 2 ½" deep 1-gang boxes and 1 ½" (38mm) deep 4" square boxes with 1-gang covers. The dual input module shall support the following circuit types: Normally-Open Alarm Latching (Manual Stations, Heat Detectors, etc.), Normally-Open Alarm Delayed Latching (Waterflow Switches), Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.), Normally-Open Active Latching (Supervisory, Tamper Switches).
- N. Single Input Signal Module, SIGA-CC1: Provide intelligent single input signal modules SIGA-CC1. The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The module shall be suitable for mounting on North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes. The single input signal module shall support the following operations: Audible/Visible Signal Power Selector (Polarized 24 Vdc @ 2A).
- O. Control Relay Module, SIGA-CR: Provide intelligent control relay modules SIGA-CR. The Control Relay Module shall provide one form "R" dry relay contact rated at 2 amps @ 24 Vdc to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware. The control relay module shall be suitable for mounting on North American 2 ½" (64mm) deep 1-gang boxes and 1 ½" deep 4" square boxes with 1-gang covers.
- P. Intelligent Manual Pull Stations — General: It shall be possible to address each Signature Series fire alarm pull station without the use of DIP or rotary switches. Devices using DIP switches for addressing shall not be acceptable. The manual stations shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The station shall be capable of storing up to 24 diagnostic codes that can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The fire alarm pull station shall be suitable for operation in the following

environment: Temperature: 32°F to 120°F (0°C to 49°C), Humidity: 0-93% RH, non-condensing.

- Q. Manual Pull Station, SIGA-270: Provide intelligent single action, single stage fire alarm stations SIGA-270. The fire alarm station shall be of metal construction with an internal toggle switch. Provide a locked test feature. Finish the station in red with silver “PULL IN CASE OF FIRE” English lettering. The manual station shall be suitable for mounting on North American 2 ½” (64mm) deep 1-gang boxes and 1 ½” (38mm) deep 4” square boxes with 1-gang covers.
- R. Notification Appliances – General: All appliances shall be UL Listed for Fire Protective Service. All strobe appliances or combination appliances with strobes shall be UL 1971 and ULC S526 Listed. All appliances shall be of the same manufacturer as the Fire Alarm Control Panel (**NO EXCEPTIONS**) specified to insure absolute compatibility between the appliances and the control panels, and to insure that the application of the appliances are done in accordance with the single manufacturers’ instructions. Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from **THE CONTROL PANEL MANUFACTURER** clearly stating that the control equipment (as submitted) is 100% compatible with the submitted Notification Appliances.
- S. Strobes, Edwards Genesis “LED” Type: Provide Edwards G1VRF (Red) or G1VWF (White) low profile wall mounted LED strobes at the locations shown on the drawings. For 110 candela applications, provide G4VRF (Red) or G4VWF (White) as indicated on the project plans. Strobes shall provide synchronized flash outputs and shall be field selectable as indicated on the drawings in one of the following intensity levels; 15 candela, 30 candela, 75 candela, or 110 candela (use model G4V for 110 candela). Low profile strobes shall mount in a North American 1-gang box or 4 inch electrical box or optionally surface mounted on a matching back box provided by the manufacturer, as directed in the field.
- T. Temporal Horn Strobes, Edwards Genesis “LED” Type Strobe with Horn: Provide Edwards G1AVRF (Red) or G1AVWF (White) low profile wall mounted LED strobes at the locations shown on the drawings. For 110 candela applications, provide G4AVRF (Red) or G4AVWF (White) as indicated on the project plans. The horn/strobe shall provide an audible output of 86 dBA at 10 ft at the high setting and for smaller room size locations (as indicated on the plans) a low dB setting (field selectable) of 80 dB at 10 ft. when measured in reverberation room per UL-464. Strobes shall provide synchronized flash outputs. Strobes shall provide synchronized flash outputs and shall be field selectable as indicated on the drawings in one of the following intensity levels; 15 candela, 30 candela, 75 candela, or 110 candela (use model G4V for 110 candela). The horn shall have a selectable steady or synchronized temporal output. Low profile strobes shall mount in a North American 1-gang box or 4 inch electrical box or optionally surface mounted on a matching back box provided by the manufacturer, as directed in the field.
- U. Temporal Horn, Edwards Genesis G1ARF: Provide Edwards Series G1ARF low profile wall mount horn at the locations shown on the drawings. The horn shall provide an audible output of 88 dBA at 10 ft at the high setting and for smaller room size locations (as indicated on the plans) a low dB setting (field selectable) of 80 dB at 10 ft. when measured in reverberation room per UL-464. The horn shall have a selectable steady or synchronized temporal output. Low profile horn shall mount in a North American 1-gang box or surface mounted on a matching back box provided by the manufacturer, as directed in the field.
- V. Multi-Voltage Control Relays, MR-200 Series: Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings

shall be DPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 Vdc, 24 Vac, 115 Vac, or 230 Vac. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

- W. Electromagnetic Doorholders – General: Electromagnetic doorholders submitted for use must have written proof of their compatibility for the purposes intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purposes intended.
- X. Wall Mounted, 1504/1505/1508/1509 Series: Provide flush, semi-flush or surface wall mounted electromagnetic doorholder/releases rated at 24 Vac/dc as directed by the Consulting Engineer. Finish shall be brushed zinc.
- Y. STI Stopper II Lexan Guards: Manual pull stations that are provided with STI Stopper II lexan guards shall include non-audible alarms as required on the plans. They shall be surface or flush mounting, as required for each individual device.
- Z. Projected Beam Detector – Edwards EC-5000R. The projected beam type smoke detector shall be a 4-wire 12/24 Vdc device monitored by the Fire Alarm control panel through a two circuit SIGA-CT2 monitor module (one zone for alarm and one for trouble). The projected beam type smoke detector shall be listed to UL 268 listed and shall consist of up to two integrated transmitters, receiver detector heads and single low level remote control unit. The detector shall operate between a range of 26.25 ft. to 330 ft. (8m to 100m). The temperature range of the system shall be -4°F to 131°F. The beam detector heads shall include an integral built-in laser pointer to assist prism mounting. The beam detector shall feature automatic gain control which will compensate for gradual signal deterioration from dirt accumulation on the lenses. The beams detector heads shall include AutoOptimise self-correcting motorized head feature to ensure unit is always receiving maximum signal available, and shall automatically compensate for building shift. The unit shall include a low level remote display and control unit with LCD read-out for set-up, reporting and testing of up to two separate detector heads. The system shall be capable of programming alarm thresholds of 10% to 60% in 1% increments. The system shall be capable of programming delay to fault and delay to alarm from 2 seconds to 30 seconds in 1 second increments. Test and acceptance of the system shall be carried out by using the UL approved internal electronic obscuration fire test. The contractor shall provide model 5000-004 prism kit for installations with the transmission distance greater than 165 ft. All beam detectors shall include a prism mounting plate (5000-007 or 5000-008) and a model 3000-201 360/180 degree adjustment bracket.

PART III - EXECUTION

INSTALLATION

- A. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer's wiring diagram. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the manufacturer, approved by the local Fire Department and specified with in.
- B. All penetration of floor slabs and firewalls shall be sleeved (1" conduit minimum) fire stopped in accordance with all local fire codes.

- C. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled so removal of the device is not required to identify the EOL device.
- D. All manual pull stations shall be mounted 48 inches above the finished floor, as measured to the handle.
- E. All audio/visual devices shall be mounted 80 inches above the finished floor, as measured to the lens. Devices shall be mounted no less than 6 inches from the ceiling. All audiovisual devices shall have lexan covers in all areas.
- F. No area smoke detectors shall be mounted within 36 inches of any HVAC supply, return air register or lighting fixture.
- G. No area smoke or heat detector shall be mounted within 12 inches of any wall. All detectors shall be installed in strict accordance with NFPA 72 (1999) guidelines for such devices.
- H. All mechanical rooms, boiler rooms, gymnasiums, wiring closets, custodian rooms, attic spaces, etc. or areas with no hung ceilings shall be piped with 3/4" conduit. All device plenum rated wiring shall be mechanically protected with conduit.

All areas in public view shall be in metal V-700 wiremold (or equal). All boxes must be painted red and labeled "FIRE ALARM".
- I. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.
- J. New door holders shall derive their 24VAC/VDC power from a separate power supply housed in a dedicated, metal enclosure. The power supply shall have a 120VAC feed, and is to be centrally located to serve door holders on a per floor or area basis. All existing door holders shall be connected to new FACP. E.C. shall extend all existing wiring in order to make this work. Locations and quantities of door holder power supplies shall be referenced and submitted in the submission package for approval by the Consulting Engineer.
- K. All low voltage wiring terminated to the fire alarm system shall be PLENUM RATED with no exceptions and no less than No. 18 AWG in size, and solid copper.
- L. All line voltage (120VAC) wiring shall be no less than No. 12 AWG in size, and solid copper. This shall include all system grounding. FACP must have a DEDICATED 20 Amp circuit marked back at the power panel NO EXCEPTIONS.
- M. All wiring shall be color-coded throughout, to National Electrical Code standards.
- N. Power-limited/Non-power-limited NEC wiring standards SHALL BE OBSERVED.
- O. All junction box covers shall be painted federal safety red and labeled FIRE ALARM SYSTEM ONLY in black letters.
- P. Fire alarm system wiring shall not co-mingle with any other system wiring in the facility. Conduits shall not be shared under any circumstance. Only when fire alarm wiring enters the enclosure of a monitored or controlled system will co-habitation be permitted (i.e. at fan starters or elevator controllers). THIS WILL BE FIELD INSPECTED BY THE PROJECT ENGINEER.
- Q. Fire alarm control panel enclosures shall have engraved labels indicating, "FIRE ALARM SYSTEM", and the areas of the building served by that panel.

- R. Auxiliary relays shall be appropriately labeled to indicate "FIRE ALARM SYSTEM" and their specific function (i.e. FAN S-1 SHUTDOWN).
- S. All fire alarm wiring shall be continuous and unspliced. Terminations shall only occur at fire alarm devices or control panel enclosures under terminal screws. All other splicing methods are specifically disallowed (i.e. plastic wirenuts).
- T. All fire alarm wiring shall be installed using a dedicated system of supports (i.e. bridle rings). Fire alarm wiring shall not be bundled or strapped to existing conduit, pipe or wire in the facility. THIS WILL BE FIELD INSPECTED BY THE PROJECT ENGINEER
- U. All fire alarm wiring shall be sleeved when passing through any wall, using conduit sleeves (1" min.) with bushings, and fire stopped in accordance with Code.
- V. The system shall be arranged to receive power from one three wire 120 Vac, 20 A supply. All low voltage operation shall be provided from the fire alarm control panel.
- W. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the Contract Drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer. Failure to bring such issues to the attention of the Project Engineer shall be the exclusive liability of the installing Electrical Contractor.
- X. The existing fire alarm system shall remain in operation until such time that approval has been granted for its removal. The installing Electrical Contractor shall be responsible for the upkeep of the existing system until such time that it can be removed.
- Y. The installing Electrical Contractor shall be responsible for the removal of ENTIRE existing fire alarm system components and controls on the demolition drawing shown or not, upon approval of the AHJ and the Consulting Engineer. The End-User reserves the right to retain any existing fire alarm system components, upon their request. All existing fire alarm system components requiring special handling for disposal (due to radioactivity) shall be the responsibility of the installing contractor. Written proof of proper disposal by the installing contractor shall be required prior to release of outstanding retainage.

3.2 FIELD QUALITY CONTROL

- A. The system shall be installed and fully tested under the supervision of a trained manufacturer's representative. The system shall be demonstrated to perform all of the function as specified.
- B. The installing contractor or fire alarm equipment vendor shall have no less than two (2) NICET Level II fire alarm technicians dedicated to this project.
- C. The Installing Contract and the Fire Alarm System Vendor shall, upon the request of the Consulting Engineer or End-User, attend any and all project meetings for the purpose of accurately determining progress.
- D. It shall be the responsibility of the installing contractor to assure that construction debris does not adversely affect any sensing devices installed as part of this project. Should it be deemed necessary by the Consulting Engineer, End-User or AHJ, the installing contractor shall be responsible for the cleaning of all smoke detectors prior to final acceptance.

3.3 TESTS

- A. The fire alarm system vendor shall test the system in accordance with the manufacturer's requirements and NFPA 72. The vendor shall provide completed NFPA 72 reports to the Consulting Engineer for review and approval prior to final acceptance.
- B. Each individual system operation on a circuit by circuit basis shall be tested for its complete operation. The procedure for testing the entire fire alarm system shall be set forth with the consent of the code enforcement official, the Engineer and the manufacturer.

3.4 DOCUMENTATION AND TRAINING

- A. The contractor shall compile and provide to the owners three (3) complete manual on the completed system to include SITE SPECIFIC operating and maintenance instruction, catalog cuts of all equipment and components, as-built wiring diagrams and a manufacturer's suggested spare parts list. An operational Video, on DVD media, shall also be included.
- B. In addition to the above manuals, the Electrical Contractor shall provide the services of the manufacturer's trained representative for **two (2)** separate calendar days for a period of four **(4) hours** per day to instruct the owners' designated personnel on the operation and maintenance of the entire system.
- C. As-built drawings shall consist of the following:
 - 1. Complete revision of all previously submitted drawings
 - 2. Point-to-point depiction of all device wiring on the device layout floor plans.
 - 3. One (1) set of B-size, laminated as-built drawings.
 - 4. Two (2) sets of 30"x42"inch 1/16"=1' scale drawings showing all points of fire alarm. One set shall be submitted with the close-out documents. Second set shall be mounted in frame with a lexan cover. These drawing must be submitted to project Engineer or approval.
- D. Turnover of all software database hard/soft copies shall be required. This shall include all possible programming software logs, diskettes or CDs containing exported project files, hard copies of all device maps, the revision number of the version of programming utility used, and all required passwords. The turnover of all database information shall occur prior to the end of the One (1) warranty period (or period as amended earlier in this specification).

END OF SECTION

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
1. Protecting existing trees and vegetation to remain.
 2. Removing trees and other vegetation.
 3. Protection of existing utilities to remain.
 4. Protection of existing structures to remain.
 5. Temporary construction fencing and site protection.
 6. Recording site pre-construction condition.
 7. Clearing and grubbing.
 8. Topsoil stripping.
 9. Demolition and removal of all above-grade site improvements in conflict with the proposed construction and as indicated on the plans.
 10. Disconnecting, capping or sealing, and abandoning site utilities in place.
 11. Disconnecting, capping or sealing, and removing site utilities.
 12. Sealing and abandoning underground structures.
 13. Relocating existing salvable improvements identified on the plans.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

- | | | |
|----|------------------------------------|-----------------|
| A. | Existing Conditions | Section 021000. |
| B. | Earth Moving: | Section 312000. |
| C. | Soil Erosion and Sediment Control: | Section 312500. |

1.4 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.5 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.6 SUBMITTALS

- A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Record drawings according to Division 01 Section "Contract Closeout."
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.
 - 2. Identify and record all existing pavement striping, pavement markings, and curb markings. This information shall be utilized to install new striping in areas of repair and/or resurfacing.
- C. At least 3-days before starting placement of flowable fill, the Contractor shall submit a mix-design for the flowable fill to the Owner's Representative.

1.7 QUALITY ASSURANCE

- A. Tree Pruning Standards: Comply with ANSI A300, "Trees, Shrubs, and Other Woody Plant Maintenance--Standard Practices," unless requirements that are more stringent are indicated.

1.8 PROJECT CONDITIONS

- A. All improvements shall be constructed on Owner's property.
- B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on owner's premises and relocated as directed by the owner's representative.
- C. Notify utility locator service for area where Project is located before site clearing.
- D. The Contractor shall provide all necessary safeguards including the installation of shoring, structural supports, protective fencing, and barriers, etc. as required to prevent injury to

workmen, bystanders, and adjacent property. All work shall be completed in accordance with local building codes, rules and regulations of other governing bodies having jurisdiction over the project. The Owner, the Owner's Representative, the Architect, or the Engineer shall not be responsible for job site safety. Job and site safety shall be the sole responsibility of the Contractor.

- E. The Contractor, at his own expense, shall repair or replace all ground surfaces, pavements, sidewalks, curbs, landscaping, etc. which are to remain and which may become damaged during the completion of the Work. All repairs shall meet the approval of the Engineer.

PART 2 - PRODUCTS

2.1 SOIL

- A. Satisfactory Soil: Requirements for satisfactory soil are specified in Division 31 Section "Earth Moving."
 - 1. Obtain approved borrow soil off-site only when satisfactory soil is not available on-site.

2.2 CHAIN LINK FENCE

- A. Previous temporary chain link fencing system as specified elsewhere in Division 01.
- B. If not specified under Division 01, provide temporary chain link fencing system of metallic-coated steel chain link fence fabric, 0.120-inch diameter wire size; 72-inches high, minimum; line posts, 1 $\frac{3}{8}$ -inches in diameter; terminal and corner posts, 1 $\frac{3}{8}$ -inches in diameter; top rail, 1 $\frac{3}{8}$ inches in diameter; bottom tension wire, 0.177-inch in diameter; with tie wires, hog ring ties, and other accessories for a complete fence system. Fence shall be founded by concrete block or sand bag ballast. The fence shall be stable, upright, continuous, and resist overturning.
- C. Provide access gates as directed by Owner's Representative.

2.3 CONCRETE FLOWABLE FILL

- A. Flowable fill shall consist of a mixture of Portland cement, fly ash, mineral filler, water and admixtures proportioned to provide a non-segregating, free-flowing, self-consolidating material that will result in a hardened, dense backfill. The Contractor shall prepare a mix design as specified herein to determine the proportion of materials necessary to meet the Specification requirements.
- B. Mix Design:
 - 1. The flowable fill shall be proportioned to be non-segregating, free-flowing, self-consolidating, low-shrinkage slurry with a minimum unconfined compressive strength of 100 psi at 28 days, as determined in accordance with ASTM D 4832.

2. The flowable fill shall have a minimum unit weight of 70 pcf.
3. The mix design shall include, but not be limited to, the following information:
 - a. Certification of compliance of the design mix relative to the mix design requirements of this Specification.
 - b. Certification of compliance of the component materials used in the mix design relative to this Specification and referenced Specifications.
 - c. Representative gradations for aggregate from the designated aggregate source and proposed gradation limits for aggregates to be used in the flowable fill.
 - d. Plastic characteristics of the design mix including temperature, slump, air entrainment, wet unit weight, yield and cement factor.
 - e. Performance characteristics of the hardened flowable fill to include compressive strength of all specimens and the corresponding average compressive strength. Compressive strength test results shall be reported for ages of one (1) day, seven (7) days, and twenty-eight (28) days.
 - f. Unit weight of all compressive strength specimens at the time of testing and the corresponding average unit weight.
 - g. The moisture density relationship for the combined cement, fly ash, mineral filler (if used), as determined in accordance with ASTM D558.
4. No flowable backfill shall be placed until the mix design has been reviewed and accepted by the Owner's Representative. The Owner's Representative's acceptance of the mix design shall be understood to indicate conditional acceptance. Final acceptance will be based on conformance with these Specifications and satisfactory test results on field samples during placement as required by these Specifications or as required by the Owner's Representative.

C. Reference Standards:

- | | | | |
|----|------------------|----------------|----------------|
| 1. | Portland Cement: | NYSDOT Section | 701-01, Type 5 |
| 2. | Fly Ash: | NYSDOT Section | 711-10 |
| 3. | Water: | NYSDOT Section | 712-01 |
| 4. | Mineral Filler: | NYSDOT Section | 703-08 |
| 5. | Admixtures: | NYSDOT Section | 711-08 |
| 6. | Concrete Brick: | NYSDOT Section | 704-02 |

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties, roadways and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.

- D. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to the Owner's Representative.

3.2 TREE PROTECTION

- A. Tree protection shall be in accordance with Section 312500 of this specification.

3.3 UTILITIES

- A. The Contractor shall protect and/or support all existing utilities and/or piping during excavation operations that expose same.
- B. Contractor will arrange for disconnecting and sealing indicated utilities and/or piping that serve existing structures before site clearing.
 - 1. Verify that utilities and/or piping have been disconnected and capped before proceeding with site clearing.
- C. Locate, identify, disconnect, and seal or cap off utilities and/or piping indicated to be removed.
 - 1. Contractor will arrange to shut off indicated utilities and/or piping with utility companies.
- D. Existing Utilities: Do not interrupt utilities and/or piping serving facilities occupied by the owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility and/or piping services according to requirements indicated:
 - 1. Notify the Owner's Representative, Utility company with jurisdiction, and affected customers of Utility not less than three days in advance of proposed utility and/or piping interruptions.
 - 2. Do not proceed with utility and/or piping interruptions without the owner's written permission.
- E. The Contractor, at his own expense, shall perform test pits at all proposed utility and sewer crossings with existing facilities to verify the location and depth of those existing utilities shown on the plans. This work shall be performed prior to the Contractor beginning work on any proposed construction. Any discrepancies or perceived conflicts shall be reported to the Owner's Representative immediately prior to proceeding with construction.
- F. The Contractor is required to notify all utility owners and operators prior to the start of work so that the utility locations may be marked-out. The Contractor shall notify the Underground Facilities Protective Organization (UFPO) at (800) 962-7962 at least seventy-two (72) hours before the start of any construction work on site and as required by the utility owners and operators. The Contractor must coordinate with all impacted utilities, and may not start the work until the utilities have been located.

- G. The Contractor shall be held responsible for any claims arising from its failure to make this notification, or its failure to do the work in accordance with the local codes, rules and regulations relating to this work.
- H. Excavate for and remove underground utilities indicated to be removed.
- I. Excavation and backfill for the removal of underground utilities shall be performed in accordance with Division 31 "Earth Moving".

3.4 CONCRETE FLOWABLE FILL

- A. Batching, mixing and delivery shall conform to the requirements of either ASTM C94 or C685.
- B. Flowable fill shall be placed when the weather conditions are favorable and when the ambient temperature is above 40 degrees F and rising.
- C. Flowable fill placement shall stop when the ambient temperature is below 36 degrees and falling. At the time of placement, flowable fill shall have a temperature of at least 50 degrees F. Flowable fill shall be cured at a minimum temperature of 40 degrees F for a minimum of 24 hours after placement.
- D. Bulkheading shall be provided by masonry means at either end of the section to be filled with flowable fill. Bulkheads shall be at least eight inches thick and constructed of concrete brick and mortar. Bulkheads shall be allowed to cure prior to placement of flowable fill. Exterior faces of the bulkheads (*i.e.* not in contact with the cured flowable fill) shall be parged with mortar.
- E. The Contractor shall verify, through independent site investigation, that the appropriate drainage pipe is going to be filled. No functioning pipes shall be filled with flowable fill. The Contractor shall make a reasonable attempt, as determined by the Owner's Representative, to ascertain if the drainage pipe is clogged. Two methods of construction exist:
 - 1. If it is determined that the drainage pipe is not clogged or that the drainage pipe is sufficiently open to allow the flowable fill to gravity feed the entire length of the pipe, the Contractor shall seal the lower end of the pipe by masonry bulkhead means. The seal shall be vented such that air voids do not form in the pipe when the flowable fill is placed. The flowable fill shall be discharged from a mixer into the high end of the drainage pipe by any means acceptable to the owner's representative. No flowable fill shall be placed into the adjacent pipes or manholes to render these structures non-functional. After completing the work, both ends of the drainage pipe should be sealed in a neat, workmanlike manner that is acceptable to the Owner's Representative.
 - 2. If it is determined that the drainage pipe is clogged, the Contractor shall make a reasonable attempt, satisfactory to the Owner's Representative, to clear the obstruction. If the Owner's Representative determines that the obstruction(s) can not be removed, the Contractor shall first fill the low end of the pipe with flowable fill. The flowable fill shall be discharged from a mixer into the low end of the drainage pipe by any means acceptable to the Owner's Representative. A seal will

be required to fill the low end of the pipe. The Contractor shall seal the low end of the drainage pipe by any means suitable to the Owner's Representative. After completing work at the low end of the pipe, the Contractor shall place flowable fill in the high end of the pipe as indicated above.

- F. After completion of the Work, the Contractor shall remove from the project site any excess flowable fill that resulted from spillage, etc., and restore the project site to a condition that is acceptable to the Owner's Representative. If excavation is required to reach the abandoned pipe, the Contractor shall restore the area to its original condition as directed by the Owner's Representative.

3.5 TEMPORARY CONSTRUCTION FENCING

- A. The Contractor shall maintain, relocate, and provide additional temporary construction fencing as directed by the Owner's Representative to coordinate the work and protect staging areas, pedestrian areas, work areas, emergency routes, field office areas, stockpile areas, etc.
- B. Install chain link fence according to ASTM F 567 and the manufacturer's written instructions.
- C. The cost of all coordination, installation, relocation, dismantling, etc. of fencing shall be included in the price bid for the project.

3.6 CLEARING AND GRUBBING

- A. Remove obstructions, trees (as indicated on the plans, either individually or by clearing limit lines), as required to construct the improvement, or if less than 1.5" dbh), shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 - 3. Completely remove stumps, roots, obstructions, and debris.
 - 4. Use only hand tools for grubbing within drip line of remaining trees.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil, unless further excavation or earthwork is indicated.
 - 1. Place fill in horizontal layers not exceeding eight (8) inch loose depth, and compact each layer to a density equal to adjacent original ground.
- C. When performing the removal of roots, stumps, etc. from around subterranean utility facilities, the contractor shall notify and coordinate his work with the utility company.
- D. When performing the removal of tree limbs, vegetation, etc. from around aerial utility facilities, the contractor shall notify and coordinate his work with the utility company.

3.7 TREE PRUNING

- A. Perform maintenance pruning (MP) where pruning is indicated on the plans.
- B. Pruning Standards: Prune trees according to ANSI A300 as follows:
 - 1. Crown cleaning: shall consist of the selective removal of one or more of the following items: dead, dying or diseased branches, weak branches and watersprouts.
 - 2. Crown thinning: shall consist of the selective removal of branches of increase light penetration, air movement and reduce weight.
 - 3. Crown raising: shall consist of the removal of the lower branches of a tree to provide clearance.
- C. Prune remaining trees impacted by temporary and new construction and at locations indicated on the plans.
 - 1. All trees (protecting the branch collar): Crown cleaning and crown thinning limbs 2.0 inches or greater.
 - 2. Within contiguous wooded stands; Crown raising to a vertical clearance of 14 feet over finished grade.
 - 3. Tie back branches to provide temporary clearance.
 - 4. Do not prune if boring insects are present.
 - 5. All pruning shall be performed by qualified arborist (ISA Certified Arborist or Tree Worker).
 - 6. Interior branches shall remain.
 - 7. No live wood greater than 4 inches in diameter shall be cut.
 - 8. Heartwood shall not be exposed if possible.
 - 9. A maximum of 20% of live wood shall be removed.
 - 10. The arborist shall identify defects by performing aerial inspection, and report to the owner's representative.
- D. Prune remaining trees to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by qualified arborist.
- E. Cut branches with sharp pruning instruments; do not break or chop.
- F. Chip branches removed from trees. Spread chips where indicated or as directed by the owner's representative; trunk shall be clear of mulch.

3.8 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil; stockpile if directed.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent mixing with underlying subsoil or other waste materials.
 - 1. Strip topsoil, trash, debris, weeds, roots, and waste.

- C. Stockpile topsoil away from edge of excavations. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Do not stockpile topsoil within drip line of remaining trees.
 - 2. Stockpile surplus topsoil and allow for re-spreading deeper topsoil.
 - a. Excess topsoil shall be evenly distributed over graded areas and shall not be removed from the site.

3.9 MAINTENANCE AND PROTECTION OF TRAFFIC

- A. The Contractor shall maintain traffic, as required during the course of the Work, in such a manner that is satisfactory to the owner's representative, and all authorities having jurisdiction. The Contractor shall comply with all rules and regulations of those permits and pay all fees, deposits, and charges in connection with these permits.
- B. The Contractor shall furnish, install, and maintain construction signage, barricades, steel roadway plates, and other protective devices as necessary and required to adequately maintain both vehicular and pedestrian traffic during the performance of the Work. The Contractor shall provide all personnel necessary for directing and controlling traffic. Emergency personnel and equipment shall have safe and adequate access to the site at all times. The Contractor must coordinate and cooperate with the Owner's Representative to maintain a level of service which is appropriate in the opinion of the Owner's Representative.
- C. If a Construction Sequencing Plan is included in the project documents, the conditions and directives indicated on same shall also be followed in addition to this specification.
- D. Channelization shall be provided by plastic traffic safety drums meeting FHWA MUTCD and New York State Supplement standards.

3.10 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
 - 1. If the area where excavation for removal of pipes, inlets or manholes, lies outside of proposed pavements, backfill shall be with suitable materials excavated from the project. Backfill of excavated areas within proposed pavement areas shall be made with select soil.
 - 2. When the removal of a portion of pipe, chamber, vault, tunnel, or conduit is required, the pipe shall be sawcut with an approved power saw. No separate payment shall be made for sawcutting.
 - 3. All existing foundations shall be removed where in conflict with proposed construction as noted on the plans. Backfill of excavated areas of former foundations shall be made with select structural fill.
 - 4. Remove all above-grade site improvements where noted on the plans or in conflict with the proposed layout

5. Remove sub-surface asbestos-containing piping materials and appurtenances in accordance with the asbestos-abatement procedures provided under this project.
 6. Underground vaults and/or structures may exist within the property and are not shown on the plans. Abandonment and/or sealing of any structures shall be completed to the satisfaction of the Owner's Representative, agency, or authority having jurisdiction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
 2. No separate payment will be made for the removal of slabs, paving, curbs, gutters, or aggregate base.
- C. When or where any direct or indirect damage or injury is done to public or private property by, or on account of, any act, omission, neglect or misconduct on the part of the Contractor in the execution of the work, such property shall be restored by the Contractor, at this expense, to a condition equal to that existing before such damage or injury was done or he shall make good such damage or injury in such other manner as may be acceptable to the Owner's Representative.
- D. Relocation and/or conflict with operations: As indicated on the plans, remove all site improvements (e.g., curb stops, benches, signs, flagpoles, utility poles) indicated to be relocated or in conflict with the proposed construction activity. Store these improvements on site at no cost of the owner. Reinstall improvements in kind at new or original location once construction activity has been completed at that location. Any damage to the improvements as a direct result of improper storage shall be repaired or replaced at the direction of the Owner's Representative and at no cost to the Owner.
- E. If a separate section is not provided for the removal and/or relocation of hedges, fences, and privately owned signs, the Contractor shall be responsible to contact the Owner's Representative of said hedge, shrub, fence or sign to determine if the Owner's Representative desires to reclaim it. If the Owner's Representative should desire to reclaim the items, the Contractor shall then use reasonable care and relocate and reset the item beyond the work limits. No separate payment shall be made for this coordination, removal or relocation.

3.11 DISPOSAL

- A. Disposal: Remove surplus soil, unsuitable topsoil (suitability to be determined by the Owner's Representative), obstructions, demolished materials, waste materials, trash, and debris, and legally dispose of them off the Owner's property.
1. All regulated materials accumulated during the clearing of the site described above, or any excess materials, shall be disposed of by the Contractor at a New York Department of Environmental Conservation approved landfill site, to be provided by the Contractor.
 2. Burning of debris will not be allowed.

3.12 RESTORATION AND CLEANING UP

- A. Unless otherwise required by the Drawings, all roadway and sidewalk pavements, crosswalks, curbs, etc., along the line of the work, which are removed, destroyed, lost or injured on account of any act or omission on the part of the Contractor, his agent, servants or employees, in the prosecution of the work will be restored to their original condition at the expense of the Contractor.
- B. On paved surfaces, the Contractor shall not use or operate tractors, bulldozers or other power operated equipment, the treads, tracks, or wheels of which are so shaped as to cut or otherwise damage such surfaces.
- C. At such times as may be directed, all gutters, sidewalks, and lawns, etc., affected by the work completed under contract shall be restored by the Contractor to the same condition in which they were at the time of the opening of the bids for this contract. Any necessary topsoiling and seeding shall be completed in accordance with the requirements of this specification.
- D. Cultivated hedges, shrubs, and plants that might be damaged by the Contractor's operations shall be protected by suitable means or shall be dug up and temporarily replaced and cared for. After the construction operations have been substantially completed, they shall be replanted in their original positions and cared for until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of kind and quality at least equal to kind and quality existing at the start of the work.
- E. At such times as may be directed, the Contractor shall remove from the site all materials which were placed thereon by him because of performing this work and which are not required by the contract to be left as part of the finished work. The entire work and portions of the site affected thereby shall be left in a satisfactory condition. The sidewalks and crosswalks shall be swept clean of the work performed under this contract, and, if required, they shall be sprinkled with water during the sweeping.
- F. No separate payment shall be made for the work involved in Restoration and Cleaning-Up as described above. The cost of this work shall be included in the prices bid for the various items scheduled in the proposal.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services, to be performed by the General Contractor, necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
1. Stake out entire site for buildings, roads, storm sewers, utilities, asphalt paving, curbs, walks, equipment pads, access roads, parking areas, etc.
 2. Provide temporary access roads with parking, shanty/storage areas, maintain access to the building, establish tree protection lines, etc.
 3. Stripping, removal, and stockpiling of topsoil, unsuitable soils, unsuitable materials and rough grading of the site within the disturbance limits shown on the plans or dictated by the construction.
 4. Establish proper sub-grade elevations.
 5. Dewatering of excavations as required by site conditions.
 6. Preparing and proof-rolling sub-grades for walks, pavements, turf areas, plantings, etc and protect against accumulation of water in excavation areas.
 7. Drainage course for slabs-on-grade, sub-base for walks and pavements, subsurface drainage backfill for walls and trenches.
 8. Temporary retaining walls, shoring, or bracing to support excavations, facilities, and construction sequencing.
 9. Provide all NYSDOT-approved imported fill required in conformance with site grading plans and details and include the cost of said approved imported fill in the proposal amount.
 10. Replacement of unsuitable soils encountered as determined by the Owner's Owner's Representative and replacement with approved, controlled, compacted fill.
 11. Excavating, filling, backfilling and drainage fill course for sidewalk, proofing and grading.
 12. Excavating, trenching, filling and backfilling, compaction, and drainage fill course for building foundations, slabs on grade, underground storm and sanitary sewage piping, water service and fire service piping, mechanical and electrical utilities and buried mechanical and electrical pits, utility structures and other appurtenances, proofing and grading.
 13. Removal from site of debris, other unsuitable materials and any excess materials that cannot be properly stored on site.
- B. Rock meeting the definition provided herein shall be removed as a change order to the Owner.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. New York State Standards and Specifications for Erosion and Sediment Control, revised and adopted through 2016, and the latest revisions thereto.
- D. Subsurface investigation results are included in the project SWPPP appendices.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

- A. Site Clearing: Section 311000.
- B. Soil Erosion and Sediment Control: Section 312500.
- C. Turf and Grasses: Section 329200.
- D. Soil Management: Section 313100.
- E. Asbestos Abatement Design Section 028213.
- F. Lead Paint Management Section 028333.
- G. PCB Material Removal Section 028400.
- H. Landscape Irrigation Section 328000.
- I. Water Utilities Section 331000.
- J. Sanitary Sewerage Utilities Section 333000.
- K. Storm Drainage Utilities Section 334000.

1.4 DEFINITIONS

- A. The following terms shall have the meanings ascribed to them in this Article, wherever they appear in this Section.
 - 1. Earth Excavation: The removal of all surface and subsurface material not classified as rock (as defined below).
 - 2. Rock: Limestone, sandstone, shale, granite, and similar material in solid beds or masses in its original or stratified position which cannot be broken or removed by mechanical equipment (*e.g.* excavators or heavy duty ripping equipment at least as powerful as a Caterpillar D9L with a Kelly Ripper KR400D-1 single shank ripper attachment) without the use of explosives, drills, wedges, or pneumatic tools; and single boulders with a volume greater than 2.0 cu yd. Subsurface concrete building foundations and subsurface concrete slabs, not indicated on the plans, with a volume greater than 2.0 cubic yards, shall be classified as rock. This classification does not include materials such as loose rock, concrete or other materials that can be removed by means other than extraordinary rock excavation techniques, but which for reasons of economy in excavating, the General Contractor chooses to

remove by extraordinary rock excavation techniques. Materials which can be loosened with a pick or backhoe, frozen materials, soft laminated shale or hardpan, pavements, curbs, and similar materials shall be classified as earth excavation. Concrete building foundations and concrete slabs, where indicated, shall be classified as earth excavation. Masonry building foundations, whether indicated or not, shall be classified as earth excavation.

3. Subgrade Surface: Surface upon which subbase or topsoil is placed.
4. Subbase: Structural material or NYSDOT Item 304.12 (where allowed) which is placed immediately beneath pavement or concrete slabs.
5. Maximum Density: The dry unit weight in pounds per cubic foot of the soil at "Optimum Moisture Content" when determined by ASTM D 1557.
6. Landscaped Areas: Areas not covered by structures, walks, roads, paving, or parking.
7. Unauthorized Excavation: The removal of material below required elevation indicated on the Drawings or beyond lateral dimensions indicated or specified without specific written direction by the Owner's Representative.
8. Unsuitable material: In-situ fill material that contains materials (asphalt and concrete debris, metals, plastics, manufactured materials, wood, organic, or any other deleterious materials) other than non-organic soil.

1.5 SUBMITTALS

A. Product Data:

1. Permanent Sheeting, Shoring, and Bracing: Specifications for materials and accessories.
2. Filter Fabric: Manufacturer's catalog sheets, specifications, and installation instructions.

B. Certification: Submit certification for the following materials:

1. Select Fill.
2. Crushed Stone.
3. Pea Gravel.
4. Sand.
5. Subbase Course Type 2.
6. Underdrain Filter, Type 1.

C. Quality Control Submittals:

1. Sheeting, Shoring, and Bracing (Not shown on the Drawings): Submit a detailed plan of intended sheeting, shoring and bracing, signed by a New York licensed Professional Engineer for information. This submittal will not relieve the Contractor of responsibility for the successful performance of the intended sheeting, shoring and bracing methods.
2. Excavation Procedure: Submit a lay out drawing or detailed outline of intended excavation procedure for information. This submittal will not relieve the Contractor of responsibility for the successful performance of intended excavation methods.

- D. Samples: Submit samples as follows. Take the samples in the presence of the Owner's Representative and complete a Granular Material Sample Information Form for each sample. Forms and field sample designation numbers will be furnished by the Owner's Representative.
1. Select Fill: 50 - 60 lb. (Two Samples).
 2. Subbase Course NYSDOT Item 304.12: 50 - 60 lb. (One Sample).
 3. Crushed Stone: 30 lb.
 4. Underdrain Filter, Type 1, Item 650.0901: 30 lb.
- E. Quality Control Submittals:
1. Subbase Materials: Name and location of source, stockpile number, and latest NYSDOT test results and approval.
 2. Other Aggregates: Name and location of source, and latest NYSDOT source number, test number, and date.
- F. Acceptance of Materials: Samples of materials proposed for use shall be submitted by the Contractor to the Owner's Representative at least three days prior to using that material. The material shall not be used until approved by the Owner's Representative. By submitting the samples of materials, the Contractor agrees that the fill materials used for construction will conform to the samples supplied. If the test results show that the materials do not meet the specifications, the Contractor shall be responsible for all costs associated with the additional sampling and re-testing of materials from a different stockpile or source. Final acceptance of fill material rests with the Owner's Representative.
1. The fact that the moisture of a satisfactory soil is not optimum shall not render it unsatisfactory. The Contractor shall plan and execute his work, and do what is necessary to bring the moisture within the specified limits. It is the Contractor's responsibility to determine the economics of using, or disposing and replacing, such materials. Material determined by the Contractor to be uneconomical for use may be disposed of as specified and replaced with other material at no additional cost to the owner and required amendment shall be performed by the Contractor at no additional cost to the Owner. All excavated unsatisfactory soil is to be removed from site, unless directed otherwise.
- G. The Owner's Representative has the right to revise the type of materials for various portions of the construction as may be required for the satisfactory execution of the work.
- H. Earthwork Analysis: The Contractor shall prepare, at his expense, an earthwork analysis outlining the material volume to be excavated and removed from the site, all project cut volume and all project fill volume. The Contractor shall be responsible for obtaining and executing all permits required for earthwork operations.

1.6 QUALITY CONTROL

- A. Shoring, and bracing shall be performed by a specialty contractor familiar with this type of work and having a minimum of five (5) years experience. Foremen directing this work

shall have at least three (3) years experience and have directed at least five (5) similar projects.

1.7 PROJECT CONDITIONS

- A. Contractor shall protect existing trees and plants during performance of the Work unless otherwise indicated. Box trees and plants indicated to remain within the grading limit line with temporary fencing as detailed and required. Protect root systems from smothering. Do not store excavated material, or allow vehicular traffic or parking within the branch drip line. Restrict foot traffic to prevent excessive compaction of soil over root systems.
- B. Cold Weather Requirements:
 - 1. When freezing temperatures are predicted, do not excavate to final required elevations for concrete Work unless concrete can be placed immediately. Retain enough earth over the bottom elevation of footings to prevent frost penetration. If excavation has progressed to final footing elevations and concrete cannot be placed immediately, cover the bottom of the excavations with protective material to adequately insulate the exposed earth surface from frost. Remove protective material immediately before placing concrete.
 - 2. Do not backfill between November 1 and April 1, except with written permission of the owner.
- C. Thru-traffic or fill placement with heavy construction vehicles or equipment which causes rutting or weaving to occur within the perimeter of a building will not be permitted. If rutting or weaving occurs during placement of fill, deposit specified fill in a stable area outside building perimeter and spread into the footprint with tracked equipment to the specified layer thickness at no additional cost to the Owner.
- D. Existing Utilities: Prior to performing any excavation, the Contractor must call Underground Facilities Protective Organization (UFPO) at (800) 962-7962, at least seventy-two (72) hours in advance of starting work to locate and mark-out existing utilities in areas of excavation work. If utilities are required to remain in place and/or in service, provide adequate means of support and protection during earthwork operations. Repair any damage to utilities to the satisfaction of the Owner's Representative at no expense to the Owner.
- E. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, Contractor shall consult Utility Owner immediately for directions. Cooperate with Owner and Utility Owner's in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of Utility Owner at no expense to the Owner.
- F. Additional test borings and other exploratory operations may be performed by Contractor, at no additional cost to the Owner.
- G. Where dry construction practices are required and sub-surface conditions do not permit same, the Contractor shall design, install, and operate a dewatering system to keep sub-grades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

1. Contractor shall retain the services of a qualified Professional Engineer licensed in the State of New York to design the dewatering system.
2. Contractor shall be responsible for obtaining all permits for the dewatering system.

1.8 SITE LAYOUT

- A. Employ at Contractor's expense, an approved, Professional Land Surveyor licensed in the State of New York to establish contract limit lines and bench mark; layout access road, detention ponds, storm sewers, utilities, bituminous paving areas, building pads, concrete walks, curbs and pads, parking area, contractor Trailer/Storage area, etc.; set building floor elevations; stake out for sub-grade and finished grade elevations, etc.
 1. Land Surveyor shall be approved by Owner.
- B. Should Land Surveyor encounter discrepancies in grades and/or conditions noted on Contract Documents, he shall contact the Owner's Representative in writing before proceeding with further work. This work shall be done immediately upon execution of the contract for construction prior to the submittals process and prior to the commencement of any excavation or construction on the site and shall include, but not be limited to, checking and verification of grades on the Contract Documents.
- C. The Land Surveyor shall provide a plan of the stakeout of the structure(s) to the Owner's Representative prior to any concrete placement.
- D. At completion, Land Surveyor will submit sealed and certified as-built mylar drawings of grades, locations, invert elevations, pipe sizes, etc. to the Owner's Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Select Fill: Imported, sound, durable, sand, gravel, stone, or blends of these materials, free from organic and other deleterious materials to meet the following gradation:

Sieve	Percent Passing
3 inch	100
¼ inch	30-70
No. 40	5-40
No. 200	0-10

1. Subbase Course Type 2 material in accordance with NYSDOT Article 304-2 may be used for select fill.

2. On-site soil shall not be used as select fill or structural fill and shall be removed and disposed of from the site in accordance with this specification.
- B. Suitable Soil (Fill and Backfill for Landscaped Areas): Material consisting of mineral soil (inorganic), blasted or broken rock and similar materials of natural or man-made origin, including mixtures thereof. Maximum particle size shall not exceed the lesser of four (4) inches or 2/3 of the specified layer thickness prior to compaction.
1. Material containing cinders, industrial waste, sludge, building rubble, land fill, muck, and peat shall be considered unsuitable for fill and backfill, except topsoil and organic silt may be used as suitable material in landscaped areas provided it is placed in the top layer of the subgrade surface.
 2. The on-site soils are generally suitable for reuse as fill in landscape areas outside the footprint of buildings and site improvements (*e.g.* parking lots, driveways, sidewalks, pads, etc.).
- C. Crushed Stone, Crushed Gravel, or Screened Gravel: Comply with applicable portions of NYS DOT Section 703-02, except as otherwise indicated.
1. Gradation: ¾ inches to 1- ½ inches.
- D. No. 2 Crushed Stone: washed stone; free of shale, clay, friable material and debris; graded in accordance with ASTM C136.
- | Sieve | Percent Passing |
|----------|-----------------|
| 1-½ inch | 100 |
| 1 inch | 90-100 |
| ½ inch | 0-15 |
- E. Pea Gravel: Aggregate Type: Natural stone; washed, free of clay, shale, organic matter; graded in accordance with ASTM C136.
- F. Underdrain Filter: NYSDOT Item 605.0901, Type 1

2.2 BRICK AND MORTAR

- A. Manhole Brick: Standard size, ASTM C 32, Grade MS.
- B. Mortar Materials: Dry packaged, proportioned for Type M unit masonry mortar, complying with ASTM C 387.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Excavate earth as required for the Work.
- B. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Comply with Code of Federal Regulations Title 29 - Labor, Part 1926 (OSHA).
 - 1. Trenches: Deposit excavated material on one side of trench only. Trim banks of excavated material to prevent cave-ins and prevent material from falling or sliding into trench. Keep a clear footway between excavated material and trench edge. Maintain areas to allow free drainage of surface water.
- C. Stockpile excavated materials classified as suitable material where directed, until required for fill. Place, grade, and shape stockpiles for proper drainage as approved by the Owner's Representative.
- D. Excavation for Structures: Conform to elevations, lines, and limits indicated. Excavate to a vertical tolerance of plus or minus 1 inch. Extend excavation a sufficient lateral distance to provide clearance to execute the Work.
- E. Excavation for Slopes: Shall be limited to a maximum of 3-feet horizontal to 1-foot vertical.
- F. Pipe Trenches: Open only enough trench length to facilitate laying pipe sections. Unless otherwise indicated on the Drawings, excavate trenches approximately 24 inches wide plus the outside pipe diameter, equally divided on each side of pipe centerline. Cut trenches to cross section, elevation, profile, line, and grade indicated. Accurately grade and shape trench bottom for uniform bearing of pipe in undisturbed earth. Excavate at bell and coupling joints to allow ample room for proper pipe connections.
 - 1. Trench in Rock: Excavate an additional 6 inches below bottom of pipe for bed of cushion material under the piping.
 - 2. Where unsuitable materials are encountered, excavate and remove unsuitable material below the footing bottoms beneath the footing footprints plus the area a minimum of 2 feet beyond the edges of footings or greater to allow for the specified proofrolling. The limits of removal of unsuitable material shall have a minimum depth of 2 feet below the footing bottom and shall extend a minimum distance beyond the edge of footing equivalent to the depth of removal below the footing. Place compacted select fill in the resulting excavation after proofrolling the full excavation bottom.
 - 3. All subgrades shall be proofrolled by the Contractor using a vibratory roller having a minimum static weight of ten tons and inspected by the Owner's Representative to verify the acceptability of the subgrade before placement of fill or concrete. Unsuitable materials shall be removed as determined by the owner's representative based on visual inspection and observation of proof rolling. The existing fill subgrades should be compacted to at least 95 percent of the maximum dry density value determined by ASTM D 1557.
- G. Open Ditches: Cut ditches to cross sections and grades indicated.

- H. Pavement: Excavate to subgrade surface elevation as shown on the plans.
- I. Hand Excavation: Excavate by manual methods at locations and depths indicated on the plans or as required to prevent damage to utilities and/or to prevent harm to the public and the Contractor's employees or assigns.
- J. Unauthorized Excavations: Unless otherwise directed, backfill unauthorized excavation under footings, foundation bases, and retaining walls with compacted structural material without altering the required footing elevation. Elsewhere, backfill and compact unauthorized excavation as specified for authorized excavation of the same classification, unless otherwise directed by the Owner's Representative.
 - 1. Unauthorized excavations under structural Work such as footings, foundation bases, and retaining walls shall be reported immediately to the Owner's Representative before any concrete or backfilling Work commences.
- K. Notify the Owner's Representative upon completion of excavation operations. Do not proceed with the Work until the excavation is inspected and approved. Inspection of the excavation by the owner's representative will be made on 3 working days notice.
- L. Where the natural soils consist of both silty sands and silty clays (which are susceptible to softening and disturbance from excess moisture and construction equipment traffic), the Contractor should expect additional excavation of soft natural soils to be required if the earthwork is being performed during the traditionally wet seasons or following extended periods of inclement weather. Over-excavation of unsuitable soils would be minimized if the earthwork is performed during favorable weather conditions and prudent earthwork procedures are used. The Contractor shall maintain favorable soil conditions at no additional cost to the owner.
- M. Manholes: Excavate to the following depths below bottom of concrete for addition of Subbase Course Type 2:
 - 1. Exterior: 12 inches unless otherwise indicated.

3.2 SHORING AND BRACING

- A. Shoring and Bracing: Where required, provide and install materials for shoring and bracing (sheet piling, uprights, stringers, cross braces, etc.), ensuring good, serviceable material condition. Shoring and Bracing shall accommodate the staging of the work and shall not adversely impact existing subsurface utilities or structures. Maintain shoring and bracing throughout the life of the excavations. Extend shoring and bracing as excavation progresses. Shop drawings of the shoring and bracing shall be prepared by a licensed professional engineer and submitted for review prior to proceeding with the work.
- B. The Contractor shall not install shoring and bracing where vibrations will be created during normal working hours without the Owner's written permission prior to the start of work.

3.3 SETTLEMENT DETECTION

- A. Establish a settlement detection method approved by the Owner's Representative for structures subject to settlement from excavation, underpinning, sheeting or shoring operations. Maintain surveillance to detect any settlement. At a minimum, follow this procedure:
 - 1. Before starting any excavating, survey and record the position of the structure to be monitored in relation to an approved remote permanent bench mark. At least twice each day during the operations and for a period of not less than 7 days after completion of the Work, carefully check the position of the existing structure to detect any settlement. Furnish a written record of each position check to the Owner's Representative on the same day the check is made. Should any settlement be detected, immediately correct this condition by means of temporary shoring.
- B. Maximum permissible deflection (horizontal/vertical):
 - 1. Adjacent to permanent structure: 1/4-inch / 1/4-inch.
 - 2. Adjacent to temporary structure: 1-inch / 1-inch

3.4 DEWATERING

- A. Prevent surface and subsurface water from flowing into excavations and trenches and from flooding the site and surrounding area.
- B. Do not allow water to accumulate in excavations or trenches. Remove water from all excavations immediately so as not to adversely affect construction procedures or cause excessive disturbance of underlying natural soil, to prevent softening of foundation bottoms, to prevent undercutting footings, and to prevent soil changes detrimental to the stability of subgrades and foundations. Furnish and maintain pumps, sumps, suction and discharge piping systems, and other system components at own expense as necessary to convey the water away from the Site.
- C. Where necessary, lower groundwater level in advance of excavation to facilitate construction in accordance with these specifications.
- D. Convey water removed from excavations, and rain water, to collecting or run-off area. Cut and maintain temporary drainage ditches and provide other necessary diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
- E. Provide temporary controls to restrict the velocity of discharged water as necessary to prevent erosion and siltation of receiving areas.

3.5 PLACING FILL AND BACKFILL

- A. Preparation of Fill Areas: Strip vegetation, topsoil, subsoil with organic material and other deleterious materials prior to placement of fill. Remove old pavements. Prior to

placement of fill, smooth out and compact areas where wheel rutting has occurred due to stripping or earthwork operations.

- B. Backfill excavations as promptly as Work permits, but not until acceptance by the Owner's Representative of construction below finish grade including suitability of subgrade and pipe bedding.
- C. Place backfill and fill materials in layers not more than eight (8) inches thick in loose depth unless otherwise specified. Before compaction, moisten or aerate each layer as necessary to facilitate compaction to the required density. Do not place backfill or fill material on surfaces that are muddy, frozen, or covered with ice.
 - 1. Place fill and backfill against foundation walls and in confined areas (such as trenches) not easily accessible by larger compaction equipment, in maximum 4 inch thick (loose depth) layers.
- D. Under Pavements and Walks:
 - 1. Up to Subgrade Surface Elevation: Place on-site soil when fill or backfill is required.
 - 2. Subbase Material: Place as indicated.
- E. Landscaped Areas: Place suitable soil when required to complete fill or backfill areas up to subgrade surface elevation. Do not use material containing rocks over 4 inches in diameter within the top 12 inches of suitable soil.
- F. Rigid and Flexible Pipe in Trenches: Place bedding material as specified on the plans.
 - 1. Place cushion material a minimum of 4 inches deep under pipe, 4 inches on either side and 12 inches above top of pipe. Complete balance of backfill as specified. Compact all backfill in layers.
 - 2. Trench in Rock: Place a minimum 6 inch deep bed of cushion material under pipe.
- G. Under manholes:
 - 1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.
 - 2. Subbase Material: Place 12 inches of Subbase Course Type 2 over subgrade surface.
- H. Backfilling Excavation Resulting from Removal of Unsuitable Material beneath Structures and Other Improvements: Backfill the excavation with compacted select fill.
- I. Boulders may be spread out at the bottom of any proposed deep fills outside of building areas and a minimum of 10 feet from other foundations, retaining wall systems, or underground utilities, provided that fill materials can be completely compacted around the boulders. Boulders should not be placed within 3 feet of finished grade.

3.6 COMPACTION

- A. Compact each layer of fill and backfill for the following area classifications to the percentage of maximum density specified below and at a moisture content suitable to obtain the required densities, but at not less than 2 percent drier or more than 2 percent wetter than the optimum content as determined by ASTM D 1557.
 - 1. Landscaped Areas: 92 percent.
 - 2. Pavements and Walks: 95 percent.
 - 3. Pipe Trenches: 95 percent.
 - 4. Pipe Bedding: 95 percent.
 - 5. Manholes (entire area within 10 feet outside perimeter): 95 percent.
- B. When the existing ground surface to be compacted has a density less than that specified for the particular area classification, break up and pulverize, and moisture condition to facilitate compaction to the required percentage of maximum density.
- C. Moisture Control:
 - 1. Where fill or backfill must be moisture conditioned before compaction, uniformly apply water to the surface and to each layer of fill or backfill. Prevent ponding or other free water on surface subsequent to, and during compaction operations.
 - 2. Remove and replace, or scarify and air dry, soil that is too wet to permit compaction to specified density. Soil that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a value which will permit compaction to the percentage of maximum density specified.
 - 3. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

3.7 ROUGH GRADING

- A. Exterior Grading: Trim and grade area within the Limit of Disturbance and excavations outside the limit line, required by this Contract, to a level of 4 inches below the finish grades indicated unless otherwise specified herein or where greater depths are indicated. Provide smooth uniform transition to adjacent areas.
 - 1. Landscaped Areas: Provide uniform subgrade surface within 1 inch of required level to receive topsoil thickness specified. Compact fill as specified to within 3 inches of subgrade surface. Remove objectionable material detrimental to proper compaction or to placing full depth of topsoil. If the top 3 inches of subgrade has become compacted before placement of topsoil, harrow or otherwise loosen rough graded surface to receive topsoil to a depth of 3 inches immediately prior to placing topsoil.

3.8 SUBGRADE SURFACE FOR WALKS AND PAVEMENT

- A. Shape and grade subgrade surface as follows:

1. Pavements: Shape the surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subgrade surface elevation.
- B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.
- C. Thoroughly compact subgrade surface for walks and pavement by mechanical rolling, tamping, or with vibratory equipment as approved to the density specified.

3.9 FINISH GRADING

- A. Uniformly grade rough graded areas within limits of the Limit of Disturbance to finish grade elevations indicated.
- B. Grade and compact to smooth finished surface within tolerances specified, and to uniform levels or slopes between points where finish elevations are indicated or between such points and existing finished grade.
- C. Grade areas adjacent to building lines so as to drain away from structures and to prevent ponding.
- D. Finish surfaces free from irregular surface changes, and as follows:
 1. Grassed Areas: Finish areas to receive topsoil to within 1 inch above or below the required subgrade surface elevations.
 2. Pavements: Place and compact subbase material as specified. Shape surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subbase elevation.
- E. Spread topsoil directly upon prepared subgrade surface to a depth measuring 4 inches after natural settlement of the topsoil has occurred in areas to be seeded or to receive sod. Place to greater depth when necessary to adjust grades to required elevations.
 1. Approved existing topsoil excavated from within the Limit of Work may be used. Provide additional topsoil from outside sources as required.
- F. Finish topsoil surface free of depressions which will trap water, free of stones over 1 inch in any dimension, and free of debris.

3.10 MAINTENANCE AND RESTORATION

- A. Restore grades to indicated levels where settlement or damage due to performance of the Work has occurred. Correct conditions contributing to settlement. Remove and replace improperly placed or poorly compacted fill materials.
- B. Restore pavements, walks, curbs, lawns, and other exterior surfaces damaged during performance of the Work to match the appearance and performance of existing corresponding surfaces as closely as practicable.

- C. Topsoil and seed or sod damaged lawn areas. Water as required until physical completion of the Work.

3.11 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS

- A. Remove from the Owner's property and dispose of excess and unsuitable materials, including materials resulting from clearing and grubbing and removal of existing improvements.
- B. Transport excess topsoil to areas on the owner's property designated by the Owner's Representative. Smooth grade deposited topsoil and establish turf.
- C. Burning shall not be permitted.

3.12 FIELD QUALITY CONTROL

- A. Compaction Testing: Notify the Owner's Representative at least 3 working days in advance of all phases of clearing, stripping, filling and backfilling operations. Compaction testing will be performed by the Owner's Representative to ascertain the compacted density of the proofrolled existing soil, fill and backfill materials. Compaction testing will be performed on certain layers of the fill and backfill as determined by the Owner's Representative. If a compacted layer fails to meet the specified percentage of maximum density, the layer shall be recompacted and will be retested. No additional material may be placed over a compacted layer until the specified density is achieved.
 - 1. Contractor shall provide the testing results to the Owner's Representative.
- B. Proofrolling
 - 1. Soil sungrades, should be proofrolled under the observation of the Owner's Representative. Proofrolling should consist of four (4) passes with a vibratory roller having a static weight of at least ten (10) tons in open areas and a 1.5 ton trench roller in confined areas.
 - 2. Proofrolling should not be performed in wet areas until they are dewatered and allowed to dry. Proofrolling soils that are too wet to compact may create more unstable conditions.
 - 3. Any soil deemed unsuitable by the Owner's Representative (areas found to be soft and yielding during proofrolling), should be removed at the direction of the Owner's Representative. Over excavated areas should be backfilled with an approved, compacted fill.
 - 4. All costs associated with proofrolling and remediate disclosed by same shall be borne by the Contractor.

3.13 SUBCONTRACTING OF UTILITY INSTALLATION

- A. Unless otherwise noted, General Contractor shall be responsible for site trenching, including, but not limited to, excavation and excavation of backfill material.

- B. Once trench has been constructed by the General Contractor, subcontractor shall perform utility installation prior to the General Contractor backfilling trench for the following:
1. Water utilities
 2. Sanitary Sewerage Utilities
 3. Storm Drainage Utilities
 4. Electric Conduit
 5. Gas conduit
 6. Irrigation

3.14 PROTECTION

- A. Protect graded areas from traffic and erosion and keep them free of trash and debris.

END OF SECTION 312000

SECTION 312500 - EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
1. Soil Erosion and Sediment Control shall include implementation and maintenance of soil erosion and sediment control devices and construction methods, as shown on the Plans, as required under the Guidelines or as directed by the Owner's Representative, State or Municipality, which will reduce or prevent soil losses and associated damages from sedimentation during construction of this project. All costs associated with the provision of Soil Erosion and Sediment Control acceptable to the above parties shall be included in the price bid for the project. Work shall include, but not necessarily be limited to the following:
 - a. Install and maintain silt fence as required by the Contractor's staging of construction, or as directed.
 - b. Install and maintain construction entrance pad(s) at all access points.
 - c. Install and maintain inlet protection as required by the Contractor's staging of construction, or as directed.
 - d. Install and maintain diversion swales and/or berms as required by the Contractor's staging of construction, or as directed.
 - e. Install and maintain sediment traps/ponds as required by the Contractor's staging of construction, or as directed.
 - f. Plant and maintain temporary seeding to control surface runoff by site conditions.
 - g. Construct and maintain stockpile areas as required by the Contractor's staging of construction, or as directed.
 - h. Install and maintain tree protection during construction as required by the Contractor's staging of construction, or as directed.
 - i. Implement ongoing dust control.
 2. All work under this item must comply with the New York State Guidelines for Urban Erosion and Sediment Control, revised and adopted through 2016, and the latest revisions thereto. Additionally, this work is subject to the review and inspection by the owner's representative, and the Contractor shall comply with all corrective directives issued by these entities without additional payment. Any penalties levied by the Municipality, County, or State, or any direct or consequential damages arising out of a Stop Work Order issued by the Municipality, County, or State, if due to inaction by the Contractor, shall be borne solely by the Contractor, at no additional cost to the Owner.
- B. The Owner's Representative has the authority to limit the surface area of erodible earth exposed by earthwork operations and to direct the Contractor to provide immediate

temporary or permanent erosion or pollution control measures to minimize damage to property.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. New York State Standards and Specifications for Erosion and Sediment Control, revised and adopted through 2016, and the latest revisions thereto.
- D. Stormwater Pollution Prevention Plan prepared for this project.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

- A. Site Clearing: Section 311000.
- B. Earth Moving: Section 312000.

1.4 SUBMITTALS:

- A. Product Data:
 - 1. Silt fence: Manufacturer's catalog sheets, specifications, and installation instructions.
 - 2. Filter Fabric: Manufacturer's catalog sheets, specifications, and installation instructions.
- B. Certifications:
 - 1. Proof of current endorsed NYSDEC 4-hour training for Contractor's trained individual
 - 2. Completed Contractor's SPDES certification (see SWPPP appendix).
 - 3. Completed Subcontractor's SPDES certification(s) as applicable (see SWPPP appendix).

PART 2 - PRODUCTS

2.1 EROSION CONTROL DEVICES

- A. Hay or Straw bales shall conform to NYS DOT Section 713-18 or 713-19 and shall be bound with wire or baling twine. The twine shall be polypropylene which has a knot strength of 170 pounds and straight break strength of 300 pounds, minimum.

- B. Silt Fence may be commercially available silt fence systems, consisting of synthetic geotextile fabrics and hardwood stakes. The height of the fence shall be a minimum of two (2) feet, and the fabric shall be wide enough to allow for a minimum embedment in the ground of two (2) feet of fabric. Sections shall be joined in a manner such that the fence shall function continuously.
- C. Rapid germination grasses such as fescue or rye.
- D. Stakes for securing bales may either be steel or wood and shall conform to the sizes shown on the Plans.
- E. Mulches: Hay, straw, wood cellulose, fiber mats, geotextiles, and other materials approved by the owner's representative.
- F. Stone: Well-graded aggregate compliant with NYSDOT Section 703.
- G. Filter Fabric shall be commercially available non-woven geotextile with the following properties:
 - 1. Grab Tensile Strength ASTM D4632: 120 lbs.
 - 2. Mullen Burst Strength ASTM D3786: 225 psi.
 - 3. Trapezoidal Tear Strength ASTM D4355: 50 lbs.
 - 4. Puncture Strength ASTM D4833: 70 lbs.
 - 5. UV Resistance after 500 hours ASTM D4355: 70% strength
 - 6. Apparent Opening Size ASTM D4751: US Sieve #70
 - 7. Permittivity ASTM D4491: 1.8 sec-1

PART 3 - EXECUTION

3.1 GENERAL

- A. The contractor shall incorporate all temporary soil erosion and sediment control measures into the project at the earliest practicable time, to maintain the maximum protection against soil erosion and sedimentation possible, throughout the life of the contract.
- B. All erosion and sediment control practices shall conform to the Standards for Soil Erosion and Sediment Control in the State of New York.
- C. A schedule of construction operations shall be submitted to the Owner's Representative for approval. Said schedule shall outline construction phasing and shall indicate how and where erosion control measures will be utilized. The schedule shall include indications of locations for construction staging, soil stockpiles, etc., and any disturbances outside the limit of excavation shown on the Plans.
- D. Prior to initial clearing of the area to be excavated, erosion control measures shall be installed, such as stone construction entrance, hay bales, silt fence, and inlet protection.
- E. The smallest practicable area of land shall be disturbed at any one time during the project and, whenever feasible, natural vegetation shall be retained and protected. Stripping of

vegetation, grading and other soil disturbances shall be completed in a manner that will minimize soil erosion and sedimentation.

1. The Owner's Representative may limit the area of clearing and grubbing and earthwork operations in progress commensurate with the Contractor's demonstrated capability in protecting erodible earth surfaces with temporary or permanent erosion control measures.
 2. Under no circumstances will the area of erodible material exposed at one time exceed five (5) acres without prior written approval of the Owner's Representative and NYSDEC.
 3. The Owner's Representative may increase or decrease the area of erodible earth material exposed at one time as determined by his analysis of project, weather and other conditions.
- F. All other construction procedures shall conform to the NYS DOT Standard Specifications Section 209.
- G. Incorporate permanent control features into the work at the earliest practical time.
- H. Sweeping of hardscape shall be performed weekly (as a minimum), at the end of a work day when construction activity results in the tracking of sediment onto hardscape, or as directed by the Owner's Representative to remove accumulated sediment generated by construction operations.

3.2 STOCKPILE

- A. Stockpile topsoil in storage piles in areas where directed by the Owner's Representative. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust.
- B. Protect all soil and topsoil stockpiles as directed by the Owner's Representative or other authority having jurisdiction over the project.

3.3 TREE PROTECTION

- A. Fencing or other barrier will be installed at the drip line of the tree branches.
- B. Boards will not be nailed to trees during building operations.
- C. Feeder root should not be cut in an area inside the drip line of tree branches.
- D. Damaged trunks or exposed roots will be painted immediately with a good grade of "tree paint". Care of serious injury should be prescribed by a professional forester or licensed tree expert.
- E. Tree limb removal, where necessary, will be done flush to trunk or main branch and that area painted with a good grade of "tree paint".
- F. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction.

- G. Additional requirements are provided on the details shown on the project plans.

3.4 SPDES COMPLIANCE PROVISIONS

- A. The Contractor shall install, maintain and service as needed all construction run-off collection/prevention measures as indicated on the drawings and the Stormwater Pollution Prevention Plan (SWPPP) or as directed by the Owner's Representative.
- B. The Contractor must have at least one trained person responsible for implementation of the SWPPP, and have at least one trained person on site on a daily basis when soil disturbance activities are being performed. Trained contractors must have 4 hours of training in the principles and practices of erosion and sediment control endorsed by NYS DEC. Proof of training shall be submitted to the Owner's Representative prior to commencing construction.
- C. A qualified person from the Owner will perform SPDES-compliance inspections required by the Permit on a weekly basis. All recommendations and suggested modifications must be addressed by the Contractor within 1 working day of issuance of notice by the Owner's Representative. Under certain circumstances, the Owner and/or the NYSDEC has the right to direct more than one weekly inspection and visit the project construction site at any point over the course of construction.

END OF SECTION 312500

BEGIN ATTACHMENT TO SECTION 31 25 00

SWPPP



PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.

SWPPP

Stormwater Pollution Prevention Plan
Orangetown Town Hall Addition and
Alterations

Submitted By:

**Tectonic Engineering
Consultants, Geologists & Land
Surveyors, D.P.C.**

Casey O'Mara, P.E.
Senior Engineer
comara@tectonicengineering.com
845 534 5959 x2131 tel

70 Pleasant Hill Road, PO Box 37
Mountainville, NY 10953
tectonicengineering.com

STORMWATER POLLUTION PREVENTION PLAN (SWPPP) ORANGETOWN TOWN HALL ADDITION AND ALTERATIONS

RO: JUNE 2021
R1: JULY 2021
R2: AUGUST 2021
R3: SEPTEMBER 2021
R4: OCTOBER 2021

PREPARED BY:

TECTONIC ENGINEERING CONSULTANTS, GEOLOGISTS & LAND SURVEYORS D.P.C.
70 PLEASANT HILL ROAD
MOUNTAINVILLE, NY 10953



Casey O'Mara
Casey Catherine O'Mara

New York State Professional Engineer #091164

SITE CONTACT INFORMATION

SITE OWNER	PHONE/MOBILE	RESPONSIBILITIES
Town of Orangetown	P:() - M:() -	See GP 0-20-001 (All Parts) in Appendix A
PROJECT CONTRACTOR		
	P:() - M:() -	See GP 0-20-001 (Part IV.B) in Appendix A
TRAINED CONTRACTOR		
	P:() - M:() -	See GP 0-20-001 (Part IV.B) in Appendix A
QUALIFIED SWPPP INSPECTOR		
	P() - M() -	See GP 0-20-001 (Part IV.C) in Appendix A
QUALIFIED SWPPP PROFESSIONAL		
	P() - M() -	See GP 0-20-001 (Part III, A and Part IV.C) in Appendix A
DESIGN ENGINEERS		
1. Tectonic Lou J. Greco, PE	P:(845) 534 - 5959 M:() -	Project Manager
2. Tectonic Casey C. O'Mara, PE	P:(845) 534 - 5959 M:() -	SWPPP Engineer
3. Tectonic James Moyik	P:(845) 534 - 5959 M:() -	SWPPP Author

PREFACE

Important Note: This SWPPP shall be treated as part of the contract documents. Pursuant to Section 402 of the Clean Water Act (CWA), stormwater discharges from certain construction activities are unlawful unless they are authorized by a National Pollutant Discharge Elimination System (NPDES) permit or by a state permit program. The New York's State Pollutant Discharge Elimination System (SPDES) is an approved NPDES program with permits issued in accordance with the Environmental Conservation Law (ECL).

This SWPPP has been developed in compliance with all requirements of the SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-20-001) and conforms to all New York State Department of Environmental Conservation (NYSDEC) technical standards. A copy of GP-0-20-001 (the Permit) has been included in Appendix A and is considered part of the SWPPP. Prior to the commencement of construction activity, the owner(s) or operator(s) must identify the contractor(s) and subcontractor(s) that will be responsible for installing, constructing, repairing, inspecting, and maintaining the erosion and sediment control practices included in the SWPPP; and the contractor(s) and subcontractor(s) that will be responsible for the construction of all post-construction stormwater management practices included in the SWPPP. The owner(s) or operator(s) shall have each of these contractors or subcontractors identify at least one trained individual from their company that will be responsible for implementation of the SWPPP. The owner(s) or operator(s) shall ensure that at least one trained individual is on site on a daily basis when soil disturbance activities are being performed.

All contractors and subcontractors identified in the SWPPP, in accordance with the Permit must agree to implement applicable provisions of the SWPPP and satisfy the certification requirement of the Permit. The owner(s) or operator(s) shall have each of these contractors and subcontractors identified sign a copy of the certification statement included in Appendix H, extracted from Part III.A.5 of the Permit, before they commence any construction activity and shall be retained at the project site for the duration of construction. Contractors and subcontractors; however, who are not operator(s), as defined in the Permit, are not required to submit a Notice of Intent (NOI) in addition to the NOI submitted by the operator(s). The owner(s) or operator(s) shall ensure that the provisions of the SWPPP are implemented from the commencement of construction activity until all areas of disturbance have achieved final stabilization and the Notice of Termination (NOT) has been submitted to the Department.

REVISION SCHEDULE

This Stormwater Pollution Prevention Plan (SWPPP) should be revised and updated to address changes in site conditions, new or revised government regulations, and additional on-site stormwater pollution controls.

All revisions to the SWPPP must be documented on the SWPPP Revision Documentation Form, which should include the information shown below. The authorized facility representative who approves the SWPPP should be an individual at or near the top of the facility's management organization, such as the president, vice president, construction manager, site supervisor, or environmental manager. The signature of this representative attests that the SWPPP revision information is true and accurate. Previous authors and facility representatives are not responsible for the revisions.

SWPPP REVISION DOCUMENTATION FORM

Rev.	Date	Author	Company Representative Signature	Notes
0	June 2021	C OMARA	<i>Casey O'Mara</i>	Original submission
1	July 2021	C OMARA	<i>Casey O'Mara</i>	Town Comments
2	August 2021	C OMARA	<i>Casey O'Mara</i>	Town Comments
3	September 2021	C OMARA	<i>Casey O'Mara</i>	Town Comments
4	October 2021	C OMARA	<i>Casey O'Mara</i>	Town Comments
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1.0 INTRODUCTION

This SWPPP has been developed in compliance with all NYSDEC technical standards for the construction of the proposed site. The primary purposes for this plan are to:

- Identify the SWPPP coordinator and their duties;
- Identify any SWPPP team members that will assist in the implementation of the SWPPP during construction;
- Define the site characteristics and type of construction;
- Identify the receiving bodies of water for the site's stormwater;
- Introduce the site plan for the proposed site;
- Identify potential pollutants and sources within the site's drainage area;
- Describe practices that will be implemented for erosion and sediment control;
- Describe any temporary or permanent, structural or non-structural, BMPs (Best Management Practices) that will be utilized to manage stormwater quality and quantity.
- Create an implementation schedule for the practices within this SWPPP;
- Outline a monitoring plan to ensure this plans effectiveness and provide provisions for necessary revisions; and
- Describe and provide support for the final stabilization design to ensure water quality and quantity management after the construction of the site.

This SWPPP evaluates the existing (pre-construction) and proposed (post-construction) conditions and recommends measures to mitigate stormwater quantity and quality impacts that will result from the proposed site during construction and upon final stabilization. Review of this plan should be in conjunction with the engineering drawings for this project prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C.

2.0 PROJECT BACKGROUND

2.1 PROJECT OVERVIEW

The Orangetown Town Hall Addition and Alterations project consists of demolition of an existing building, construction of a new addition to the building, redesign of the existing landscaped and parking areas, and the associated utilities including stormwater infrastructure to mitigate impacts. The project is considered a redevelopment project with increased

impervious that will be treated as new development according to the NYS Stormwater Management Design Manual, dated January 2015. The total project area is 5.09 acres, and the associated disturbed area is 2.93 acres. The disturbed area results in a net increase of 0.57 acres of impervious area across the project site. This project disturbs more than (1) acre and is therefore required to have a stormwater pollution prevention plan associated with it. The maximum soil exposure limit is 14 days. This plan includes a detention design to regulate post-construction flow rates back to their pre-construction values, and a green infrastructure plan involving the irrigation of captured stormwater run-off using a cistern (Recommended in section 5.3.10 of SWDM). Additionally, cascade hydrodynamic separators (Recommended in section 9.4.2 of SWDM) will be used as an alternative practice to meet water quality and quantity demands.

2.2 SITE LOCATION

The proposed project site is the expansion of the Orangetown Town Hall, a municipal building located at 26 Orangeburg Road, Orangeburg, NY 10962. Located immediately east of exit 6E on the Palisades Interstate Parkway. There is no 100-year floodplain or other Special Flood Hazard Areas on the property.

2.3 SOILS AND SURFACE COVER

The soils of the site consist approximately ninety-two percent (92%) of Wethersfield gravelly silt loam soils, 3 to 8 percent slopes, approximately two percent (2%) of Wethersfield urban land complex, 8 to 15 percent slopes, and approximately six (6%) Urban land, according to the United States Department of Agriculture (USDA), Soil Conservation Service's Soil Survey of Rockland County, New York. The report for the hydrological group of these soils is considered primarily C with smaller areas of urban land that were not given a group. The groundwater level was observed at 205.5 feet. The nearest surface water to the site is Sparkill Creek. The surface water is not within the area of disturbance or close enough to impact the hydrological analysis.

2.4 POST DEVELOPMENT SITE CONDITIONS

The proposed development at the Town Hall includes the removal of an existing building. A new building will be constructed and connected to the west face of the existing building. A new parking lot is to be constructed to the east of the building in the grassy field area, and an existing parking lot is to be removed in order for the new building to be constructed. The entrance

ramp to the town hall is to be modified. Overall impervious land area will increase. A cistern is to be implemented for irrigation and to provide run-off reduction. The cistern will capture run-off from the site to be used later for lawn and landscaping irrigation. Cascade separators will be used to provide WQv as an alternative treatment method for the redevelopment requirement. Separators are most useful on space limited sites where there is not enough room for other structural control methods. The water quantity storage is provided by ACF Environmental LD-Double-Mini storage units.

2.5 VEGETATION CLEARING AND PLANTING

Existing vegetation onsite that is to be removed is grass as well as some shrubbery at the North end of the Property. There are 51 trees surrounding the property are also being removed where the parking pavement is being constructed and where grading is necessary. Fourteen (14) trees will be planted as indicated on the landscaping plan. New trees (Acre Saccharum and Gleditisia Triacanthos "Shade Master) and shrubs (Euonymus Patens "Manhattan", Ilex Crenata Hetzi, and Juniperus Procumbens Nana) are to be planted in accordance with C-106: Lighting and Landscaping Plan.

3.0 POST-CONSTRUCTION STORMWATER MANAGEMENT

The approach to the stormwater management design requires compliance with the New York State Standards for Erosion and Sediment Control and the quantity control requirements included in the New York State Stormwater Management Design Manual (SWDM).

3.1 EXISTING HYDROLOGY

The site has been analyzed as two (2) existing drainage areas under current conditions and is shown on the Existing Drainage Area Map included in Appendix B. The area is composed of existing buildings, existing parking lots, and existing lawn. Hydrologic calculations have been performed for these drainage areas and are included in Appendix D. Stormwater run-off will ultimately be received by the town's drainage system and will not be received by any local water bodies. Review of Rockland County GIS wetland mapping indicates that the site has no known wetlands associated with the project site. Table 1 below shows the rainfall intensity of the project site according to the National Weather Service NOAA Atlas. The extreme precipitation was downloaded from Cornell University's Precipitation tool indicating a 24-hour, 100-year rainfall depth of 8.93 inches. A copy of the precipitation data is included in Appendix D-I. A more conservative value of 9.07 inches provided by the Town of Orangetown was used in the analysis.

Table 1 : Rainfall Parameters

Storm Recurrence Interval	Rainfall Depth for 24hr Storm (inch)
1-Year	2.85 (NOAA)
10-Year	5.51 (NOAA)
100-Year	9.07 (Orangetown Directive)

The peak runoff flows were calculated for the existing conditions of the site at the discharge points for each drainage area. The methodology utilized for this analysis is based upon the USDA, Soil Conservation Service's Technical Release No. 20 and Technical Release No. 55, as utilized by the software entitled HydroCAD version 10.00. HydroCAD, developed by Autodesk is a CAD based program for analyzing the hydrology and hydraulics of stormwater runoff. It utilizes the latest techniques to predict the consequences of a given storm event. Hydro CAD has the capability of computing hydrographs (representing discharge rates characteristic of specific watershed conditions, precipitation, and geologic factors), combining hydrographs, and routing flows through pipes and detention. For this analysis, the property was analyzed for both the existing and proposed conditions. A summary of the parameters results is tabulated below in Table 2.

Table 2 Existing Hydrology Parameters

Drainage Area ID	Area (acres)	Description of Cover	CN	Tc (min)	To Drainage Point
A	0.87	Northern Portion of the Existing Building Pavement/Parking Grass along fence	90	8.0	DP-1
B	4.28	Existing Buildings Pavement/Parking Grass areas East of the Building Sidewalk along streets	86	8.0	

3.2 PROPOSED HYDROLOGY

The site, under proposed conditions, will include a new building conjoined with the existing building, increase of the parking lot area, and a reduction in the lawn area. The design point, at the southeast corner of the site, by the roadway intersection, was maintained. The roof drainage from the addition and the drainage of the western entrance and parking lot are collected as sub- catchment B1 and routed to the cistern for rainwater harvesting and subsurface storage controlled with an outlet control structure. The remaining

area of sub-catchment B, B2, utilizes the existing stormwater infrastructure. The proposed drainage areas are shown in the Proposed Drainage Area Map included in Appendix B. Hydrologic calculations have been performed for each drainage area as described in the prior section and are included in Appendix D-1. A summary of the drainage areas is tabulated below in Table 3.

Table 3: Proposed Hydrology Parameters

Drainage Area ID	Area (acres)	Description of Cover	CN	Tc (min)	To Drainage Point
A	0.69	Existing Building Pavement/Parking Grass along fence Additional parking area added in grass area	91	8	DP-1
B1	1.09	Proposed Building Addition Pavement/Parking Detention Storage Area	91	6	
B2	3.43	Pavement/Parking Grass in front of building and by streets Sidewalk along streets	87	8	

3.3 OVERALL WATER QUALITY VOLUME (WQ_v)

Water quality control, as outlined in the SWDM, was designed to mitigate the impacts of the redevelopment of the site resulting from the increase in impervious cover. The maximum soil exposure limit is 14 days. The water quality requirement for redevelopment was calculated from the existing impervious area being disturbed. The water quality requirement for new development was calculated from the increase in impervious area. The required water quality volumes were calculated for the site are summarized in Table 4 below.

Table 4: Project Area Breakdown

Existing Area		Proposed Area	
Area Type	Area (acres)	Area Type	Area (acres)
Parking/Pavement	0.91	Parking/Pavement	1.20
Buildings	0.23	Buildings	0.37
Sidewalks/Misc.	0.14	Sidewalks/Misc.	0.28
Grass/Landscaped	1.65	Grass/Landscaped	1.08
Total Disturbed Area =			2.93

Existing Area		Proposed Area	
Area Type	Area (acres)	Area Type	Area (acres)
Total Existing Impervious Area (Redevelopment) =			1.28
Total Increase in Impervious Area (New Development) =			0.57

3.4 WQ_v –RUNOFF REDUCTION VOLUME- CISTERN

Runoff Reduction techniques were used to mitigate the impacts from the increased impervious. The minimum Runoff Reduction (S) required for the site's hydrologic soil type C is $0.3 \times WQ_v(\text{New Development})$. Runoff Reduction is summarized in Table 5.

Table 5: New Development WQ_v Requirements

New Development Requirement	Value	
New Development WQ _v Requirement / RR _v	3,241 ft ³	
Minimum RR _v Required (S) ($0.3 \times RR_v$)	972 ft ³	
Rainwater Harvesting- Cistern Volume	3,700 ft ³	27,678 gals
WQ _v Credit towards Redevelopment	459 ft ³	

The water quality required to mitigate the existing impervious area is summarized in Table 5. The cistern was sized to collect the WQ_v generated from Drainage Area B2. The cistern is full after a WQ_v storm. The cistern would be full for the 1-year, 10-year and 100-year storm events. There is a diversion structure upstream of the cistern to convey the larger storm event to the underground storage.

The cistern will provide irrigation to the areas identified on the Landscaping and Lighting Plan, Sheet C-106. The irrigated area is a minimum of 16,000 square feet with four zones. The irrigation system can utilize a spray, rotor, or drip system. The area will also have new tree plantings. The cistern is provided by Contech Engineering Solutions LLC, Model 72" Duromaxx Urbangreen RWH SRPE with a total capacity of 3,700 cf. A water budget analysis is included in Appendix D-III.

3.5 WQ_v – HYDRODYNAMIC SEPARATOR (ALTERNATIVE PRACTICE)

The volume of the cistern in excess of the required WQ_v for new development can be used as credit toward the redevelopment WQ_v requirement. Based on Section 9.2.1.B.IV of the SWDM, the remaining

redevelopment WQv that could be treated by alternative measured is calculated using the following equation:

$$\%WQv \text{ Treatment by Alternative Practice} = (25 - \%Runoff \text{ Reduction}) * 3$$

Additional WQv required by redevelopment is provided through the alternative practice of cascade separators on the East and West side of the property. The western separator addresses the treatment of flows from the proposed building addition and associated paved walkways. The eastern separator provides treatment for the proposed eastern parking area. Each Cascade Separator™ is a CS-4 unit provided by Contech Engineering Solutions, LLC and provides a WQv capacity of 1.8 cfs, and a bypass capacity of 30 cfs. Together, the cistern and the cascade separators provide sufficient WQv based on Chapters 4 and 9 of the SWDM. A summary of the redevelopment WQv required and provided for the project is summarized in Table 6.

Table 6: WQv Summary

WQv Required/ Provided	Value
Redevelopment Volume Credit from Runoff Reduction (Percentage of Total)	459 ft ³ (7%)
Total Redevelopment WQv Required	6,620 ft ³
%WQv Treatment by Alternative Practice = (25 - %Runoff Reduction) * 3 =(25%-7%)*3= 54%	
WQv Required by Alternative Practice (Percentage of Redevelopment Requirement)	3,575 ft ³ (54%)
WQv Treated by Cascade HDS (western portion)	567 ft ³
WQv Treated by Cascade HDS (eastern portion)	3,089 ft ³
Total WQv Provided by Cascade HDS	3,657 ft ³
Water Quality Volume Peak Flow (western portion)	1.19 cfs
Water Quality Volume Peak Flow (eastern portion)	0.86 cfs

3.6 WATER QUANTITY CONTROL

Water quantity control, as outlined in the SWDM, was designed to mitigate the impacts of the increased runoff from the site resulting from the increase in impervious cover. The SWDM states that if 100% of the RRV is met than Channel Protection is not required. Channel Protection is also not required for redevelopment projects if the hydrology is consistent with predevelopment conditions and the post development flows are less than the predevelopment flows. The proposed peak discharges for the 10-year

and 100-year storms were also reduced from the existing peak discharge through the underground detention system and outlet control structure. The runoff from Drainage Area B1 is captured and stored on site with a controlled discharge. Controlling and reducing the runoff from the west side offsets the increase in runoff from the eastern parking area. Therefore, additional detention is unnecessary to reduce the peak flow. The pre vs. post peak flows for the design point as shown in Table 8 below. The underground detention system is comprised of 456 ACF Environmental LD-Double-Mini storage units with a cumulative capacity of 4,668 cf. The peak volumes and elevations within the underground storage for each storm are summarized in Table 7.

Table 7: Peak Volumes and Elevations within Subsurface Storage

Storm Recurrence	Peak Volume (cf)	Peak Elevation (ft)
1-Year	1,996 ft ³	214.16'
10-Year	3,181 ft ³	215.05'
100-Year	4,247 ft ³	215.84'
Top of the System	4,668 ft ³	216.16'

The capacities of the proposed stormwater pipes were analyzed using Autodesk Storm and Sanitary Analysis 2019 under the 100-year intensities. A copy of the output is included in Appendix D-V.

The peak discharges have been reduced in the proposed condition for the design storms. The existing peak flows and the proposed peak flows leaving the site are summarized in Table 8.

Table 8: Existing and Proposed Peak Flows

Drainage Point	Peak Flow Rates (cfs)					
	1-Year		10-Year		100-Year	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
DP-1	8.82	8.54	21.86	21.59	39.34	39.29

3.7 DOWNSTREAM IMPACTS

The downstream impacts are successfully mitigated by the overall stormwater design for the site. Hydrodynamic separators, a cistern and stormwater detention provide runoff reduction, water quality and quantity controls to the runoff from the site where there were none previously.

4.0 IDENTIFICATION OF POTENTIAL STORMWATER CONTAMINANTS

The purpose of this section is to identify pollutants that could impact stormwater during construction of the site.

4.1 SIGNIFICANT MATERIAL INVENTORY

Pollutants resulting from clearing, grading, excavation, storage areas, and building materials, which have the potential to be present in stormwater runoff, are listed in Table 9 on the following page. This table includes information regarding material type, chemical and physical description, potential sources, and the specific regulated storm water pollutants associated with each material.

Table 9: Potential Construction Site Stormwater Pollutants

Trade Name Material	Chemical / Physical Description	Potential Source	Stormwater Pollutants	Storage	Containment	Disposal
				See Section of SWPPP ¹ :		
Pesticides	Various colored to colorless liquid, powder, pellets, or grains	Landscaped areas	Chlorinated hydrocarbons, organophosphates, carbonates, arsenic	7.1 7.7.a 7.8.a	7.7.a 7.8.e 7.9	7.7.b,c,d
Fertilizer	Liquid or solid grains	Landscaped areas	Nitrogen, phosphorous	7.1 7.7.a 7.8.a	7.7.a	7.7.b,c,d
Plaster	White granules or powder	Building construction	Calcium sulphate, calcium carbonate, sulfuric acid	7.1 7.7.a 7.8.a	7.7.a	7.7.b,c,d
Cleaning solvents	Colorless, blue, or yellow-green liquid	Building construction	Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillates	7.1 7.7.a 7.8.a	7.7.a 7.9	7.7.b,c,d 7.8.g
Asphalt	Black solid	Parking lot construction	Oil, petroleum distillates, solids	7.1	NA	7.7.b,c,d
Concrete	White solid	Building/parking lot const.	Limestone, sand	7.1	5.2.e 7.8.f	5.2.e 7.7.b,c,d
Glue, adhesives	White or yellow liquid	Building construction	Polymers, epoxies	7.1 7.7.a 7.8.a	7.7.a 7.9	7.7.b,c,d
Paint	Various colored liquid	Building construction and parking lot markings	Metal oxides, Stoddard solvent, talc, calcium carbonate, arsenic	7.1 7.7.a 7.8.a	7.7.a 7.9	7.7.b,c,d
Curing compounds	Creamy white liquid	Building construction, curbing and structures	Naphtha	7.1 7.7.a 7.8.a	7.7.a 7.8.f 7.9	7.7.b,c,d
Wastewater from equipment	Water	On-site equipment	Soil, oil and grease, solids	NA	7.8.b,c,d	7.7.b,c,d 7.8.c,d
Wood preservatives	Clear amber or dark brown liquid	Building construction	Stoddard solvent, petroleum distillates, arsenic, copper, chromium	7.1 7.7.a 7.8.a	7.7.a	7.7.b,c,d

Trade Name Material	Chemical / Physical Description	Potential Source	Stormwater Pollutants	Storage	Containment	Disposal
				See Section of SWPPP ¹ :		
Hydraulic oil/fluids	Brown oily petroleum hydrocarbon	On-site equipment	Mineral oil	7.1 7.7.a 7.8.a	7.7.a 7.8.b,c,l,k 7.9	7.7.b,c,d 7.8.j
Gasoline	Colorless, pale brown or pink petroleum hydrocarbon	On-site equipment	Benzene, ethyl benzene, toluene, xylene, MTBE	7.1 7.7.a 7.8.a,i	7.7.a 7.8.b,c,l,k 7.9	7.7.b,c,d 7.8.j
Diesel Fuel	Clear, blue-green to yellow liquid	On-site equipment	Petroleum distillate, oil and grease, naphthalene, xylenes	7.1 7.7.a 7.8.a,i	7.7.a 7.8.b,c,l,k 7.9	7.7.b,c,d 7.8.j
Kerosene	Pale yellow liquid petroleum hydrocarbon	On-site equipment	Coal oil, petroleum distillates	7.1 7.7.a 7.8.a	7.7.a 7.8.b,c,l,k 7.9	7.7.b,c,d 7.8.j
Antifreeze / coolant	Clear green/yellow liquid	On-site equipment	Ethylene glycol, propylene glycol, heavy metals	7.1 7.7.a 7.8.a	7.7.a 7.8.b,c,l,k 7.9	7.7.b,c,d
Erosion	Solid particles	Cleared and graded areas and tree removal areas	Soil, sediment	5.0	5.0	5.1.i

¹**Bold** indicates specific instruction for material listed.

4.2 POTENTIAL AREAS FOR STORMWATER CONTAMINATION

There are five main potential sources for stormwater contamination: the construction debris from past demolitions, on site and new building construction, the parking lot construction, the sidewalk construction, and landscaped areas. During construction, all of the five areas mentioned will also contain the potential containment sources of cleared and graded areas, and on-site equipment. These main sources are located within the limits of disturbance and are shown on the Erosion Control Plan.

4.3 SUMMARY OF AVAILABLE STORMWATER SAMPLING DATA

There is no existing stormwater sampling data available.

5.0 SOIL EROSION AND SEDIMENT CONTROLS

The soil erosion and sediment control measures outlined herein are incorporated into the project site plans. Additionally, a construction schedule and phasing plan to aid in the proper implementation of erosion and sediment controls has been included with the Erosion Control Plan. General measures that will be implemented are as follows:

5.1 GENERAL MEASURES

- a. There shall be no increase in turbidity that will cause a substantial visible contrast to natural conditions. There shall be no increase in suspended, colloidal and settleable solids that will cause deposition or impair the waters for their best usage. There shall be no residue from oil and floating substances, or visible oil film, or globules of grease.
- b. Site preparation activities shall be planned to minimize the area and duration of soil disruption.
- c. All facilities and systems of treatment and control shall be operated and maintained at all times to achieve compliance with the SWPPP.
- d. In no case shall erodible materials be stockpiled within 25 feet of any wetland, stream or other surface water body.
- e. All unnecessary removal of healthy trees shall be avoided. Materials shall not be stored nor machinery operated within the drip-line of the trees to remain.
- f. To facilitate final stabilization, intermediate silt fences/dikes/diversions may be removed upon initial catch of upslope final

seeding/mulching. Perimeter and base of slope silt fences/dikes shall remain in place until final stabilization is achieved to protect offsite discharge potential.

- g. The site shall be inspected daily by the Contractor and every seven (7) days by the Owner's Representative as a minimum. They shall inspect and maintain the integrity and function of all temporary erosion control measures throughout the duration of the development process.
- h. To assure proper function, siltation barriers shall be maintained in good condition and reinforced, extended, repaired or replaced as necessary. All accumulated sediment shall be removed and contained in appropriate spoil areas.
- i. Onsite soils removed from the site should follow all applicable local, state, and federal regulations as outlined in Specification Section 31-31-00: Soil Management included in Appendix N.
- j. The maximum time limit for any soil exposure shall be 14 days.

5.2 TEMPORARY STRUCTURAL MEASURES

Temporary structural practices are used during construction to prevent offsite sedimentation. The length of time that temporary practices are functional varies from project to project, since the sediment control strategy may change as construction activity progresses. Runoff control measures should be the first items constructed when grading begins, and be completely functional before downslope land disturbance takes place. Only after the runoff control structures are operational and sediment control measures are in place, should clearing and grading on the rest of the construction site begin.

- a. Silt Fence- Prior to the initiation of and during construction activities, a geotextile filter fabric (silt fence) will be established along the down slope perimeter of areas to be disturbed. To facilitate effectiveness of the silt fence, daily inspections, and inspections immediately after significant storm events will be performed by site personnel. Maintenance of the fence will be performed as needed.
- b. Straw Bale Dike- A temporary barrier of straw, or similar material, used to intercept sediment laden runoff from small drainage areas of disturbed soil. The purpose of a bale dike is to reduce runoff velocity and effect deposition of the transported sediment load. Straw bale dikes have an estimated design life of three (3) months.
- c. Stabilization Construction Entrance- Prior to construction, stabilized construction entrances will be installed at points of entry and egress

from the site to reduce the tracking of sediment onto public roadways. Construction traffic must enter and exit the site at the stabilized construction entrance. When necessary, the placement of additional aggregate atop the filter fabric will be done to assure the minimum thickness is maintained. All sediments and soils spilled, dropped, or washed onto the adjacent streets must be removed immediately. Periodic inspection and needed maintenance shall be provided after each substantial rainfall event.

- d. Temporary Soil Stockpile- Materials such as topsoil, will be temporarily stockpiled (if necessary) on-site during construction. Stockpiles will be located in an area away from storm drainage, water bodies, and/or courses, and will be properly protected from erosion by a surrounding silt fence.
- e. Concrete Truck Washout- A temporary excavated or above ground lined constructed pit where concrete truck mixers and equipment can be washed after their loads have been discharged, to prevent highly alkaline runoff from entering storm drainage systems or leaching into soil. The washout is required to have a minimum depth of 2-feet and 8-feet by 8-feet dimensions. The location of the washout should be sufficiently (minimum of 100 feet) from drainage structures and close to the gravel access drive and should have proper signage designating the "Concrete Washout Area". Material collected in concrete washout must be disposed of off-site. No burial of washout material is permitted on-site. Maintenance of the wash area is to include removal of hardened concrete.
- f. Sediment Trap- A temporary sediment device formed by excavation and/or embankment to intercept sediment-laden runoff and trap the sediment in order to protect drainageways, properties, and rights-of-way below the sediment trap from sedimentation. A stone weir sediment trap is being implemented. See Appendix E for calculations, storage requirements, and maintenance and cleanout procedures. Remove built up sediment when it reaches 50% of the design capacity.
- g. Dust Control- The control of dust resulting from land-disturbing activities. The purpose of dust control is to prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.
- h. Storm Drain Inlet Protection- A temporary barrier with low permeability, installed around inlets in the form of a fence, berm, or excavation around an opening, detaining water and thereby reducing the sediment content

of sediment laden water by settling thus preventing heavily sediment laden water from entering a storm drain system.

5.3 VEGETATIVE MEASURES

- a. As much as practical, existing vegetation shall be preserved. Following the completion of construction activities in any portion of the site, permanent vegetation shall be established on all exposed soils.
- b. Permanent vegetative cover: Immediately following the completion of construction activity in any portion of the site, permanent vegetation shall be established on all exposed soils.
- c. Washouts shall be immediately repaired, re-seeded and protected from further erosion.
- d. Permanent seeding shall occur in the spring or fall. The spring seeding window is from March 1st to May 15th and the fall seeding window is from August 15th to October 1st.
- e. Permanent seeding shall be applied at a rate of a minimum of 4.0 pounds total seed per 1000 square feet or approximately 175 pounds per acre. If hydroseeding will be the method of application, the seed rate should be increased by 25% and hydro seed areas must still receive straw and tackifier.
- f. An adequate seedbed shall be prepared by scarifying soil and removing surface debris and obstacles within the disturbed area to a depth of 4 inches.
- g. All landscaped/grassed areas will be seeded and mulched in a two-step hydraulic process to promote growth as soon as possible.
- h. All seeding shall be performed using hydroseeding. Hydroseeding slurry shall be comprised of a homogeneous mix of seed and fertilizer in water. Various specified seed mixes shall be independently mixed and applied.
- i. All disturbed areas shall be stabilized subsequent to seeding by applying 2 tons of straw mulch per acre. Straw mulch shall be anchored by applying 750 lbs of wood fiber mulch per acre with a hydroseeder. Hydromulching slurry shall be comprised of a homogeneous mix of non-asphaltic tackifier and fiber mulch in water.
- j. Deep ripping and Decompaction are key factors which help in restoring soil pore space and permeability for water infiltration. Conversely, the physical actions of cut-and-fill work, land grading, the ongoing movement of construction equipment and the transport of building

materials throughout a site alter the architecture and structure of the soil, resulting in: the mixing of layers (horizons) of soil materials, compression of those materials and diminished soil porosity which, if left unchecked, severely impairs the soil's water holding capacity and vertical drainage (rainfall infiltration), from the surface downward. The two-phase practice of 1) "Deep Ripping;" and 2) "Decompaction" (deep subsoiling), of the soil material as a step in the cleanup and restoration/landscaping of a construction site, helps mitigate the physically induced impacts of soil compression; i.e.: soil compaction or the substantial increase in the bulk density of the soil material.

5.4 SWPPP MEASURES

- a. Any modifications to the on-site SWPPP when there is a significant change in design, construction, operation, or maintenance should be submitted to the MS4 for review and approval. See Section 8.0, item d.
- b. If the SWPPP proves to be ineffective in eliminating or significantly minimizing pollutants identified in the SWPPP, or achieving the general objectives of controlling pollutants in stormwater discharged from construction activities.
- c. To identify any contractor or sub-contractor that will implement any measure of the SWPPP.
- d. All contractors and sub-contractors identified in the SWPPP as outlined above shall sign a copy of the Certification Statement before undertaking any construction activity at the site identified in the SWPPP.
- e. The developer/contractor or his builder shall have the site inspected and a log kept on site. The documents must be maintained in a secure location, such as a job trailer, on-site construction office, or a mailbox with lock; that is accessible during normal working hours to an individual performing a compliance inspection.
- f. Owner's qualified inspector shall conduct site inspections for all construction activities every 7 days and within 24 hours of any storm event producing 0.5 inch of precipitation or more. See section 7.11 and Appendix A- SPDES General Permit for Construction Activity, Part IV, Section C.
- g. To effectively control wind erosion, water shall be applied to all exposed soils as necessary of the project site as designed.

6.0 CONSTRUCTION SEQUENCE

Sequence of Construction Activities: The Contractor's work schedule and methods shall be consistent with the SWPPP or amended SWPPP. Once approved, the progress schedule shall become a part of the SWPPP. Throughout the entirety of construction, areas for contractor use shall be provided as described in the sequencing plan to allow for equipment parking (when not in use), storage, construction materials, stockpiles, debris, waste and borrow areas, and general staging areas.

The following list is a suggested sequence of major construction activities for the project to meet the NYSDEC erosion control requirements:

1. All approvals and permits shall be secured by the contractor.
2. A pre-construction meeting with the owner, owner's representative, municipal representative, and contractor present will be held.
3. Erosion control sequence of operations shall be coordinated with the Sequencing Plan on C-107.
4. Certifications obtained from contractors, subcontractors, and any others performing site disturbances, including underground utility contractors, be signed and maintained on site.
5. Construction entrance, silt fence storm drain inlets protection, construction fence, tree protection, and other temporary erosion control measures will be installed prior to construction, including clearing, grubbing, and demolition of the site, in accordance with the NYS Standards and Specifications for Erosion and Sediment Control, latest edition.
6. Install provisions for protection of existing facilities, where indicated on the plans.
7. Changes to the erosion and sediment control sequencing shall be approved by the owner's representative.
8. Active disturbance shall be limited to less than 5 acres maximum at any time without temporary stabilization. All non-active disturbance areas shall receive temporary or permanent stabilization. Non-active disturbed soil areas shall not remain exposed for longer than 14 days without being stabilized.
9. Any borrow or waste pit located on or off-site must immediately receive temporary stabilization, shall not be left unstabilized, and be maintained per the requirements of the General Construction Permit.
10. Drainage structures and pipes shall be installed along with energy dissipaters.
11. Roadways shall be graded and immediately stabilized with proposed stone surface.
12. Sequence 1 - Erosion and Sediment Control Schedule:
 - A. Install perimeter controls, inlet protection, tree protection, and fiber rolls in vicinity of work area as shown on the plans.

- B. Install stabilized construction access in northeast corner of site near entrance to Dutch Hill Road.
 - C. Install Sediment Trap B within limits shown on the plans.
 - D. Demolish existing parking lot as shown on the plans to create an area for contractor use.
 - E. Construct proposed utilities, pavement, and hardscape within limits shown on the plans. Immediately after subgrade is established, install stone subbase layers for pavement and hardscape areas (maintain stabilized construction access until stone subbase placement is complete for new pavement). Immediately after utility installation is complete, install utility bedding and perform final grading in vicinity. Reduce area for Sediment Trap B, while maintaining volumetric capacity, as proposed pavement along eastern edge of site progresses.
 - F. Apply temporary or permanent stabilization to all areas impacted by construction that are not planned to be disturbed in follow on sequences or will be inactive for greater than fourteen (14) days.
13. Sequence 2 - Erosion and Sediment Control Schedule:
- A. Install perimeter controls, inlet protection, tree protection, and fiber rolls in vicinity of work area as shown on the plans. Maintain all erosion and sediment control measures from Sequence 1 that are still required.
 - B. Demolish existing parking lot and temporary electric within limits shown on the plans.
 - C. Install Sediment Trap A within limits shown on the plans.
 - D. Install stabilized construction access off Orangeburg rd.
 - E. Transition area for contractor use to new location on pavement installed in Sequence 1 in limits approved by the owner's representative.
 - F. Construct proposed addition, utilities, pavement, and hardscape within limits shown on the plans. Immediately after subgrade is established, install stone subbase layers for pavement and hardscape areas (maintain stabilized construction access until stone subbase placement is complete for new pavement). Immediately after utility installation is complete, install utility bedding and perform final grading in vicinity.
 - G. Apply temporary or permanent stabilization to all areas impacted by construction that are not planned to be disturbed in follow on sequences or will be inactive for greater than fourteen (14) days.
 - H. Remove Sediment Trap A once all disturbance upstream of trap has been stabilized and install stormwater vault.
14. Sequence 3 - Erosion and Sediment Control Schedule:
- A. Install perimeter controls, inlet protection, tree protection, and fiber rolls in vicinity of work area as shown on the plans. Maintain all erosion

- and sediment control measures from Sequence 1-2 that are still required.
 - B. Once existing south building demolition is completed (not in contract) and area has been handed over to owner, transition area for contractor use to this area.
 - C. Construct utilities, pavement, and hardscape within limits shown on the plans. Immediately after subgrade is established, install stone subbase layers for pavement and hardscape areas. Reduce area for Sediment Trap B while maintain Immediately after utility installation is complete, install utility bedding and perform final grading in vicinity.
 - D. Mill and overlay existing pavement areas as shown on the plans.
 - E. Apply temporary or permanent stabilization to all areas impacted by construction that are not planned to be disturbed in follow on sequences or will be inactive for greater than fourteen (14) days.
 - F. Remove Sediment Trap B once all disturbance upstream of trap has been stabilized. Stabilize area for trap once completely removed.
15. Sequence 4 - Erosion and Sediment Control Schedule:
- A. Install perimeter controls, inlet protection, tree protection, and fiber rolls in vicinity of work area as shown on the plans. Maintain all erosion and sediment control measures from Sequence 1-3 that are still required.
 - B. Construct hardscape within limits shown on the plan. Immediately after subgrade is established, install stone subbase layers for hardscape areas
 - C. Mill and overlay existing pavement areas as shown on the plans.
16. Decompact access and storage/stockpile areas.
17. All landscaped/grassed areas will be seeded and mulched in a two-step hydraulic process to promote growth as soon as possible and in accordance with Note 4 of the Erosion and Sedimentation Control Notes on Sheet C-105.
18. General contractor to remove Sediment Trap B and apply temporary stabilization to area.
19. Upon final stabilization, general contractor shall remove all erosion and sediment controls. Reapplication of hay and seed may be required in some areas if removal of temporary erosion and sediment control measures creates disturbance.
20. Remove all silt and sediment from site.
21. All debris, silt, and other obstructions are to be removed from the end of the drainage structures after all onsite work is complete and all disturbed areas have been stabilized.
22. Owner's representative to review site and direct any corrective actions deemed necessary to approve final stabilization and facilitate SPDES permit closeout.

23. Contractor to provide as-built of drainage network and post construction stormwater controls to owner's representative prior to SPDES permit closeout and in accordance with the project specifications.

7.0 NONSTRUCTURAL BMPS

There are nonstructural BMPs that are included as parts of this plan to prevent the introduction of pollutants into stormwater.

7.1 GOOD HOUSEKEEPING

All exposed areas of the site with the potential for stormwater pollutants (See Table 9) must be kept clean and orderly. Specific areas of concern for this site include, but are not limited to: storage areas, fueling areas, and equipment storage and cleaning areas. An inventory of all equipment and containers with hazardous or toxic materials should be kept on site and up to date. A schedule for Good Housekeeping practices should be created prior to construction and followed and altered as necessary throughout the project.

7.2 MINIMIZING EXPOSURE

The exposure of pollutants to rain, ice, snow, and snowmelt should be minimized by utilizing practices to limit such exposure. For example, when possible, water resistant coverings should be used to minimize exposure.

7.3 DUST CONTROL

Dust Control measures help to prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems. Dust Control measures should be installed on construction roads, access points, and other disturbed, areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the local permitting authority.

7.4 NON-DRIVING AREAS

These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

- a. Vegetative Cover- For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control
- b. Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

7.5 DRIVING AREAS

These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Provision shall be made to control the amount of airborne dust released off site from construction operations, by wetting the construction material as necessary, provided wetting will not damage utility infrastructure or create any safety hazards. All construction material shall be sufficiently wetted to prevent dust from becoming airborne before loading into trucks, vehicles, or other containers. During transport, such material shall be enclosed or covered to prevent dust dispersion.

Trucks and other vehicles used to transport particulate matter shall be covered and any particulate matter kept on site shall be sufficiently wetted or stored to prevent particulate matter from becoming airborne.

7.6 SPILL PREVENTION AND RESPONSE PROCEDURES

All potential pollutants (See Table 9) other than sediment will be handled and disposed of in a manner that does not cause contamination of stormwater. Non-sediment pollutants that may be present during construction activities have been identified in Section 4.0 of this report and refer to Appendix “E” NYSDEC Standards and Specifications for Site Pollution Prevention for Storage, Containment, and Disposal. These materials, and other materials used during construction with the potential to impact stormwater, will be stored, managed, used, and disposed of in a manner that minimizes the potential for release into the environment. Emergency contacts for the project will be posted at the project office and are included at the end of this section.

7.7 GENERAL MATERIAL AND HANDLING PRACTICES

The following general practices will be used throughout construction to reduce the potential for spills.

- a. Material Safety Data Sheets (MSDS) for potential pollutants (See Table 9 and refer to Appendix “E” NYSDEC Standards and Specifications for Site Pollution Prevention for Storage, Containment, and Disposal) should be kept on site. Potential pollutants will be stored and used in a manner

consistent with the manufacturer's instructions in a secure location. To the extent practicable, material storage areas should not be located near storm drain inlets and should be equipped with covers, roofs, or secondary containment as needed to prevent stormwater from contacting stored materials. Chemicals that are not compatible shall be stored in segregated areas so that spilled materials cannot combine and react.

- b. Materials disposal will be in accordance with the manufacturer's instructions and applicable local, state, and federal regulations.
- c. Materials no longer required for construction will be removed from the site as soon as practicable.
- d. Adequate garbage, construction waste, and sanitary waste handling and disposal facilities will be provided to the extent necessary to keep the site clear of obstruction and BMPs clear and functional.

7.8 SPECIFIC MATERIAL AND HANDLING PRACTICES

All pollutants, including waste materials and demolition debris, that occur on-site during construction will be handled in a way that does not contaminate stormwater (See Table 9 and refer to Appendix "E" NYSDEC Standards and Specifications for Site Pollution Prevention for Storage, Containment, and Disposal).

- a. All chemicals including liquid products, petroleum products, water treatment chemicals, and wastes stored on site will be covered and contained and protected from vandalism. Items should be stored in their original containers or approved containers in accordance with their respective MSDS and per all local state, and federal regulations. The container should be inspected regularly.
- b. Maintenance and repair of all equipment and vehicles involving oil changes, hydraulic system drain down, de-greasing operations, fuel tank drain down and removal, and other activities which may result in the accidental release of contaminants, will be conducted under cover during wet weather and on an impervious surface to prevent the release of contaminants onto the ground. Secondary containment (drain pan) to catch spills when removing or changing fluids. Materials spilled during maintenance operations will be cleaned up immediately and properly disposed of.
- c. All equipment and vehicles on-site shall be inspected for leaks regularly to ensure that gasoline, diesel fuel, antifreeze, oils and grease do not come in contact with soil or stormwater.

- d. Equipment wash wastewater will be settled and discharged on site by infiltration in a designated area setback from the wetlands and controlled by erosion measures.
- e. Application of agricultural chemicals, including fertilizers and pesticides, will be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations will be followed for application rates and procedures.
- f. pH-modifying sources will be managed to prevent contamination of runoff and stormwater collected on site. The most common sources of pH-modifying materials are bulk cement, cement kiln dust (CKD), fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters.
- g. Portable equipment must be stored in safe and secure locations under cover at the end of each work day.
- h. Solvents shall be disposed of in approved containers and removed from site at scheduled intervals.
- i. Fuel for construction equipment shall either be obtained from a licensed distributor of petroleum products or from an approved above ground storage tank on site (above ground storage tanks with a combined capacity of 1,100 gallons shall be installed pursuant to 6 NYCRR Part 614 Standards for New and Substantially Modified Petroleum Storage Facilities). A distributor may be contracted to arrive on site periodically and fill all equipment as necessary. All distributors of petroleum products must have appropriate permits and licenses from the NYSDEC and have adequate liability insurance to mitigate and clean up any spills that occur on site.
- j. Used oil and petroleum products shall be stored in approved containers in accordance with their respective MSDS and per all local state, and federal regulations until recycled or disposed of at an approved disposal facility.
- k. The proper equipment (pumps, funnels) should be used to transfer fluids in designated fueling areas. The fuel should not be "topped-off" in the tanks.
- l. Temporary sanitary facilities shall be leak and tip proof. A waste management company contracted to provide the routine maintenance of facilities shall have appropriate permits and licenses from the NYSDEC and adequate liability insurance to mitigate and clean up any spills that occur on site.

7.9 SPILL RESPONSE

The primary objective in responding to a spill is to quickly contain the material(s) and prevent or minimize their migration into stormwater runoff and conveyance systems. If the release has impacted on-site stormwater, it is critical to contain the released materials on site and prevent their release into receiving waters.

- a. If a spill of pollutants (See Table 9) threatens stormwater at the site, the spill response procedures outlined below must be implemented in a timely manner to prevent the release of pollutants.
- b. The site superintendent will be notified immediately when a spill, or the threat of a spill, is observed. The superintendent will assess the situation and determine the appropriate response.
- c. If spills represent an imminent threat of escaping facilities and entering the receiving waters, facility personnel will respond immediately to contain the release and notify the superintendent after the situation has been stabilized.
- d. Spill kits containing materials and equipment for spill response and cleanup will be maintained at the site. Each spill kit may contain:
 - e. Oil absorbent pads (one bale)
 - f. Oil absorbent booms (40 feet)
 - g. 55-gallon drums (2)
 - h. 9-mil plastic bags (10)
 - i. Personal protective equipment including gloves and goggles
 - j. If an oily sheen is observed on surface water (e.g., settling ponds, detention pond, and swales), absorbent pads and/or booms will be applied to contain and remove the oil. The source of the oil sheen will also be identified and removed or repaired as necessary to prevent further releases.
- k. The site superintendent, or his designee, will be responsible for completing the spill reporting form and for reporting the spill to the appropriate state or local agency.
- l. Facility personnel with primary responsibility for spill response and cleanup will receive training from the site superintendent. This training will include identifying the location of spill kits and other spill response equipment and the use of spill response materials.
- m. Spill response equipment will be inspected and maintained as necessary to replace any materials used in spill response activities.

7.10 NOTIFICATION

In the event of a spill, make the appropriate notification(s) consistent with the following procedures:

- a. Any spill of oil which a) violates water quality standards, b) produces a “sheen” on a surface water, or c) causes a sludge or emulsion must be reported immediately by telephone to the **National Response Center Hotline at (800) 424-8802**.
- b. Any oil, hazardous substance, or hazardous waste release which exceeds the reportable quantity must be reported immediately by telephone to the **National Response Center Hotline at (800) 424-8802**.
- c. Any spill of oil or hazardous substance to waters of the state must be reported immediately by telephone to the **NYSDEC spill hotline at (800) 457-7362**.
- d. Any release of a hazardous substance that may be a threat to human health or the environment must be reported to the **NYSDEC spill hotline at (800) 457-7362** immediately upon discovery.

7.11 SITE INSPECTIONS

Site inspections should be performed every seven (7) calendar days and within 24 hours of any storm event producing 0.5 inch of precipitation or more. Within one (1) business day of inspection, the qualified inspector must notify the owner or operator and the appropriate contractor or subcontractor of any corrective actions that need to be taken and that contractor or subcontractor must begin implementing the corrective actions within one (1) business day of the notification and complete within a reasonable amount of time. Inspection should be photo documented along with any corrective actions taken in response to deficiencies or opportunities for improvement.

Inspections for specific elements of the SWPPP in addition to the weekly site inspection are in accordance with New York State Standards and Specifications for Erosion and Sediment control. Copies of the applicable standards and specifications for erosion control are included in Appendix E and sample logs and checklist in Appendix J.

7.12 EMPLOYEE TRAINING

Employee training must be provided for all employees prior to their first day on site. Training must inform employees of components and goals of the SWPPP, such as: spill response, good housekeeping, material management practices, disposal and control of waste, equipment fueling, and proper storage, washing, maintenance, and inspection procedures.

8.0 GENERAL REQUIREMENTS FOR OWNERS OR OPERATORS

- a. The owner or operator shall ensure that the provisions of the SWPPP are implemented from the commencement of construction activity until all areas of disturbance have achieved final stabilization and the Notice of Termination ("NOT") has been submitted to NYSDEC.
- b. Prior to the commencement of construction activity, the owner or operator must identify the contractor(s) and subcontractor(s) that will be responsible for installing, constructing, repairing, replacing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and the contractor(s) and subcontractor(s) that will be responsible for constructing the post-construction stormwater management practices included in the SWPPP. The owner or operator shall have each of the contractors and subcontractors identify at least one person from their company that will be responsible for implementation of the SWPPP.
- c. The owner or operator shall maintain a copy of the General Permit (GP-0-20-001), NOI, NOI Acknowledgment Letter, SWPPP, MS4 SWPPP Acceptance form, inspection reports, responsible contractor's, or subcontractor's certification statement, and all documentation necessary to demonstrate eligibility with this permit at the construction site until all disturbed areas have achieved final stabilization and the NOT has been submitted to the Department. The documents must be maintained in a secure location, such as a job trailer, on-site construction office, or mailbox with lock. The secure location must be accessible during normal business hours to an individual performing a compliance inspection.
- d. The owner or operator shall notify the regulated, traditional land use control MS4 in writing of any planned amendments or modifications to the post-construction stormwater management practice component of the SWPPP. Unless otherwise notified by the regulated, traditional land use control MS4, the owner or operator shall have the SWPPP amendments or modifications reviewed and accepted by the regulated, traditional land use control MS4 prior to commencing construction of the post-construction stormwater management practice.
- e. The owner or operator is required to perform inspections as outlined in Section 7.11.
- f. The owner or operator is required to ensure the contractor and subcontractor are adhering to the SWPPP.

9.0 GENERAL REQUIREMENTS FOR CONTRACTORS AND SUBCONTRACTORS

- a. All contractors and subcontractors associated with the project must comply with the terms of the SWPPP.
- b. The contractors and subcontractors shall identify at least one person from their company that will be responsible for implementation of the SWPPP. This

person shall be known as the trained contractor. At least one trained contractor shall be on site on a daily when soil disturbance activities are being performed.

- c. The trained contractor must complete the four (4) hours of NYSDEC endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity. A copy of the certification should be submitted to the owner or operator.
- d. The trained contractor (and any trained subcontractors) shall sign a copy of the certification statement included in Appendix H and provide to the owner or operator.
- e. Any new or additional contractors hired to implement measures identified in the SWPPP after construction has commenced, must also sign the certification statement in Appendix H and provide to the owner or operator.
- f. Trained contractor must inspect the erosion and sediment control practices and pollution prevention measures being implemented within the active work area daily to ensure that they are being maintained in effective operating condition at all times. If deficiencies are identified, the contractor shall begin implementing corrective actions within one business day and shall complete the corrective actions in a reasonable time frame.
- g. Contractor/Trained Contractor also must review the Qualified Inspector's Report and the contractor or subcontractor shall begin implementing the corrective actions required within one business day of this notification and shall complete the corrective actions in a reasonable time frame.
- h. Contractors and subcontractors shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

10.0 NYSOPRHP AND T&E DOCUMENTATION

In accordance with GP-O-20-001, documentation has been provided to the Office of Parks, Recreation and Historic Preservation (OPRHP) to determine if the project would affect a historic property. OPRHP determined that no properties, including archaeological and/or historic resources, listed in or eligible for the New York State and National Registers of Historic Places will be impacted by this project. A copy of the letter response indicating this is included in Appendix I.

A Rare, Threatened, and Endangered Species Report has been prepared by Tectonic and is included in Appendix K. The conclusion of the report is that the proposed project will have no effect on federal or state regulated Rare, Threatened or Endangered species.

11.0 MONITORING, REPORTING AND RETENTION OF RECORDS

The owner and contractor are required to read, understand and comply with all monitoring, reporting and retention of records required by the SWPPP. Certification Signatures from the Owner, SWPPP preparer, Qualified Inspector and Contractor are to be kept in the SWPPP on site. Also, contractor's proof of completion for the required NYS DEC Endorsed 4-Hour Erosion and Sediment Control Course must also be supplied in the SWPPP on site.

12.0 OWNERSHIP AND MAINTENANCE OF PERMANENT STRUCTURES

The permanent stormwater structures will be owned and maintained by the Town of Orangetown in accordance with the approved plans and this SWPPP. Procedures, checklists and sample logs for maintenance are included in Appendix M.

ACRONYMS

BMP: Best Management Practice

CWA: Clean Water Act

DPW: Department of Public Works

EPA: Environmental Protection Agency

ECL: Environmental Conservation Law

HDS: Hydrodynamic Separator

MSDS: Material Safety Data Sheet

NOI: Notice of Intent

NOT: Notice of Termination

NPDES: National Pollution Discharge Elimination System

NYSDEC: New York State Department of Environmental Conservation

RRv: Runoff Reduction Volume

SWDM: Stormwater Management Design Manual

SPDES: State Pollution Discharge Elimination System

SWPPP: Storm Water Pollution Prevention Plan

WQv: Water Quality Volume

GLOSSARY

Commencement of Construction – the initial disturbance of soils associated with clearing, grading, or excavating activities, or other construction activities.

Existing – for purposes of site conditions “existing” refers to the site prior to renovation.

Facility – the proposed addition.

Final Stabilization – all soil disturbing activities at the site have been completed, and that a uniform perennial vegetative cover with a density of 80% has been established, or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

Owner or Operator - means the person, persons or legal entity which owns or leases the property on which the construction activity is occurring; and/or an entity that has operational control over the construction plans and specifications, including the ability to make modifications to the plans and specifications.

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Proposed – for the purposes of site conditions “proposed” refers to the site post renovation.

Qualified professional – means a person that is knowledgeable in the principles and practices of stormwater management and treatment, such as a licensed Professional Engineer, licensed Landscape Architect or other Department endorsed individual(s). Individuals preparing SWPPPs that require the post-construction stormwater management practice component must have an understanding of the principles of hydrology, water quality management practice design, water quantity control design, and, in many cases, the principles of hydraulics in order to prepare a SWPPP that conforms to the Department’s technical standard. All components of the SWPPP that involve the practice of engineering, as defined by the NYS Education Law (see Article 145), shall be prepared by, or under the direct supervision of, a professional engineer licensed to practice in the State of New York.

Redevelopment Activity(ies) – means the disturbance and reconstruction of existing impervious area, including impervious areas that were removed from a project site within five (5) years of preliminary project plan submission to the local government (i.e. site plan, subdivision, etc.).

Stabilization – covering or maintaining an existing cover over soil. Cover can be vegetative (e.g. grass, trees, seed and mulch, shrubs, or turf) or non-vegetative (e.g. geotextiles, riprap, or gabions).

Trained Individual – means an employee from a contracting (construction) firm that has received four (4) hours of training, which has been endorsed by the Department, from a Soil and Water Conservation District, CPESC, Inc. or other Department endorsed entity, in proper erosion and sediment control principles no later than two (2) years from the date of project approval. After receiving the initial training, the trained individual shall receive four (4) hours of training every three (3) years. This individual will be responsible for implementation of the SWPPP.

APPENDIX A



Department of
Environmental
Conservation

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SPDES GENERAL PERMIT
FOR STORMWATER DISCHARGES

From

CONSTRUCTION ACTIVITY

Permit No. GP- 0-20-001

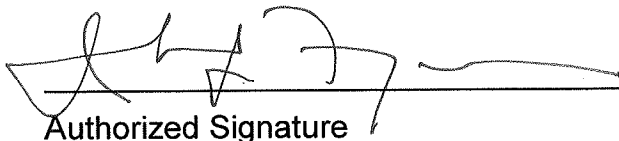
Issued Pursuant to Article 17, Titles 7, 8 and Article 70
of the Environmental Conservation Law

Effective Date: January 29, 2020

Expiration Date: January 28, 2025

John J. Ferguson

Chief Permit Administrator



Authorized Signature

1-23-20
Date

Address: NYS DEC
Division of Environmental Permits
625 Broadway, 4th Floor
Albany, N.Y. 12233-1750

PREFACE

Pursuant to Section 402 of the Clean Water Act (“CWA”), stormwater *discharges* from certain *construction activities* are unlawful unless they are authorized by a *National Pollutant Discharge Elimination System (“NPDES”)* permit or by a state permit program. New York administers the approved State Pollutant Discharge Elimination System (SPDES) program with permits issued in accordance with the New York State Environmental Conservation Law (ECL) Article 17, Titles 7, 8 and Article 70.

An *owner or operator* of a *construction activity* that is eligible for coverage under this permit must obtain coverage prior to the *commencement of construction activity*. Activities that fit the definition of “*construction activity*”, as defined under 40 CFR 122.26(b)(14)(x), (15)(i), and (15)(ii), constitute construction of a *point source* and therefore, pursuant to ECL section 17-0505 and 17-0701, the *owner or operator* must have coverage under a SPDES permit prior to *commencing construction activity*. The *owner or operator* cannot wait until there is an actual *discharge* from the *construction site* to obtain permit coverage.

***Note: The italicized words/phrases within this permit are defined in Appendix A.**

**NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SPDES GENERAL PERMIT FOR STORMWATER DISCHARGES FROM
CONSTRUCTION ACTIVITIES**

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Part 1. PERMIT COVERAGE AND LIMITATIONS

A. Permit Application

This permit authorizes stormwater *discharges to surface waters of the State* from the following *construction activities* identified within 40 CFR Parts 122.26(b)(14)(x), 122.26(b)(15)(i) and 122.26(b)(15)(ii), provided all of the eligibility provisions of this permit are met:

1. *Construction activities* involving soil disturbances of one (1) or more acres; including disturbances of less than one acre that are part of a *larger common plan of development or sale* that will ultimately disturb one or more acres of land; excluding *routine maintenance activity* that is performed to maintain the original line and grade, hydraulic capacity or original purpose of a facility;
2. *Construction activities* involving soil disturbances of less than one (1) acre where the Department has determined that a *SPDES* permit is required for stormwater *discharges* based on the potential for contribution to a violation of a *water quality standard* or for significant contribution of *pollutants to surface waters of the State*.
3. *Construction activities* located in the watershed(s) identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.

B. Effluent Limitations Applicable to Discharges from Construction Activities

Discharges authorized by this permit must achieve, at a minimum, the effluent limitations in Part I.B.1. (a) – (f) of this permit. These limitations represent the degree of effluent reduction attainable by the application of best practicable technology currently available.

1. Erosion and Sediment Control Requirements - The *owner or operator* must select, design, install, implement and maintain control measures to *minimize the discharge of pollutants* and prevent a violation of the *water quality standards*. The selection, design, installation, implementation, and maintenance of these control measures must meet the non-numeric effluent limitations in Part I.B.1.(a) – (f) of this permit and be in accordance with the New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016, using sound engineering judgment. Where control measures are not designed in conformance with the design criteria included in the technical standard, the *owner or operator* must include in the *Stormwater Pollution Prevention Plan* (“SWPPP”) the reason(s) for the

deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

- a. **Erosion and Sediment Controls.** Design, install and maintain effective erosion and sediment controls to *minimize* the *discharge of pollutants* and prevent a violation of the *water quality standards*. At a minimum, such controls must be designed, installed and maintained to:
- (i) *Minimize* soil erosion through application of runoff control and soil stabilization control measure to *minimize pollutant discharges*;
 - (ii) Control stormwater *discharges*, including both peak flowrates and total stormwater volume, to *minimize* channel and *streambank* erosion and scour in the immediate vicinity of the *discharge* points;
 - (iii) *Minimize* the amount of soil exposed during *construction activity*;
 - (iv) *Minimize* the disturbance of *steep slopes*;
 - (v) *Minimize* sediment *discharges* from the site;
 - (vi) Provide and maintain *natural buffers* around surface waters, direct stormwater to vegetated areas and maximize stormwater infiltration to reduce *pollutant discharges*, unless *infeasible*;
 - (vii) *Minimize* soil compaction. Minimizing soil compaction is not required where the intended function of a specific area of the site dictates that it be compacted;
 - (viii) Unless *infeasible*, preserve a sufficient amount of topsoil to complete soil restoration and establish a uniform, dense vegetative cover; and
 - (ix) *Minimize* dust. On areas of exposed soil, *minimize* dust through the appropriate application of water or other dust suppression techniques to control the generation of pollutants that could be discharged from the site.
- b. **Soil Stabilization.** In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within fourteen (14) days from the date the current soil disturbance activity ceased. For construction sites that *directly discharge* to one of the 303(d) segments

listed in Appendix E or is located in one of the watersheds listed in Appendix C, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. See Appendix A for definition of *Temporarily Ceased*.

- c. **Dewatering.** *Discharges* from *dewatering* activities, including *discharges* from *dewatering* of trenches and excavations, must be managed by appropriate control measures.
- d. **Pollution Prevention Measures.** Design, install, implement, and maintain effective pollution prevention measures to *minimize* the *discharge* of *pollutants* and prevent a violation of the *water quality standards*. At a minimum, such measures must be designed, installed, implemented and maintained to:
 - (i) *Minimize* the *discharge* of *pollutants* from equipment and vehicle washing, wheel wash water, and other wash waters. This applies to washing operations that use clean water only. Soaps, detergents and solvents cannot be used;
 - (ii) *Minimize* the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste, hazardous and toxic waste, and other materials present on the site to precipitation and to stormwater. Minimization of exposure is not required in cases where the exposure to precipitation and to stormwater will not result in a *discharge* of *pollutants*, or where exposure of a specific material or product poses little risk of stormwater contamination (such as final products and materials intended for outdoor use) ; and
 - (iii) Prevent the *discharge* of *pollutants* from spills and leaks and implement chemical spill and leak prevention and response procedures.
- e. **Prohibited Discharges.** The following *discharges* are prohibited:
 - (i) Wastewater from washout of concrete;
 - (ii) Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;

- (iii) Fuels, oils, or other *pollutants* used in vehicle and equipment operation and maintenance;
 - (iv) Soaps or solvents used in vehicle and equipment washing; and
 - (v) Toxic or hazardous substances from a spill or other release.
- f. Surface Outlets. When discharging from basins and impoundments, the outlets shall be designed, constructed and maintained in such a manner that sediment does not leave the basin or impoundment and that erosion at or below the outlet does not occur.

C. Post-construction Stormwater Management Practice Requirements

1. The *owner or operator* of a *construction activity* that requires post-construction stormwater management practices pursuant to Part III.C. of this permit must select, design, install, and maintain the practices to meet the *performance criteria* in the New York State Stormwater Management Design Manual (“Design Manual”), dated January 2015, using sound engineering judgment. Where post-construction stormwater management practices (“SMPs”) are not designed in conformance with the *performance criteria* in the Design Manual, the *owner or operator* must include in the SWPPP the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.
2. The *owner or operator* of a *construction activity* that requires post-construction stormwater management practices pursuant to Part III.C. of this permit must design the practices to meet the applicable *sizing criteria* in Part I.C.2.a., b., c. or d. of this permit.

a. Sizing Criteria for New Development

- (i) Runoff Reduction Volume (“RRv”): Reduce the total Water Quality Volume (“WQv”) by application of RR techniques and standard SMPs with RRv capacity. The total WQv shall be calculated in accordance with the criteria in Section 4.2 of the Design Manual.
- (ii) Minimum RRv and Treatment of Remaining Total WQv: Construction activities that cannot meet the criteria in Part I.C.2.a.(i) of this permit due to site limitations shall direct runoff from all newly constructed impervious areas to a RR technique or standard SMP with RRv capacity unless infeasible. The specific site limitations that prevent the reduction of 100% of the WQv shall be documented in the SWPPP.

For each impervious area that is not directed to a RR technique or standard SMP with RRv capacity, the SWPPP must include documentation which demonstrates that all options were considered and for each option explains why it is considered infeasible.

In no case shall the runoff reduction achieved from the newly constructed impervious areas be less than the Minimum RRv as calculated using the criteria in Section 4.3 of the Design Manual. The remaining portion of the total WQv that cannot be reduced shall be treated by application of standard SMPs.

- (iii) Channel Protection Volume (“Cpv”): Provide 24 hour extended detention of the post-developed 1-year, 24-hour storm event; remaining after runoff reduction. The Cpv requirement does not apply when:
 - (1) Reduction of the entire Cpv is achieved by application of runoff reduction techniques or infiltration systems, or
 - (2) The site discharges directly to tidal waters, or fifth order or larger streams.
- (iv) *Overbank* Flood Control Criteria (“Qp”): Requires storage to attenuate the post-development 10-year, 24-hour peak discharge rate (Qp) to predevelopment rates. The Qp requirement does not apply when:
 - (1) the site discharges directly to tidal waters or fifth order or larger streams, or
 - (2) A downstream analysis reveals that *overbank* control is not required.
- (v) Extreme Flood Control Criteria (“Qf”): Requires storage to attenuate the post-development 100-year, 24-hour peak discharge rate (Qf) to predevelopment rates. The Qf requirement does not apply when:
 - (1) the site discharges directly to tidal waters or fifth order or larger streams, or
 - (2) A downstream analysis reveals that *overbank* control is not required.

b. Sizing Criteria for New Development in Enhanced Phosphorus Removal Watershed

- (i) Runoff Reduction Volume (RRv): Reduce the total Water Quality Volume (WQv) by application of RR techniques and standard SMPs with RRv capacity. The total WQv is the runoff volume from the 1-year, 24 hour design storm over the post-developed watershed and shall be

calculated in accordance with the criteria in Section 10.3 of the Design Manual.

- (ii) Minimum RRv and Treatment of Remaining Total WQv: *Construction activities* that cannot meet the criteria in Part I.C.2.b.(i) of this permit due to *site limitations* shall direct runoff from all newly constructed *impervious areas* to a RR technique or standard SMP with RRv capacity unless *infeasible*. The specific *site limitations* that prevent the reduction of 100% of the WQv shall be documented in the SWPPP. For each *impervious area* that is not directed to a RR technique or standard SMP with RRv capacity, the SWPPP must include documentation which demonstrates that all options were considered and for each option explains why it is considered *infeasible*.

In no case shall the runoff reduction achieved from the newly constructed *impervious areas* be less than the Minimum RRv as calculated using the criteria in Section 10.3 of the Design Manual. The remaining portion of the total WQv that cannot be reduced shall be treated by application of standard SMPs.

- (iii) Channel Protection Volume (Cpv): Provide 24 hour extended detention of the post-developed 1-year, 24-hour storm event; remaining after runoff reduction. The Cpv requirement does not apply when:
 - (1) Reduction of the entire Cpv is achieved by application of runoff reduction techniques or infiltration systems, or
 - (2) The site *discharges* directly to tidal waters, or fifth order or larger streams.
- (iv) Overbank Flood Control Criteria (Qp): Requires storage to attenuate the post-development 10-year, 24-hour peak *discharge* rate (Qp) to predevelopment rates. The Qp requirement does not apply when:
 - (1) the site *discharges* directly to tidal waters or fifth order or larger streams, or
 - (2) A downstream analysis reveals that *overbank* control is not required.
- (v) Extreme Flood Control Criteria (Qf): Requires storage to attenuate the post-development 100-year, 24-hour peak *discharge* rate (Qf) to predevelopment rates. The Qf requirement does not apply when:
 - (1) the site *discharges* directly to tidal waters or fifth order or larger streams, or
 - (2) A downstream analysis reveals that *overbank* control is not required.

c. Sizing Criteria for Redevelopment Activity

- (i) Water Quality Volume (WQv): The WQv treatment objective for *redevelopment activity* shall be addressed by one of the following options. *Redevelopment activities* located in an Enhanced Phosphorus Removal Watershed (see Part III.B.3. and Appendix C of this permit) shall calculate the WQv in accordance with Section 10.3 of the Design Manual. All other *redevelopment activities* shall calculate the WQv in accordance with Section 4.2 of the Design Manual.
 - (1) Reduce the existing *impervious cover* by a minimum of 25% of the total disturbed, *impervious area*. The Soil Restoration criteria in Section 5.1.6 of the Design Manual must be applied to all newly created pervious areas, or
 - (2) Capture and treat a minimum of 25% of the WQv from the disturbed, *impervious area* by the application of standard SMPs; or reduce 25% of the WQv from the disturbed, *impervious area* by the application of RR techniques or standard SMPs with RRv capacity., or
 - (3) Capture and treat a minimum of 75% of the WQv from the disturbed, *impervious area* as well as any additional runoff from tributary areas by application of the alternative practices discussed in Sections 9.3 and 9.4 of the Design Manual., or
 - (4) Application of a combination of 1, 2 and 3 above that provide a weighted average of at least two of the above methods. Application of this method shall be in accordance with the criteria in Section 9.2.1(B) (IV) of the Design Manual.

If there is an existing post-construction stormwater management practice located on the site that captures and treats runoff from the *impervious area* that is being disturbed, the WQv treatment option selected must, at a minimum, provide treatment equal to the treatment that was being provided by the existing practice(s) if that treatment is greater than the treatment required by options 1 – 4 above.

- (ii) Channel Protection Volume (Cpv): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site.
- (iii) Overbank Flood Control Criteria (Qp): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site.
- (iv) Extreme Flood Control Criteria (Qf): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site

d. Sizing Criteria for Combination of Redevelopment Activity and New Development

Construction projects that include both New Development and Redevelopment Activity shall provide post-construction stormwater management controls that meet the sizing criteria calculated as an aggregate of the Sizing Criteria in Part I.C.2.a. or b. of this permit for the New Development portion of the project and Part I.C.2.c of this permit for Redevelopment Activity portion of the project.

D. Maintaining Water Quality

The Department expects that compliance with the conditions of this permit will control *discharges* necessary to meet applicable *water quality standards*. It shall be a violation of the *ECL* for any discharge to either cause or contribute to a violation of *water quality standards* as contained in Parts 700 through 705 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York, such as:

1. There shall be no increase in turbidity that will cause a substantial visible contrast to natural conditions;
2. There shall be no increase in suspended, colloidal or settleable solids that will cause deposition or impair the waters for their best usages; and
3. There shall be no residue from oil and floating substances, nor visible oil film, nor globules of grease.

If there is evidence indicating that the stormwater *discharges* authorized by this permit are causing, have the reasonable potential to cause, or are contributing to a violation of the *water quality standards*; the *owner or operator* must take appropriate corrective action in accordance with Part IV.C.5. of this general permit and document in accordance with Part IV.C.4. of this general permit. To address the *water quality standard* violation the *owner or operator* may need to provide additional information, include and implement appropriate controls in the SWPPP to correct the problem, or obtain an individual SPDES permit.

If there is evidence indicating that despite compliance with the terms and conditions of this general permit it is demonstrated that the stormwater *discharges* authorized by this permit are causing or contributing to a violation of *water quality standards*, or if the Department determines that a modification of the permit is necessary to prevent a violation of *water quality standards*, the authorized *discharges* will no longer be eligible for coverage under this permit. The Department may require the *owner or operator* to obtain an individual SPDES permit to continue discharging.

E. Eligibility Under This General Permit

1. This permit may authorize all *discharges* of stormwater from *construction activity* to *surface waters of the State* and *groundwaters* except for ineligible *discharges* identified under subparagraph F. of this Part.
2. Except for non-stormwater *discharges* explicitly listed in the next paragraph, this permit only authorizes stormwater *discharges*; including stormwater runoff, snowmelt runoff, and surface runoff and drainage, from *construction activities*.
3. Notwithstanding paragraphs E.1 and E.2 above, the following non-stormwater discharges are authorized by this permit: those listed in 6 NYCRR 750-1.2(a)(29)(vi), with the following exception: “Discharges from firefighting activities are authorized only when the firefighting activities are emergencies/unplanned”; waters to which other components have not been added that are used to control dust in accordance with the SWPPP; and uncontaminated *discharges* from *construction site* de-watering operations. All non-stormwater discharges must be identified in the SWPPP. Under all circumstances, the *owner or operator* must still comply with *water quality standards* in Part I.D of this permit.
4. The *owner or operator* must maintain permit eligibility to *discharge* under this permit. Any *discharges* that are not compliant with the eligibility conditions of this permit are not authorized by the permit and the *owner or operator* must either apply for a separate permit to cover those ineligible *discharges* or take steps necessary to make the *discharge* eligible for coverage.

F. Activities Which Are Ineligible for Coverage Under This General Permit

All of the following are **not** authorized by this permit:

1. *Discharges* after *construction activities* have been completed and the site has undergone *final stabilization*;
2. *Discharges* that are mixed with sources of non-stormwater other than those expressly authorized under subsection E.3. of this Part and identified in the SWPPP required by this permit;
3. *Discharges* that are required to obtain an individual SPDES permit or another SPDES general permit pursuant to Part VII.K. of this permit;
4. *Construction activities* or *discharges* from *construction activities* that may adversely affect an *endangered or threatened species* unless the *owner or*

operator has obtained a permit issued pursuant to 6 NYCRR Part 182 for the project or the Department has issued a letter of non-jurisdiction for the project. All documentation necessary to demonstrate eligibility shall be maintained on site in accordance with Part II.D.2 of this permit;

5. *Discharges* which either cause or contribute to a violation of *water quality standards* adopted pursuant to the *ECL* and its accompanying regulations;
6. *Construction activities* for residential, commercial and institutional projects:
 - a. Where the *discharges* from the *construction activities* are tributary to waters of the state classified as AA or AA-s; and
 - b. Which are undertaken on land with no existing *impervious cover*; and
 - c. Which disturb one (1) or more acres of land designated on the current United States Department of Agriculture ("USDA") Soil Survey as Soil Slope Phase "D", (provided the map unit name is inclusive of slopes greater than 25%), or Soil Slope Phase "E" or "F" (regardless of the map unit name), or a combination of the three designations.
7. *Construction activities* for linear transportation projects and linear utility projects:
 - a. Where the *discharges* from the *construction activities* are tributary to waters of the state classified as AA or AA-s; and
 - b. Which are undertaken on land with no existing *impervious cover*; and
 - c. Which disturb two (2) or more acres of land designated on the current USDA Soil Survey as Soil Slope Phase "D" (provided the map unit name is inclusive of slopes greater than 25%), or Soil Slope Phase "E" or "F" (regardless of the map unit name), or a combination of the three designations.

8. *Construction activities* that have the potential to affect an *historic property*, unless there is documentation that such impacts have been resolved. The following documentation necessary to demonstrate eligibility with this requirement shall be maintained on site in accordance with Part II.D.2 of this permit and made available to the Department in accordance with Part VII.F of this permit:
- a. Documentation that the *construction activity* is not within an archeologically sensitive area indicated on the sensitivity map, and that the *construction activity* is not located on or immediately adjacent to a property listed or determined to be eligible for listing on the National or State Registers of Historic Places, and that there is no new permanent building on the *construction site* within the following distances from a building, structure, or object that is more than 50 years old, or if there is such a new permanent building on the *construction site* within those parameters that NYS Office of Parks, Recreation and Historic Preservation (OPRHP), a Historic Preservation Commission of a Certified Local Government, or a qualified preservation professional has determined that the building, structure, or object more than 50 years old is not historically/archeologically significant.
 - 1-5 acres of disturbance - 20 feet
 - 5-20 acres of disturbance - 50 feet
 - 20+ acres of disturbance - 100 feet, or
 - b. DEC consultation form sent to OPRHP, and copied to the NYS DEC Agency Historic Preservation Officer (APO), and
 - (i) the State Environmental Quality Review (SEQR) Environmental Assessment Form (EAF) with a negative declaration or the Findings Statement, with documentation of OPRHP's agreement with the resolution; or
 - (ii) documentation from OPRHP that the *construction activity* will result in No Impact; or
 - (iii) documentation from OPRHP providing a determination of No Adverse Impact; or
 - (iv) a Letter of Resolution signed by the owner/operator, OPRHP and the DEC APO which allows for this *construction activity* to be eligible for coverage under the general permit in terms of the State Historic Preservation Act (SHPA); or
 - c. Documentation of satisfactory compliance with Section 106 of the National Historic Preservation Act for a coterminous project area:

- (i) No Affect
- (ii) No Adverse Affect
- (iii) Executed Memorandum of Agreement, or

d. Documentation that:

- (i) SHPA Section 14.09 has been completed by NYS DEC or another state agency.

9. *Discharges from construction activities* that are subject to an existing SPDES individual or general permit where a SPDES permit for *construction activity* has been terminated or denied; or where the *owner or operator* has failed to renew an expired individual permit.

Part II. PERMIT COVERAGE

A. How to Obtain Coverage

1. An *owner or operator* of a *construction activity* that is not subject to the requirements of a regulated, traditional land use control MS4 must first prepare a SWPPP in accordance with all applicable requirements of this permit and then submit a completed Notice of Intent (NOI) to the Department to be authorized to discharge under this permit.
2. An *owner or operator* of a *construction activity* that is subject to the requirements of a *regulated, traditional land use control MS4* must first prepare a SWPPP in accordance with all applicable requirements of this permit and then have the SWPPP reviewed and accepted by the *regulated, traditional land use control MS4* prior to submitting the NOI to the Department. The *owner or operator* shall have the "MS4 SWPPP Acceptance" form signed in accordance with Part VII.H., and then submit that form along with a completed NOI to the Department.
3. The requirement for an *owner or operator* to have its SWPPP reviewed and accepted by the *regulated, traditional land use control MS4* prior to submitting the NOI to the Department does not apply to an *owner or operator* that is obtaining permit coverage in accordance with the requirements in Part II.F. (Change of Owner or Operator) or where the *owner or operator* of the *construction activity* is the *regulated, traditional land use control MS4*. This exemption does not apply to *construction activities* subject to the New York City Administrative Code.

B. Notice of Intent (NOI) Submittal

1. Prior to December 21, 2020, an owner or operator shall use either the electronic (eNOI) or paper version of the NOI that the Department prepared. Both versions of the NOI are located on the Department's website (<http://www.dec.ny.gov/>). The paper version of the NOI shall be signed in accordance with Part VII.H. of this permit and submitted to the following address:

**NOTICE OF INTENT
NYS DEC, Bureau of Water Permits
625 Broadway, 4th Floor
Albany, New York 12233-3505**

2. Beginning December 21, 2020 and in accordance with EPA's 2015 NPDES Electronic Reporting Rule (40 CFR Part 127), the *owner or operator* must submit the NOI electronically using the *Department's* online NOI.
3. The *owner or operator* shall have the SWPPP preparer sign the "SWPPP Preparer Certification" statement on the NOI prior to submitting the form to the Department.
4. As of the date the NOI is submitted to the Department, the *owner or operator* shall make the NOI and SWPPP available for review and copying in accordance with the requirements in Part VII.F. of this permit.

C. Permit Authorization

1. An *owner or operator* shall not *commence construction activity* until their authorization to *discharge* under this permit goes into effect.
2. Authorization to *discharge* under this permit will be effective when the *owner or operator* has satisfied all of the following criteria:
 - a. project review pursuant to the State Environmental Quality Review Act ("SEQRA") have been satisfied, when SEQRA is applicable. See the Department's website (<http://www.dec.ny.gov/>) for more information,
 - b. where required, all necessary Department permits subject to the *Uniform Procedures Act* ("UPA") (see 6 NYCRR Part 621), or the equivalent from another New York State agency, have been obtained, unless otherwise notified by the Department pursuant to 6 NYCRR 621.3(a)(4). *Owners or operators of construction activities* that are required to obtain UPA permits

must submit a preliminary SWPPP to the appropriate DEC Permit Administrator at the Regional Office listed in Appendix F at the time all other necessary *UPA* permit applications are submitted. The preliminary SWPPP must include sufficient information to demonstrate that the *construction activity* qualifies for authorization under this permit,

- c. the final SWPPP has been prepared, and
 - d. a complete NOI has been submitted to the Department in accordance with the requirements of this permit.
3. An *owner or operator* that has satisfied the requirements of Part II.C.2 above will be authorized to *discharge* stormwater from their *construction activity* in accordance with the following schedule:
- a. For *construction activities* that are not subject to the requirements of a *regulated, traditional land use control MS4*:
 - (i) Five (5) business days from the date the Department receives a complete electronic version of the NOI (eNOI) for *construction activities* with a SWPPP that has been prepared in conformance with the design criteria in the technical standard referenced in Part III.B.1 and the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C.; or
 - (ii) Sixty (60) business days from the date the Department receives a complete NOI (electronic or paper version) for *construction activities* with a SWPPP that has not been prepared in conformance with the design criteria in technical standard referenced in Part III.B.1. or, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C., the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, or;
 - (iii) Ten (10) business days from the date the Department receives a complete paper version of the NOI for *construction activities* with a SWPPP that has been prepared in conformance with the design criteria in the technical standard referenced in Part III.B.1 and the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C.

- b. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4*:
 - (i) Five (5) business days from the date the Department receives both a complete electronic version of the NOI (eNOI) and signed “MS4 SWPPP Acceptance” form, or
 - (ii) Ten (10) business days from the date the Department receives both a complete paper version of the NOI and signed “MS4 SWPPP Acceptance” form.
- 4. Coverage under this permit authorizes stormwater *discharges* from only those areas of disturbance that are identified in the NOI. If an *owner or operator* wishes to have stormwater *discharges* from future or additional areas of disturbance authorized, they must submit a new NOI that addresses that phase of the development, unless otherwise notified by the Department. The *owner or operator* shall not *commence construction activity* on the future or additional areas until their authorization to *discharge* under this permit goes into effect in accordance with Part II.C. of this permit.

D. General Requirements For Owners or Operators With Permit Coverage

- 1. The *owner or operator* shall ensure that the provisions of the SWPPP are implemented from the *commencement of construction activity* until all areas of disturbance have achieved *final stabilization* and the Notice of Termination (“NOT”) has been submitted to the Department in accordance with Part V. of this permit. This includes any changes made to the SWPPP pursuant to Part III.A.4. of this permit.
- 2. The *owner or operator* shall maintain a copy of the General Permit (GP-0-20-001), NOI, *NOI Acknowledgment Letter*, SWPPP, MS4 SWPPP Acceptance form, inspection reports, responsible contractor’s or subcontractor’s certification statement (see Part III.A.6.), and all documentation necessary to demonstrate eligibility with this permit at the *construction site* until all disturbed areas have achieved *final stabilization* and the NOT has been submitted to the Department. The documents must be maintained in a secure location, such as a job trailer, on-site construction office, or mailbox with lock. The secure location must be accessible during normal business hours to an individual performing a compliance inspection.
- 3. The *owner or operator* of a *construction activity* shall not disturb greater than five (5) acres of soil at any one time without prior written authorization from the Department or, in areas under the jurisdiction of a *regulated, traditional land*

- use control MS4, the regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*). At a minimum, the *owner or operator* must comply with the following requirements in order to be authorized to disturb greater than five (5) acres of soil at any one time:
- a. The *owner or operator* shall have a *qualified inspector* conduct **at least** two (2) site inspections in accordance with Part IV.C. of this permit every seven (7) calendar days, for as long as greater than five (5) acres of soil remain disturbed. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.
 - b. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. The soil stabilization measures selected shall be in conformance with the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016.
 - c. The *owner or operator* shall prepare a phasing plan that defines maximum disturbed area per phase and shows required cuts and fills.
 - d. The *owner or operator* shall install any additional site-specific practices needed to protect water quality.
 - e. The *owner or operator* shall include the requirements above in their SWPPP.
4. In accordance with statute, regulations, and the terms and conditions of this permit, the Department may suspend or revoke an *owner's or operator's* coverage under this permit at any time if the Department determines that the SWPPP does not meet the permit requirements or consistent with Part VII.K..
 5. Upon a finding of significant non-compliance with the practices described in the SWPPP or violation of this permit, the Department may order an immediate stop to all activity at the site until the non-compliance is remedied. The stop work order shall be in writing, describe the non-compliance in detail, and be sent to the *owner or operator*.
 6. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4*, the *owner or operator* shall notify the

regulated, traditional land use control MS4 in writing of any planned amendments or modifications to the post-construction stormwater management practice component of the SWPPP required by Part III.A. 4. and 5. of this permit. Unless otherwise notified by the *regulated, traditional land use control MS4*, the *owner or operator* shall have the SWPPP amendments or modifications reviewed and accepted by the *regulated, traditional land use control MS4* prior to commencing construction of the post-construction stormwater management practice.

E. Permit Coverage for Discharges Authorized Under GP-0-15-002

1. Upon renewal of SPDES General Permit for Stormwater Discharges from *Construction Activity* (Permit No. GP-0-15-002), an *owner or operator* of a *construction activity* with coverage under GP-0-15-002, as of the effective date of GP- 0-20-001, shall be authorized to *discharge* in accordance with GP- 0-20-001, unless otherwise notified by the Department.

An *owner or operator* may continue to implement the technical/design components of the post-construction stormwater management controls provided that such design was done in conformance with the technical standards in place at the time of initial project authorization. However, they must comply with the other, non-design provisions of GP-0-20-001.

F. Change of Owner or Operator

1. When property ownership changes or when there is a change in operational control over the construction plans and specifications, the original *owner or operator* must notify the new *owner or operator*, in writing, of the requirement to obtain permit coverage by submitting a NOI with the Department. For *construction activities* subject to the requirements of a *regulated, traditional land use control MS4*, the original *owner or operator* must also notify the MS4, in writing, of the change in ownership at least 30 calendar days prior to the change in ownership.
2. Once the new *owner or operator* obtains permit coverage, the original *owner or operator* shall then submit a completed NOT with the name and permit identification number of the new *owner or operator* to the Department at the address in Part II.B.1. of this permit. If the original *owner or operator* maintains ownership of a portion of the *construction activity* and will disturb soil, they must maintain their coverage under the permit.
3. Permit coverage for the new *owner or operator* will be effective as of the date the Department receives a complete NOI, provided the original *owner or*

operator was not subject to a sixty (60) business day authorization period that has not expired as of the date the Department receives the NOI from the new *owner or operator*.

Part III. STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

A. General SWPPP Requirements

1. A SWPPP shall be prepared and implemented by the *owner or operator* of each *construction activity* covered by this permit. The SWPPP must document the selection, design, installation, implementation and maintenance of the control measures and practices that will be used to meet the effluent limitations in Part I.B. of this permit and where applicable, the post-construction stormwater management practice requirements in Part I.C. of this permit. The SWPPP shall be prepared prior to the submittal of the NOI. The NOI shall be submitted to the Department prior to the *commencement of construction activity*. A copy of the completed, final NOI shall be included in the SWPPP.
2. The SWPPP shall describe the erosion and sediment control practices and where required, post-construction stormwater management practices that will be used and/or constructed to reduce the *pollutants* in stormwater *discharges* and to assure compliance with the terms and conditions of this permit. In addition, the SWPPP shall identify potential sources of pollution which may reasonably be expected to affect the quality of stormwater *discharges*.
3. All SWPPPs that require the post-construction stormwater management practice component shall be prepared by a *qualified professional* that is knowledgeable in the principles and practices of stormwater management and treatment.
4. The *owner or operator* must keep the SWPPP current so that it at all times accurately documents the erosion and sediment controls practices that are being used or will be used during construction, and all post-construction stormwater management practices that will be constructed on the site. At a minimum, the *owner or operator* shall amend the SWPPP, including construction drawings:
 - a. whenever the current provisions prove to be ineffective in minimizing *pollutants* in stormwater *discharges* from the site;

- b. whenever there is a change in design, construction, or operation at the *construction site* that has or could have an effect on the *discharge* of *pollutants*;
 - c. to address issues or deficiencies identified during an inspection by the *qualified inspector*, the Department or other regulatory authority; and
 - d. to document the final construction conditions.
5. The Department may notify the *owner or operator* at any time that the SWPPP does not meet one or more of the minimum requirements of this permit. The notification shall be in writing and identify the provisions of the SWPPP that require modification. Within fourteen (14) calendar days of such notification, or as otherwise indicated by the Department, the *owner or operator* shall make the required changes to the SWPPP and submit written notification to the Department that the changes have been made. If the *owner or operator* does not respond to the Department's comments in the specified time frame, the Department may suspend the *owner's or operator's* coverage under this permit or require the *owner or operator* to obtain coverage under an individual SPDES permit in accordance with Part II.D.4. of this permit.
6. Prior to the *commencement of construction activity*, the *owner or operator* must identify the contractor(s) and subcontractor(s) that will be responsible for installing, constructing, repairing, replacing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and the contractor(s) and subcontractor(s) that will be responsible for constructing the post-construction stormwater management practices included in the SWPPP. The *owner or operator* shall have each of the contractors and subcontractors identify at least one person from their company that will be responsible for implementation of the SWPPP. This person shall be known as the *trained contractor*. The *owner or operator* shall ensure that at least one *trained contractor* is on site on a daily basis when soil disturbance activities are being performed.

The *owner or operator* shall have each of the contractors and subcontractors identified above sign a copy of the following certification statement below before they commence any *construction activity*:

"I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the *qualified inspector* during a site inspection. I also understand that the *owner or operator* must comply with

the terms and conditions of the most current version of the New York State Pollutant Discharge Elimination System ("SPDES") general permit for stormwater *discharges* from *construction activities* and that it is unlawful for any person to cause or contribute to a violation of *water quality standards*. Furthermore, I am aware that there are significant penalties for submitting false information, that I do not believe to be true, including the possibility of fine and imprisonment for knowing violations"

In addition to providing the certification statement above, the certification page must also identify the specific elements of the SWPPP that each contractor and subcontractor will be responsible for and include the name and title of the person providing the signature; the name and title of the *trained contractor* responsible for SWPPP implementation; the name, address and telephone number of the contracting firm; the address (or other identifying description) of the site; and the date the certification statement is signed. The *owner or operator* shall attach the certification statement(s) to the copy of the SWPPP that is maintained at the *construction site*. If new or additional contractors are hired to implement measures identified in the SWPPP after construction has commenced, they must also sign the certification statement and provide the information listed above.

7. For projects where the Department requests a copy of the SWPPP or inspection reports, the *owner or operator* shall submit the documents in both electronic (PDF only) and paper format within five (5) business days, unless otherwise notified by the Department.

B. Required SWPPP Contents

1. Erosion and sediment control component - All SWPPPs prepared pursuant to this permit shall include erosion and sediment control practices designed in conformance with the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016. Where erosion and sediment control practices are not designed in conformance with the design criteria included in the technical standard, the *owner or operator* must demonstrate *equivalence* to the technical standard. At a minimum, the erosion and sediment control component of the SWPPP shall include the following:
 - a. Background information about the scope of the project, including the location, type and size of project

- b. A site map/construction drawing(s) for the project, including a general location map. At a minimum, the site map shall show the total site area; all improvements; areas of disturbance; areas that will not be disturbed; existing vegetation; on-site and adjacent off-site surface water(s); floodplain/floodway boundaries; wetlands and drainage patterns that could be affected by the *construction activity*; existing and final contours ; locations of different soil types with boundaries; material, waste, borrow or equipment storage areas located on adjacent properties; and location(s) of the stormwater *discharge(s)*;
- c. A description of the soil(s) present at the site, including an identification of the Hydrologic Soil Group (HSG);
- d. A construction phasing plan and sequence of operations describing the intended order of *construction activities*, including clearing and grubbing, excavation and grading, utility and infrastructure installation and any other activity at the site that results in soil disturbance;
- e. A description of the minimum erosion and sediment control practices to be installed or implemented for each *construction activity* that will result in soil disturbance. Include a schedule that identifies the timing of initial placement or implementation of each erosion and sediment control practice and the minimum time frames that each practice should remain in place or be implemented;
- f. A temporary and permanent soil stabilization plan that meets the requirements of this general permit and the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016, for each stage of the project, including initial land clearing and grubbing to project completion and achievement of *final stabilization*;
- g. A site map/construction drawing(s) showing the specific location(s), size(s), and length(s) of each erosion and sediment control practice;
- h. The dimensions, material specifications, installation details, and operation and maintenance requirements for all erosion and sediment control practices. Include the location and sizing of any temporary sediment basins and structural practices that will be used to divert flows from exposed soils;
- i. A maintenance inspection schedule for the contractor(s) identified in Part III.A.6. of this permit, to ensure continuous and effective operation of the erosion and sediment control practices. The maintenance inspection

schedule shall be in accordance with the requirements in the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016;

- j. A description of the pollution prevention measures that will be used to control litter, construction chemicals and construction debris from becoming a *pollutant* source in the stormwater *discharges*;
 - k. A description and location of any stormwater *discharges* associated with industrial activity other than construction at the site, including, but not limited to, stormwater *discharges* from asphalt plants and concrete plants located on the *construction site*; and
 - l. Identification of any elements of the design that are not in conformance with the design criteria in the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016. Include the reason for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.
2. Post-construction stormwater management practice component – The *owner or operator* of any construction project identified in Table 2 of Appendix B as needing post-construction stormwater management practices shall prepare a SWPPP that includes practices designed in conformance with the applicable *sizing criteria* in Part I.C.2.a., c. or d. of this permit and the *performance criteria* in the technical standard, New York State Stormwater Management Design Manual dated January 2015

Where post-construction stormwater management practices are not designed in conformance with the *performance criteria* in the technical standard, the *owner or operator* must include in the SWPPP the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

The post-construction stormwater management practice component of the SWPPP shall include the following:

- a. Identification of all post-construction stormwater management practices to be constructed as part of the project. Include the dimensions, material specifications and installation details for each post-construction stormwater management practice;

- b. A site map/construction drawing(s) showing the specific location and size of each post-construction stormwater management practice;
- c. A Stormwater Modeling and Analysis Report that includes:
 - (i) Map(s) showing pre-development conditions, including watershed/subcatchments boundaries, flow paths/routing, and design points;
 - (ii) Map(s) showing post-development conditions, including watershed/subcatchments boundaries, flow paths/routing, design points and post-construction stormwater management practices;
 - (iii) Results of stormwater modeling (i.e. hydrology and hydraulic analysis) for the required storm events. Include supporting calculations (model runs), methodology, and a summary table that compares pre and post-development runoff rates and volumes for the different storm events;
 - (iv) Summary table, with supporting calculations, which demonstrates that each post-construction stormwater management practice has been designed in conformance with the *sizing criteria* included in the Design Manual;
 - (v) Identification of any *sizing criteria* that is not required based on the requirements included in Part I.C. of this permit; and
 - (vi) Identification of any elements of the design that are not in conformance with the *performance criteria* in the Design Manual. Include the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the Design Manual;
- d. Soil testing results and locations (test pits, borings);
- e. Infiltration test results, when required; and
- f. An operations and maintenance plan that includes inspection and maintenance schedules and actions to ensure continuous and effective operation of each post-construction stormwater management practice. The plan shall identify the entity that will be responsible for the long term operation and maintenance of each practice.

3. Enhanced Phosphorus Removal Standards - All construction projects identified in Table 2 of Appendix B that are located in the watersheds identified in Appendix C shall prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the applicable *sizing criteria* in Part I.C.2. b., c. or d. of this permit and the *performance criteria*, Enhanced Phosphorus Removal Standards included in the Design Manual. At a minimum, the post-construction stormwater management practice component of the SWPPP shall include items 2.a - 2.f. above.

C. Required SWPPP Components by Project Type

Unless otherwise notified by the Department, *owners or operators of construction activities* identified in Table 1 of Appendix B are required to prepare a SWPPP that only includes erosion and sediment control practices designed in conformance with Part III.B.1 of this permit. *Owners or operators of the construction activities* identified in Table 2 of Appendix B shall prepare a SWPPP that also includes post-construction stormwater management practices designed in conformance with Part III.B.2 or 3 of this permit.

Part IV. INSPECTION AND MAINTENANCE REQUIREMENTS

A. General Construction Site Inspection and Maintenance Requirements

1. The *owner or operator* must ensure that all erosion and sediment control practices (including pollution prevention measures) and all post-construction stormwater management practices identified in the SWPPP are inspected and maintained in accordance with Part IV.B. and C. of this permit.
2. The terms of this permit shall not be construed to prohibit the State of New York from exercising any authority pursuant to the ECL, common law or federal law, or prohibit New York State from taking any measures, whether civil or criminal, to prevent violations of the laws of the State of New York or protect the public health and safety and/or the environment.

B. Contractor Maintenance Inspection Requirements

1. The *owner or operator* of each *construction activity* identified in Tables 1 and 2 of Appendix B shall have a *trained contractor* inspect the erosion and sediment control practices and pollution prevention measures being implemented within the active work area daily to ensure that they are being maintained in effective operating condition at all times. If deficiencies are identified, the contractor shall

begin implementing corrective actions within one business day and shall complete the corrective actions in a reasonable time frame.

2. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and *temporary stabilization* measures have been applied to all disturbed areas, the *trained contractor* can stop conducting the maintenance inspections. The *trained contractor* shall begin conducting the maintenance inspections in accordance with Part IV.B.1. of this permit as soon as soil disturbance activities resume.
3. For construction sites where soil disturbance activities have been shut down with partial project completion, the *trained contractor* can stop conducting the maintenance inspections if all areas disturbed as of the project shutdown date have achieved *final stabilization* and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational.

C. Qualified Inspector Inspection Requirements

The *owner or operator* shall have a *qualified inspector* conduct site inspections in conformance with the following requirements:

[Note: The *trained contractor* identified in Part III.A.6. and IV.B. of this permit **cannot** conduct the *qualified inspector* site inspections unless they meet the *qualified inspector* qualifications included in Appendix A. In order to perform these inspections, the *trained contractor* would have to be a:

- licensed Professional Engineer,
 - Certified Professional in Erosion and Sediment Control (CPESC),
 - New York State Erosion and Sediment Control Certificate Program holder
 - Registered Landscape Architect, or
 - someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided they have received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity].
1. A *qualified inspector* shall conduct site inspections for all *construction activities* identified in Tables 1 and 2 of Appendix B, with the exception of:
 - a. the construction of a single family residential subdivision with 25% or less *impervious cover* at total site build-out that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres and is not located

in one of the watersheds listed in Appendix C and not directly discharging to one of the 303(d) segments listed in Appendix E;

- b. the construction of a single family home that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres and is not located in one of the watersheds listed in Appendix C and not directly discharging to one of the 303(d) segments listed in Appendix E;
 - c. construction on agricultural property that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres; and
 - d. *construction activities* located in the watersheds identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.
2. Unless otherwise notified by the Department, the *qualified inspector* shall conduct site inspections in accordance with the following timetable:
- a. For construction sites where soil disturbance activities are on-going, the *qualified inspector* shall conduct a site inspection at least once every seven (7) calendar days.
 - b. For construction sites where soil disturbance activities are on-going and the *owner or operator* has received authorization in accordance with Part II.D.3 to disturb greater than five (5) acres of soil at any one time, the *qualified inspector* shall conduct at least two (2) site inspections every seven (7) calendar days. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.
 - c. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and *temporary stabilization* measures have been applied to all disturbed areas, the *qualified inspector* shall conduct a site inspection at least once every thirty (30) calendar days. The *owner or operator* shall notify the DOW Water (SPDES) Program contact at the Regional Office (see contact information in Appendix F) or, in areas under the jurisdiction of a *regulated, traditional land use control MS4*, the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*) in writing prior to reducing the frequency of inspections.

- d. For construction sites where soil disturbance activities have been shut down with partial project completion, the *qualified inspector* can stop conducting inspections if all areas disturbed as of the project shutdown date have achieved *final stabilization* and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational. The *owner or operator* shall notify the DOW Water (SPDES) Program contact at the Regional Office (see contact information in Appendix F) or, in areas under the jurisdiction of a *regulated, traditional land use control MS4*, the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*) in writing prior to the shutdown. If soil disturbance activities are not resumed within 2 years from the date of shutdown, the *owner or operator* shall have the *qualified inspector* perform a final inspection and certify that all disturbed areas have achieved *final stabilization*, and all temporary, structural erosion and sediment control measures have been removed; and that all post-construction stormwater management practices have been constructed in conformance with the SWPPP by signing the “*Final Stabilization*” and “*Post-Construction Stormwater Management Practice*” certification statements on the NOT. The *owner or operator* shall then submit the completed NOT form to the address in Part II.B.1 of this permit.
 - e. For construction sites that directly *discharge* to one of the 303(d) segments listed in Appendix E or is located in one of the watersheds listed in Appendix C, the *qualified inspector* shall conduct at least two (2) site inspections every seven (7) calendar days. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.
3. At a minimum, the *qualified inspector* shall inspect all erosion and sediment control practices and pollution prevention measures to ensure integrity and effectiveness, all post-construction stormwater management practices under construction to ensure that they are constructed in conformance with the SWPPP, all areas of disturbance that have not achieved *final stabilization*, all points of *discharge* to natural surface waterbodies located within, or immediately adjacent to, the property boundaries of the *construction site*, and all points of *discharge* from the *construction site*.
 4. The *qualified inspector* shall prepare an inspection report subsequent to each and every inspection. At a minimum, the inspection report shall include and/or address the following:

- a. Date and time of inspection;
- b. Name and title of person(s) performing inspection;
- c. A description of the weather and soil conditions (e.g. dry, wet, saturated) at the time of the inspection;
- d. A description of the condition of the runoff at all points of *discharge* from the *construction site*. This shall include identification of any *discharges* of sediment from the *construction site*. Include *discharges* from conveyance systems (i.e. pipes, culverts, ditches, etc.) and overland flow;
- e. A description of the condition of all natural surface waterbodies located within, or immediately adjacent to, the property boundaries of the *construction site* which receive runoff from disturbed areas. This shall include identification of any *discharges* of sediment to the surface waterbody;
- f. Identification of all erosion and sediment control practices and pollution prevention measures that need repair or maintenance;
- g. Identification of all erosion and sediment control practices and pollution prevention measures that were not installed properly or are not functioning as designed and need to be reinstalled or replaced;
- h. Description and sketch of areas with active soil disturbance activity, areas that have been disturbed but are inactive at the time of the inspection, and areas that have been stabilized (temporary and/or final) since the last inspection;
- i. Current phase of construction of all post-construction stormwater management practices and identification of all construction that is not in conformance with the SWPPP and technical standards;
- j. Corrective action(s) that must be taken to install, repair, replace or maintain erosion and sediment control practices and pollution prevention measures; and to correct deficiencies identified with the construction of the post-construction stormwater management practice(s);
- k. Identification and status of all corrective actions that were required by previous inspection; and

- I. Digital photographs, with date stamp, that clearly show the condition of all practices that have been identified as needing corrective actions. The *qualified inspector* shall attach paper color copies of the digital photographs to the inspection report being maintained onsite within seven (7) calendar days of the date of the inspection. The *qualified inspector* shall also take digital photographs, with date stamp, that clearly show the condition of the practice(s) after the corrective action has been completed. The *qualified inspector* shall attach paper color copies of the digital photographs to the inspection report that documents the completion of the corrective action work within seven (7) calendar days of that inspection.
5. Within one business day of the completion of an inspection, the *qualified inspector* shall notify the *owner or operator* and appropriate contractor or subcontractor identified in Part III.A.6. of this permit of any corrective actions that need to be taken. The contractor or subcontractor shall begin implementing the corrective actions within one business day of this notification and shall complete the corrective actions in a reasonable time frame.
6. All inspection reports shall be signed by the *qualified inspector*. Pursuant to Part II.D.2. of this permit, the inspection reports shall be maintained on site with the SWPPP.

Part V. TERMINATION OF PERMIT COVERAGE

A. Termination of Permit Coverage

1. An *owner or operator* that is eligible to terminate coverage under this permit must submit a completed NOT form to the address in Part II.B.1 of this permit. The NOT form shall be one which is associated with this permit, signed in accordance with Part VII.H of this permit.
2. An *owner or operator* may terminate coverage when one or more the following conditions have been met:
 - a. Total project completion - All *construction activity* identified in the SWPPP has been completed; and all areas of disturbance have achieved *final stabilization*; and all temporary, structural erosion and sediment control measures have been removed; and all post-construction stormwater management practices have been constructed in conformance with the SWPPP and are operational;

- b. Planned shutdown with partial project completion - All soil disturbance activities have ceased; and all areas disturbed as of the project shutdown date have achieved *final stabilization*; and all temporary, structural erosion and sediment control measures have been removed; and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational;
 - c. A new *owner or operator* has obtained coverage under this permit in accordance with Part II.F. of this permit.
 - d. The *owner or operator* obtains coverage under an alternative SPDES general permit or an individual SPDES permit.
3. For *construction activities* meeting subdivision 2a. or 2b. of this Part, the *owner or operator* shall have the *qualified inspector* perform a final site inspection prior to submitting the NOT. The *qualified inspector* shall, by signing the “*Final Stabilization*” and “Post-Construction Stormwater Management Practice certification statements on the NOT, certify that all the requirements in Part V.A.2.a. or b. of this permit have been achieved.
4. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4* and meet subdivision 2a. or 2b. of this Part, the *owner or operator* shall have the *regulated, traditional land use control MS4* sign the “MS4 Acceptance” statement on the NOT in accordance with the requirements in Part VII.H. of this permit. The *regulated, traditional land use control MS4* official, by signing this statement, has determined that it is acceptable for the *owner or operator* to submit the NOT in accordance with the requirements of this Part. The *regulated, traditional land use control MS4* can make this determination by performing a final site inspection themselves or by accepting the *qualified inspector’s* final site inspection certification(s) required in Part V.A.3. of this permit.
5. For *construction activities* that require post-construction stormwater management practices and meet subdivision 2a. of this Part, the *owner or operator* must, prior to submitting the NOT, ensure one of the following:
- a. the post-construction stormwater management practice(s) and any right-of-way(s) needed to maintain such practice(s) have been deeded to the municipality in which the practice(s) is located,

- b. an executed maintenance agreement is in place with the municipality that will maintain the post-construction stormwater management practice(s),
- c. for post-construction stormwater management practices that are privately owned, the *owner or operator* has a mechanism in place that requires operation and maintenance of the practice(s) in accordance with the operation and maintenance plan, such as a deed covenant in the *owner or operator's* deed of record,
- d. for post-construction stormwater management practices that are owned by a public or private institution (e.g. school, university, hospital), government agency or authority, or public utility; the *owner or operator* has policy and procedures in place that ensures operation and maintenance of the practices in accordance with the operation and maintenance plan.

Part VI. REPORTING AND RETENTION RECORDS

A. Record Retention

The *owner or operator* shall retain a copy of the NOI, NOI Acknowledgment Letter, SWPPP, MS4 SWPPP Acceptance form and any inspection reports that were prepared in conjunction with this permit for a period of at least five (5) years from the date that the Department receives a complete NOT submitted in accordance with Part V. of this general permit.

B. Addresses

With the exception of the NOI, NOT, and MS4 SWPPP Acceptance form (which must be submitted to the address referenced in Part II.B.1 of this permit), all written correspondence requested by the Department, including individual permit applications, shall be sent to the address of the appropriate DOW Water (SPDES) Program contact at the Regional Office listed in Appendix F.

Part VII. STANDARD PERMIT CONDITIONS

A. Duty to Comply

The *owner or operator* must comply with all conditions of this permit. All contractors and subcontractors associated with the project must comply with the terms of the SWPPP. Any non-compliance with this permit constitutes a violation of the Clean Water

Act (CWA) and the ECL and is grounds for an enforcement action against the *owner or operator* and/or the contractor/subcontractor; permit revocation, suspension or modification; or denial of a permit renewal application. Upon a finding of significant non-compliance with this permit or the applicable SWPPP, the Department may order an immediate stop to all *construction activity* at the site until the non-compliance is remedied. The stop work order shall be in writing, shall describe the non-compliance in detail, and shall be sent to the *owner or operator*.

If any human remains or archaeological remains are encountered during excavation, the *owner or operator* must immediately cease, or cause to cease, all *construction activity* in the area of the remains and notify the appropriate Regional Water Engineer (RWE). *Construction activity* shall not resume until written permission to do so has been received from the RWE.

B. Continuation of the Expired General Permit

This permit expires five (5) years from the effective date. If a new general permit is not issued prior to the expiration of this general permit, an *owner or operator* with coverage under this permit may continue to operate and *discharge* in accordance with the terms and conditions of this general permit, if it is extended pursuant to the State Administrative Procedure Act and 6 NYCRR Part 621, until a new general permit is issued.

C. Enforcement

Failure of the *owner or operator*, its contractors, subcontractors, agents and/or assigns to strictly adhere to any of the permit requirements contained herein shall constitute a violation of this permit. There are substantial criminal, civil, and administrative penalties associated with violating the provisions of this permit. Fines of up to \$37,500 per day for each violation and imprisonment for up to fifteen (15) years may be assessed depending upon the nature and degree of the offense.

D. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for an *owner or operator* in an enforcement action that it would have been necessary to halt or reduce the *construction activity* in order to maintain compliance with the conditions of this permit.

E. Duty to Mitigate

The *owner or operator* and its contractors and subcontractors shall take all reasonable steps to *minimize* or prevent any *discharge* in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

F. Duty to Provide Information

The *owner or operator* shall furnish to the Department, within a reasonable specified time period of a written request, all documentation necessary to demonstrate eligibility and any information to determine compliance with this permit or to determine whether cause exists for modifying or revoking this permit, or suspending or denying coverage under this permit, in accordance with the terms and conditions of this permit. The NOI, SWPPP and inspection reports required by this permit are public documents that the *owner or operator* must make available for review and copying by any person within five (5) business days of the *owner or operator* receiving a written request by any such person to review these documents. Copying of documents will be done at the requester's expense.

G. Other Information

When the *owner or operator* becomes aware that they failed to submit any relevant facts, or submitted incorrect information in the NOI or in any of the documents required by this permit, or have made substantive revisions to the SWPPP (e.g. the scope of the project changes significantly, the type of post-construction stormwater management practice(s) changes, there is a reduction in the sizing of the post-construction stormwater management practice, or there is an increase in the disturbance area or *impervious area*), which were not reflected in the original NOI submitted to the Department, they shall promptly submit such facts or information to the Department using the contact information in Part II.A. of this permit. Failure of the *owner or operator* to correct or supplement any relevant facts within five (5) business days of becoming aware of the deficiency shall constitute a violation of this permit.

H. Signatory Requirements

1. All NOIs and NOTs shall be signed as follows:
 - a. For a corporation these forms shall be signed by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

- (i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or
 - (ii) the manager of one or more manufacturing, production or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;
 - b. For a partnership or sole proprietorship these forms shall be signed by a general partner or the proprietor, respectively; or
 - c. For a municipality, State, Federal, or other public agency these forms shall be signed by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:
 - (i) the chief executive officer of the agency, or
 - (ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).
2. The SWPPP and other information requested by the Department shall be signed by a person described in Part VII.H.1. of this permit or by a duly authorized representative of that person. A person is a duly authorized representative only if:
- a. The authorization is made in writing by a person described in Part VII.H.1. of this permit;
 - b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field,

superintendent, position of *equivalent* responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position) and,

- c. The written authorization shall include the name, title and signature of the authorized representative and be attached to the SWPPP.
3. All inspection reports shall be signed by the *qualified inspector* that performs the inspection.
4. The MS4 SWPPP Acceptance form shall be signed by the principal executive officer or ranking elected official from the *regulated, traditional land use control MS4*, or by a duly authorized representative of that person.

It shall constitute a permit violation if an incorrect and/or improper signatory authorizes any required forms, SWPPP and/or inspection reports.

I. Property Rights

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations. *Owners or operators* must obtain any applicable conveyances, easements, licenses and/or access to real property prior to *commencing construction activity*.

J. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

K. Requirement to Obtain Coverage Under an Alternative Permit

1. The Department may require any owner or operator authorized by this permit to apply for and/or obtain either an individual SPDES permit or another SPDES general permit. When the Department requires any discharger authorized by a general permit to apply for an individual SPDES permit, it shall notify the discharger in writing that a permit application is required. This notice shall

include a brief statement of the reasons for this decision, an application form, a statement setting a time frame for the owner or operator to file the application for an individual SPDES permit, and a deadline, not sooner than 180 days from owner or operator receipt of the notification letter, whereby the authorization to discharge under this general permit shall be terminated. Applications must be submitted to the appropriate Permit Administrator at the Regional Office. The Department may grant additional time upon demonstration, to the satisfaction of the Department, that additional time to apply for an alternative authorization is necessary or where the Department has not provided a permit determination in accordance with Part 621 of this Title.

2. When an individual SPDES permit is issued to a discharger authorized to *discharge* under a general SPDES permit for the same *discharge(s)*, the general permit authorization for outfalls authorized under the individual SPDES permit is automatically terminated on the effective date of the individual permit unless termination is earlier in accordance with 6 NYCRR Part 750.

L. Proper Operation and Maintenance

The *owner or operator* shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the *owner or operator* to achieve compliance with the conditions of this permit and with the requirements of the SWPPP.

M. Inspection and Entry

The *owner or operator* shall allow an authorized representative of the Department, EPA, applicable county health department, or, in the case of a *construction site* which *discharges* through an *MS4*, an authorized representative of the *MS4* receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the owner's or operator's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;
2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and

3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment), practices or operations regulated or required by this permit.
4. Sample or monitor at reasonable times, for purposes of assuring permit compliance or as otherwise authorized by the Act or ECL, any substances or parameters at any location.

N. Permit Actions

This permit may, at any time, be modified, suspended, revoked, or renewed by the Department in accordance with 6 NYCRR Part 621. The filing of a request by the *owner or operator* for a permit modification, revocation and reissuance, termination, a notification of planned changes or anticipated noncompliance does not limit, diminish and/or stay compliance with any terms of this permit.

O. Definitions

Definitions of key terms are included in Appendix A of this permit.

P. Re-Opener Clause

1. If there is evidence indicating potential or realized impacts on water quality due to any stormwater discharge associated with construction activity covered by this permit, the owner or operator of such discharge may be required to obtain an individual permit or alternative general permit in accordance with Part VII.K. of this permit or the permit may be modified to include different limitations and/or requirements.
2. Any Department initiated permit modification, suspension or revocation will be conducted in accordance with 6 NYCRR Part 621, 6 NYCRR 750-1.18, and 6 NYCRR 750-1.20.

Q. Penalties for Falsification of Forms and Reports

In accordance with 6NYCRR Part 750-2.4 and 750-2.5, any person who knowingly makes any false material statement, representation, or certification in any application, record, report or other document filed or required to be maintained under this permit, including reports of compliance or noncompliance shall, upon conviction, be punished in accordance with ECL §71-1933 and or Articles 175 and 210 of the New York State Penal Law.

R. Other Permits

Nothing in this permit relieves the *owner or operator* from a requirement to obtain any other permits required by law.

APPENDIX A – Acronyms and Definitions

Acronyms

APO – Agency Preservation Officer
BMP – Best Management Practice
CPESC – Certified Professional in Erosion and Sediment Control
Cpv – Channel Protection Volume
CWA – Clean Water Act (or the Federal Water Pollution Control Act, 33 U.S.C. §1251 et seq)
DOW – Division of Water
EAF – Environmental Assessment Form
ECL - Environmental Conservation Law
EPA – U. S. Environmental Protection Agency
HSG – Hydrologic Soil Group
MS4 – Municipal Separate Storm Sewer System
NOI – Notice of Intent
NOT – Notice of Termination
NPDES – National Pollutant Discharge Elimination System
OPRHP – Office of Parks, Recreation and Historic Places
Qf – Extreme Flood
Qp – Overbank Flood
RRv – Runoff Reduction Volume
RWE – Regional Water Engineer
SEQR – State Environmental Quality Review
SEQRA - State Environmental Quality Review Act
SHPA – State Historic Preservation Act
SPDES – State Pollutant Discharge Elimination System
SWPPP – Stormwater Pollution Prevention Plan
TMDL – Total Maximum Daily Load
UPA – Uniform Procedures Act
USDA – United States Department of Agriculture
WQv – Water Quality Volume

Definitions

All definitions in this section are solely for the purposes of this permit.

Agricultural Building – a structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products; excluding any structure designed, constructed or used, in whole or in part, for human habitation, as a place of employment where agricultural products are processed, treated or packaged, or as a place used by the public.

Agricultural Property – means the land for construction of a barn, *agricultural building*, silo, stockyard, pen or other structural practices identified in Table II in the “Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State” prepared by the Department in cooperation with agencies of New York Nonpoint Source Coordinating Committee (dated June 2007).

Alter Hydrology from Pre to Post-Development Conditions - means the post-development peak flow rate(s) has increased by more than 5% of the pre-developed condition for the design storm of interest (e.g. 10 yr and 100 yr).

Combined Sewer - means a sewer that is designed to collect and convey both “sewage” and “stormwater”.

Commence (Commencement of) Construction Activities - means the initial disturbance of soils associated with clearing, grading or excavation activities; or other construction related activities that disturb or expose soils such as demolition, stockpiling of fill material, and the initial installation of erosion and sediment control practices required in the SWPPP. See definition for “*Construction Activity(ies)*” also.

Construction Activity(ies) - means any clearing, grading, excavation, filling, demolition or stockpiling activities that result in soil disturbance. Clearing activities can include, but are not limited to, logging equipment operation, the cutting and skidding of trees, stump removal and/or brush root removal. Construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

Construction Site – means the land area where *construction activity(ies)* will occur. See definition for “*Commence (Commencement of) Construction Activities*” and “*Larger Common Plan of Development or Sale*” also.

Dewatering – means the act of draining rainwater and/or groundwater from building foundations, vaults or excavations/trenches.

Direct Discharge (to a specific surface waterbody) - means that runoff flows from a *construction site* by overland flow and the first point of discharge is the specific surface waterbody, or runoff flows from a *construction site* to a separate storm sewer system

and the first point of discharge from the separate storm sewer system is the specific surface waterbody.

Discharge(s) - means any addition of any pollutant to waters of the State through an outlet or *point source*.

Embankment – means an earthen or rock slope that supports a road/highway.

Endangered or Threatened Species – see 6 NYCRR Part 182 of the Department’s rules and regulations for definition of terms and requirements.

Environmental Conservation Law (ECL) - means chapter 43-B of the Consolidated Laws of the State of New York, entitled the Environmental Conservation Law.

Equivalent (Equivalence) – means that the practice or measure meets all the performance, longevity, maintenance, and safety objectives of the technical standard and will provide an equal or greater degree of water quality protection.

Final Stabilization - means that all soil disturbance activities have ceased and a uniform, perennial vegetative cover with a density of eighty (80) percent over the entire pervious surface has been established; or other equivalent stabilization measures, such as permanent landscape mulches, rock rip-rap or washed/crushed stone have been applied on all disturbed areas that are not covered by permanent structures, concrete or pavement.

General SPDES permit - means a SPDES permit issued pursuant to 6 NYCRR Part 750-1.21 and Section 70-0117 of the ECL authorizing a category of discharges.

Groundwater(s) - means waters in the saturated zone. The saturated zone is a subsurface zone in which all the interstices are filled with water under pressure greater than that of the atmosphere. Although the zone may contain gas-filled interstices or interstices filled with fluids other than water, it is still considered saturated.

Historic Property – means any building, structure, site, object or district that is listed on the State or National Registers of Historic Places or is determined to be eligible for listing on the State or National Registers of Historic Places.

Impervious Area (Cover) - means all impermeable surfaces that cannot effectively infiltrate rainfall. This includes paved, concrete and gravel surfaces (i.e. parking lots, driveways, roads, runways and sidewalks); building rooftops and miscellaneous impermeable structures such as patios, pools, and sheds.

Infeasible – means not technologically possible, or not economically practicable and achievable in light of best industry practices.

Larger Common Plan of Development or Sale - means a contiguous area where multiple separate and distinct *construction activities* are occurring, or will occur, under one plan. The term “plan” in “larger common plan of development or sale” is broadly defined as any announcement or piece of documentation (including a sign, public notice or hearing, marketing plan, advertisement, drawing, permit application, State Environmental Quality Review Act (SEQRA) environmental assessment form or other documents, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating that *construction activities* may occur on a specific plot.

For discrete construction projects that are located within a larger common plan of development or sale that are at least 1/4 mile apart, each project can be treated as a separate plan of development or sale provided any interconnecting road, pipeline or utility project that is part of the same “common plan” is not concurrently being disturbed.

Minimize – means reduce and/or eliminate to the extent achievable using control measures (including best management practices) that are technologically available and economically practicable and achievable in light of best industry practices.

Municipal Separate Storm Sewer (MS4) - a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

- (i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to surface waters of the State;
- (ii) Designed or used for collecting or conveying stormwater;
- (iii) Which is not a *combined sewer*; and
- (iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

National Pollutant Discharge Elimination System (NPDES) - means the national system for the issuance of wastewater and stormwater permits under the Federal Water Pollution Control Act (Clean Water Act).

Natural Buffer – means an undisturbed area with natural cover running along a surface water (e.g. wetland, stream, river, lake, etc.).

New Development – means any land disturbance that does not meet the definition of Redevelopment Activity included in this appendix.

New York State Erosion and Sediment Control Certificate Program – a certificate program that establishes and maintains a process to identify and recognize individuals who are capable of developing, designing, inspecting and maintaining erosion and sediment control plans on projects that disturb soils in New York State. The certificate program is administered by the New York State Conservation District Employees Association.

NOI Acknowledgment Letter - means the letter that the Department sends to an owner or operator to acknowledge the Department's receipt and acceptance of a complete Notice of Intent. This letter documents the owner's or operator's authorization to discharge in accordance with the general permit for stormwater discharges from *construction activity*.

Nonpoint Source - means any source of water pollution or pollutants which is not a discrete conveyance or *point source* permitted pursuant to Title 7 or 8 of Article 17 of the Environmental Conservation Law (see ECL Section 17-1403).

Overbank –means flow events that exceed the capacity of the stream channel and spill out into the adjacent floodplain.

Owner or Operator - means the person, persons or legal entity which owns or leases the property on which the *construction activity* is occurring; an entity that has operational control over the construction plans and specifications, including the ability to make modifications to the plans and specifications; and/or an entity that has day-to-day operational control of those activities at a project that are necessary to ensure compliance with the permit conditions.

Performance Criteria – means the design criteria listed under the “Required Elements” sections in Chapters 5, 6 and 10 of the technical standard, New York State Stormwater Management Design Manual, dated January 2015. It does not include the Sizing Criteria (i.e. WQv, RRv, Cpv, Qp and Qf) in Part I.C.2. of the permit.

Point Source - means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel or other floating craft, or landfill leachate collection system from which *pollutants* are or may be discharged.

Pollutant - means dredged spoil, filter backwash, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand and industrial, municipal, agricultural waste and ballast discharged into water; which may cause or might reasonably be expected to cause pollution of the waters of the state in contravention of the standards or guidance values adopted as provided in 6 NYCRR Parts 700 et seq .

Qualified Inspector - means a person that is knowledgeable in the principles and practices of erosion and sediment control, such as a licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, New York State Erosion and Sediment Control Certificate Program holder or other Department endorsed individual(s).

It can also mean someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided that person has training in the principles and practices of erosion and sediment control. Training in the principles and practices of erosion and sediment control means that the individual working under the direct supervision of the licensed Professional Engineer or Registered Landscape Architect has received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity. After receiving the initial training, the individual working under the direct supervision of the licensed Professional Engineer or Registered Landscape Architect shall receive four (4) hours of training every three (3) years.

It can also mean a person that meets the *Qualified Professional* qualifications in addition to the *Qualified Inspector* qualifications.

Note: Inspections of any post-construction stormwater management practices that include structural components, such as a dam for an impoundment, shall be performed by a licensed Professional Engineer.

Qualified Professional - means a person that is knowledgeable in the principles and practices of stormwater management and treatment, such as a licensed Professional Engineer, Registered Landscape Architect or other Department endorsed individual(s). Individuals preparing SWPPPs that require the post-construction stormwater management practice component must have an understanding of the principles of hydrology, water quality management practice design, water quantity control design, and, in many cases, the principles of hydraulics. All components of the SWPPP that involve the practice of engineering, as defined by the NYS Education Law (see Article 145), shall be prepared by, or under the direct supervision of, a professional engineer licensed to practice in the State of New York.

Redevelopment Activity(ies) – means the disturbance and reconstruction of existing impervious area, including impervious areas that were removed from a project site within five (5) years of preliminary project plan submission to the local government (i.e. site plan, subdivision, etc.).

Regulated, Traditional Land Use Control MS4 - means a city, town or village with land use control authority that is authorized to discharge under New York State DEC's

SPDES General Permit For Stormwater Discharges from Municipal Separate Stormwater Sewer Systems (MS4s) or the City of New York's Individual SPDES Permit for their Municipal Separate Storm Sewer Systems (NY-0287890).

Routine Maintenance Activity - means *construction activity* that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility, including, but not limited to:

- Re-grading of gravel roads or parking lots,
- Cleaning and shaping of existing roadside ditches and culverts that maintains the approximate original line and grade, and hydraulic capacity of the ditch,
- Cleaning and shaping of existing roadside ditches that does not maintain the approximate original grade, hydraulic capacity and purpose of the ditch if the changes to the line and grade, hydraulic capacity or purpose of the ditch are installed to improve water quality and quantity controls (e.g. installing grass lined ditch),
- Placement of aggregate shoulder backing that stabilizes the transition between the road shoulder and the ditch or *embankment*,
- Full depth milling and filling of existing asphalt pavements, replacement of concrete pavement slabs, and similar work that does not expose soil or disturb the bottom six (6) inches of subbase material,
- Long-term use of equipment storage areas at or near highway maintenance facilities,
- Removal of sediment from the edge of the highway to restore a previously existing sheet-flow drainage connection from the highway surface to the highway ditch or *embankment*,
- Existing use of Canal Corp owned upland disposal sites for the canal, and
- Replacement of curbs, gutters, sidewalks and guide rail posts.

Site limitations – means site conditions that prevent the use of an infiltration technique and or infiltration of the total WQv. Typical site limitations include: seasonal high groundwater, shallow depth to bedrock, and soils with an infiltration rate less than 0.5 inches/hour. The existence of site limitations shall be confirmed and documented using actual field testing (i.e. test pits, soil borings, and infiltration test) or using information from the most current United States Department of Agriculture (USDA) Soil Survey for the County where the project is located.

Sizing Criteria – means the criteria included in Part I.C.2 of the permit that are used to size post-construction stormwater management control practices. The criteria include; Water Quality Volume (WQv), Runoff Reduction Volume (RRv), Channel Protection Volume (Cpv), *Overbank Flood* (Qp), and *Extreme Flood* (Qf).

State Pollutant Discharge Elimination System (SPDES) - means the system established pursuant to Article 17 of the ECL and 6 NYCRR Part 750 for issuance of permits authorizing discharges to the waters of the state.

Steep Slope – means land area designated on the current United States Department of Agriculture (“USDA”) Soil Survey as Soil Slope Phase “D”, (provided the map unit name is inclusive of slopes greater than 25%) , or Soil Slope Phase E or F, (regardless of the map unit name), or a combination of the three designations.

Streambank – as used in this permit, means the terrain alongside the bed of a creek or stream. The bank consists of the sides of the channel, between which the flow is confined.

Stormwater Pollution Prevention Plan (SWPPP) – means a project specific report, including construction drawings, that among other things: describes the construction activity(ies), identifies the potential sources of pollution at the *construction site*; describes and shows the stormwater controls that will be used to control the pollutants (i.e. erosion and sediment controls; for many projects, includes post-construction stormwater management controls); and identifies procedures the *owner or operator* will implement to comply with the terms and conditions of the permit. See Part III of the permit for a complete description of the information that must be included in the SWPPP.

Surface Waters of the State - shall be construed to include lakes, bays, sounds, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic ocean within the territorial seas of the state of New York and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface waters), which are wholly or partially within or bordering the state or within its jurisdiction. Waters of the state are further defined in 6 NYCRR Parts 800 to 941.

Temporarily Ceased – means that an existing disturbed area will not be disturbed again within 14 calendar days of the previous soil disturbance.

Temporary Stabilization - means that exposed soil has been covered with material(s) as set forth in the technical standard, New York Standards and Specifications for Erosion and Sediment Control, to prevent the exposed soil from eroding. The materials can include, but are not limited to, mulch, seed and mulch, and erosion control mats (e.g. jute twisted yarn, excelsior wood fiber mats).

Total Maximum Daily Loads (TMDLs) - A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and *nonpoint sources*. It is a calculation of the maximum amount of a pollutant that a waterbody can receive on a daily basis and still meet *water quality standards*, and an allocation of that amount to the pollutant's sources. A TMDL stipulates wasteload allocations (WLAs) for *point source* discharges, load allocations (LAs) for *nonpoint sources*, and a margin of safety (MOS).

Trained Contractor - means an employee from the contracting (construction) company, identified in Part III.A.6., that has received four (4) hours of Department endorsed

training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity. After receiving the initial training, the *trained contractor* shall receive four (4) hours of training every three (3) years.

It can also mean an employee from the contracting (construction) company, identified in Part III.A.6., that meets the *qualified inspector* qualifications (e.g. licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, New York State Erosion and Sediment Control Certificate Program holder, or someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided they have received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity).

The *trained contractor* is responsible for the day to day implementation of the SWPPP.

Uniform Procedures Act (UPA) Permit - means a permit required under 6 NYCRR Part 621 of the Environmental Conservation Law (ECL), Article 70.

Water Quality Standard - means such measures of purity or quality for any waters in relation to their reasonable and necessary use as promulgated in 6 NYCRR Part 700 et seq.

APPENDIX B – Required SWPPP Components by Project Type

Table 1
Construction Activities that Require the Preparation of a SWPPP That Only Includes Erosion and Sediment Controls

<p>The following construction activities that involve soil disturbances of one (1) or more acres of land, but less than five (5) acres:</p> <ul style="list-style-type: none">• Single family home <u>not</u> located in one of the watersheds listed in Appendix C or <u>not directly discharging</u> to one of the 303(d) segments listed in Appendix E• Single family residential subdivisions with 25% or less impervious cover at total site build-out and <u>not</u> located in one of the watersheds listed in Appendix C and <u>not</u> directly discharging to one of the 303(d) segments listed in Appendix E• Construction of a barn or other <i>agricultural building</i>, silo, stock yard or pen.
<p>The following construction activities that involve soil disturbances between five thousand (5000) square feet and one (1) acre of land:</p> <p>All construction activities located in the watersheds identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.</p>
<p>The following construction activities that involve soil disturbances of one (1) or more acres of land:</p> <ul style="list-style-type: none">• Installation of underground, linear utilities; such as gas lines, fiber-optic cable, cable TV, electric, telephone, sewer mains, and water mains• Environmental enhancement projects, such as wetland mitigation projects, stormwater retrofits and stream restoration projects• Pond construction• Linear bike paths running through areas with vegetative cover, including bike paths surfaced with an impervious cover• Cross-country ski trails and walking/hiking trails• Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are not part of residential, commercial or institutional development;• Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that include incidental shoulder or curb work along an existing highway to support construction of the sidewalk, bike path or walking path.• Slope stabilization projects• Slope flattening that changes the grade of the site, but does not significantly change the runoff characteristics

**Table 1 (Continued) CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP
THAT ONLY INCLUDES EROSION AND SEDIMENT CONTROLS**

The following construction activities that involve soil disturbances of one (1) or more acres of land:

- Spoil areas that will be covered with vegetation
- Vegetated open space projects (i.e. recreational parks, lawns, meadows, fields, downhill ski trails) excluding projects that *alter hydrology from pre to post development* conditions,
- Athletic fields (natural grass) that do not include the construction or reconstruction of *impervious area* and do not *alter hydrology from pre to post development* conditions
- Demolition project where vegetation will be established, and no redevelopment is planned
- Overhead electric transmission line project that does not include the construction of permanent access roads or parking areas surfaced with *impervious cover*
- Structural practices as identified in Table II in the "Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State", excluding projects that involve soil disturbances of greater than five acres and construction activities that include the construction or reconstruction of impervious area
- Temporary access roads, median crossovers, detour roads, lanes, or other temporary impervious areas that will be restored to pre-construction conditions once the construction activity is complete

Table 2
CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP THAT INCLUDES
POST-CONSTRUCTION STORMWATER MANAGEMENT PRACTICES

The following construction activities that involve soil disturbances of one (1) or more acres of land:

- Single family home located in one of the watersheds listed in Appendix C or *directly discharging* to one of the 303(d) segments listed in Appendix E
- Single family home that disturbs five (5) or more acres of land
- Single family residential subdivisions located in one of the watersheds listed in Appendix C or *directly discharging* to one of the 303(d) segments listed in Appendix E
- Single family residential subdivisions that involve soil disturbances of between one (1) and five (5) acres of land with greater than 25% impervious cover at total site build-out
- Single family residential subdivisions that involve soil disturbances of five (5) or more acres of land, and single family residential subdivisions that involve soil disturbances of less than five (5) acres that are part of a larger common plan of development or sale that will ultimately disturb five or more acres of land
- Multi-family residential developments; includes duplexes, townhomes, condominiums, senior housing complexes, apartment complexes, and mobile home parks
- Airports
- Amusement parks
- Breweries, cideries, and wineries, including establishments constructed on agricultural land
- Campgrounds
- Cemeteries that include the construction or reconstruction of impervious area (>5% of disturbed area) or *alter the hydrology from pre to post development conditions*
- Commercial developments
- Churches and other places of worship
- Construction of a barn or other *agricultural building* (e.g. silo) and structural practices as identified in Table II in the "Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State" that include the construction or reconstruction of *impervious area*, excluding projects that involve soil disturbances of less than five acres.
- Golf courses
- Institutional development; includes hospitals, prisons, schools and colleges
- Industrial facilities; includes industrial parks
- Landfills
- Municipal facilities; includes highway garages, transfer stations, office buildings, POTW's, water treatment plants, and water storage tanks
- Office complexes
- Playgrounds that include the construction or reconstruction of impervious area
- Sports complexes
- Racetracks; includes racetracks with earthen (dirt) surface
- Road construction or reconstruction, including roads constructed as part of the construction activities listed in Table 1

Table 2 (Continued)

**CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP THAT INCLUDES
POST-CONSTRUCTION STORMWATER MANAGEMENT PRACTICES**

The following construction activities that involve soil disturbances of one (1) or more acres of land:

- Parking lot construction or reconstruction, including parking lots constructed as part of the construction activities listed in Table 1
- Athletic fields (natural grass) that include the construction or reconstruction of impervious area (>5% of disturbed area) or *alter the hydrology from pre to post development* conditions
- Athletic fields with artificial turf
- Permanent access roads, parking areas, substations, compressor stations and well drilling pads, surfaced with *impervious cover*, and constructed as part of an over-head electric transmission line project, wind-power project, cell tower project, oil or gas well drilling project, sewer or water main project or other linear utility project
- Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a residential, commercial or institutional development
- Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a highway construction or reconstruction project
- All other construction activities that include the construction or reconstruction of *impervious area* or *alter the hydrology from pre to post development* conditions, and are not listed in Table 1

APPENDIX C – Watersheds Requiring Enhanced Phosphorus Removal

Watersheds where *owners or operators* of construction activities identified in Table 2 of Appendix B must prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the Enhanced Phosphorus Removal Standards included in the technical standard, New York State Stormwater Management Design Manual (“Design Manual”).

- Entire New York City Watershed located east of the Hudson River - Figure 1
- Onondaga Lake Watershed - Figure 2
- Greenwood Lake Watershed -Figure 3
- Oscawana Lake Watershed – Figure 4
- Kinderhook Lake Watershed – Figure 5

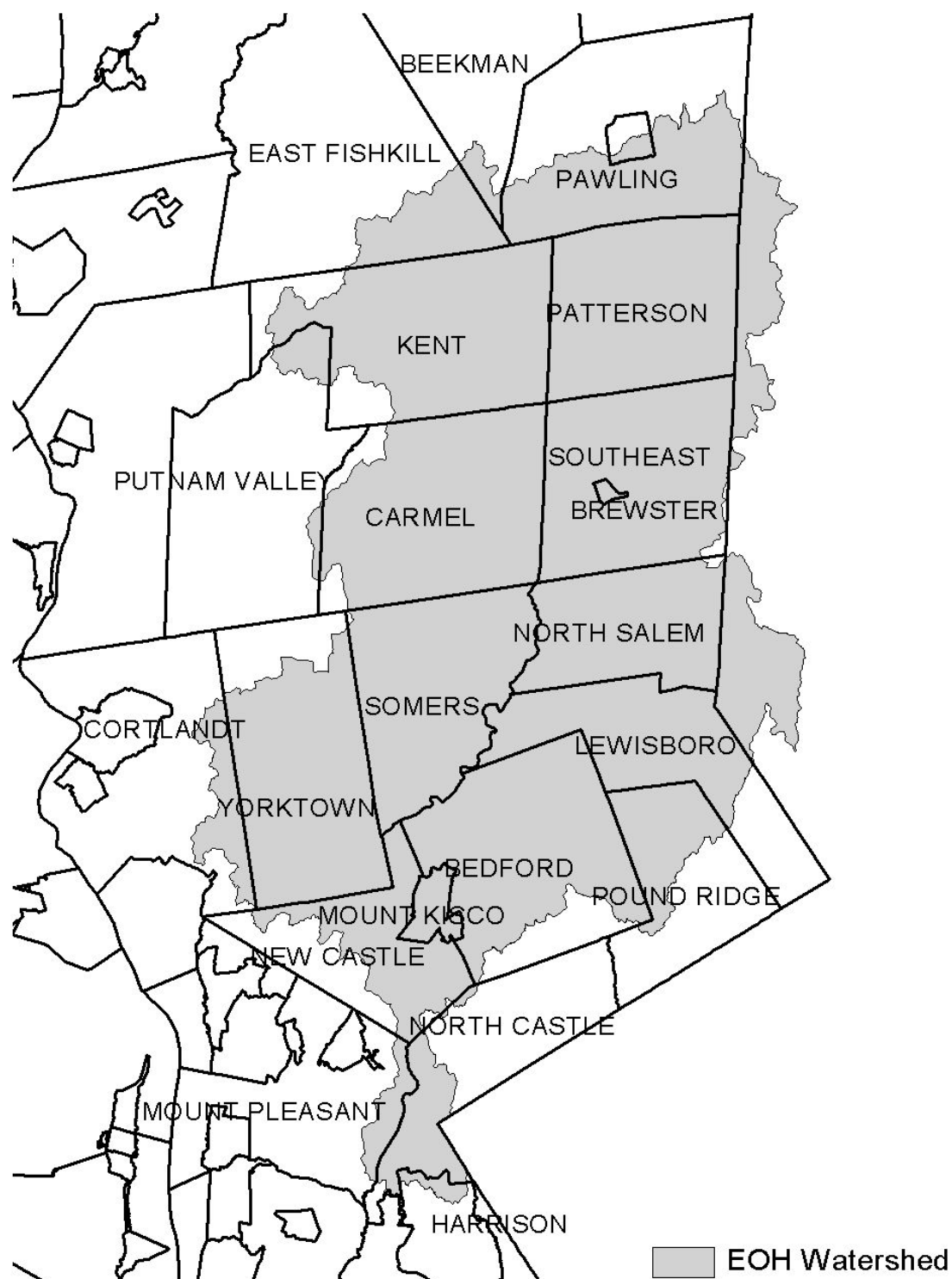
Figure 1 - New York City Watershed East of the Hudson

Figure 2 - Onondaga Lake Watershed

Figure 3 - Greenwood Lake Watershed

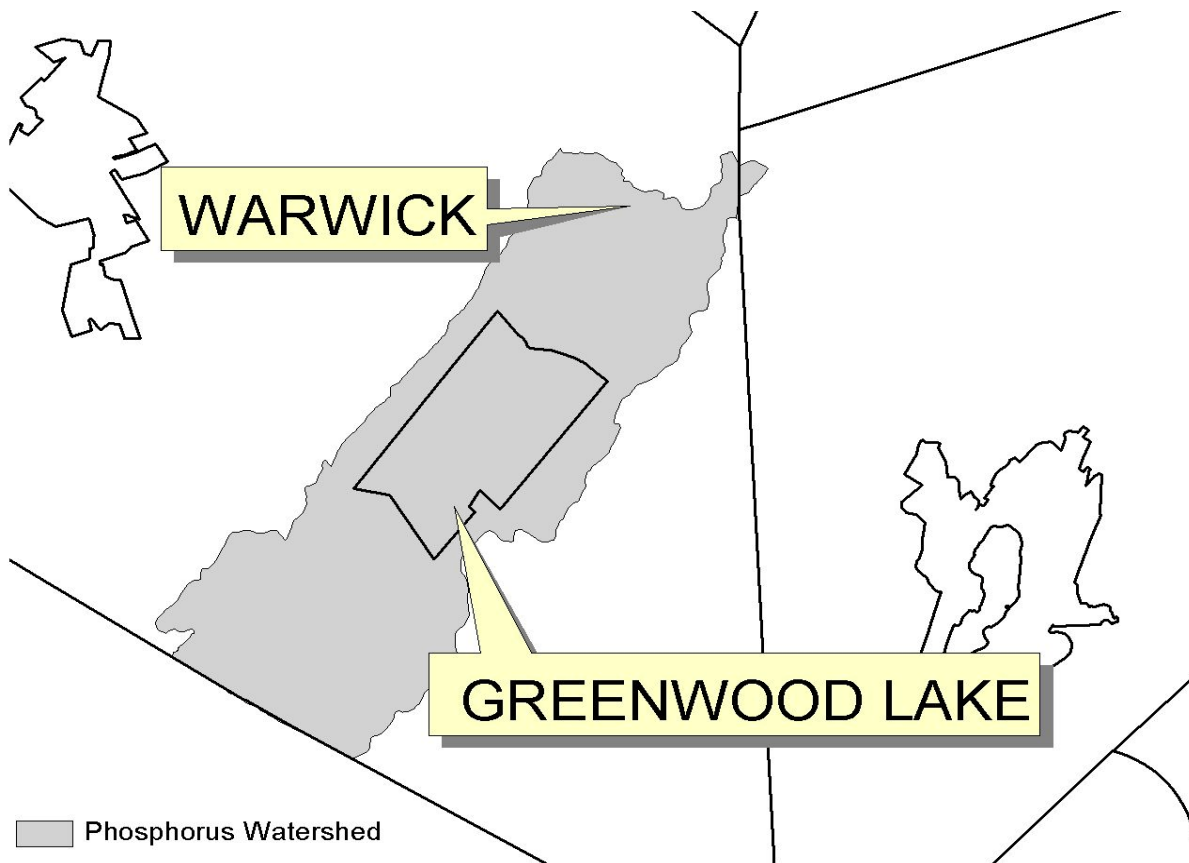


Figure 4 - Oscawana Lake Watershed

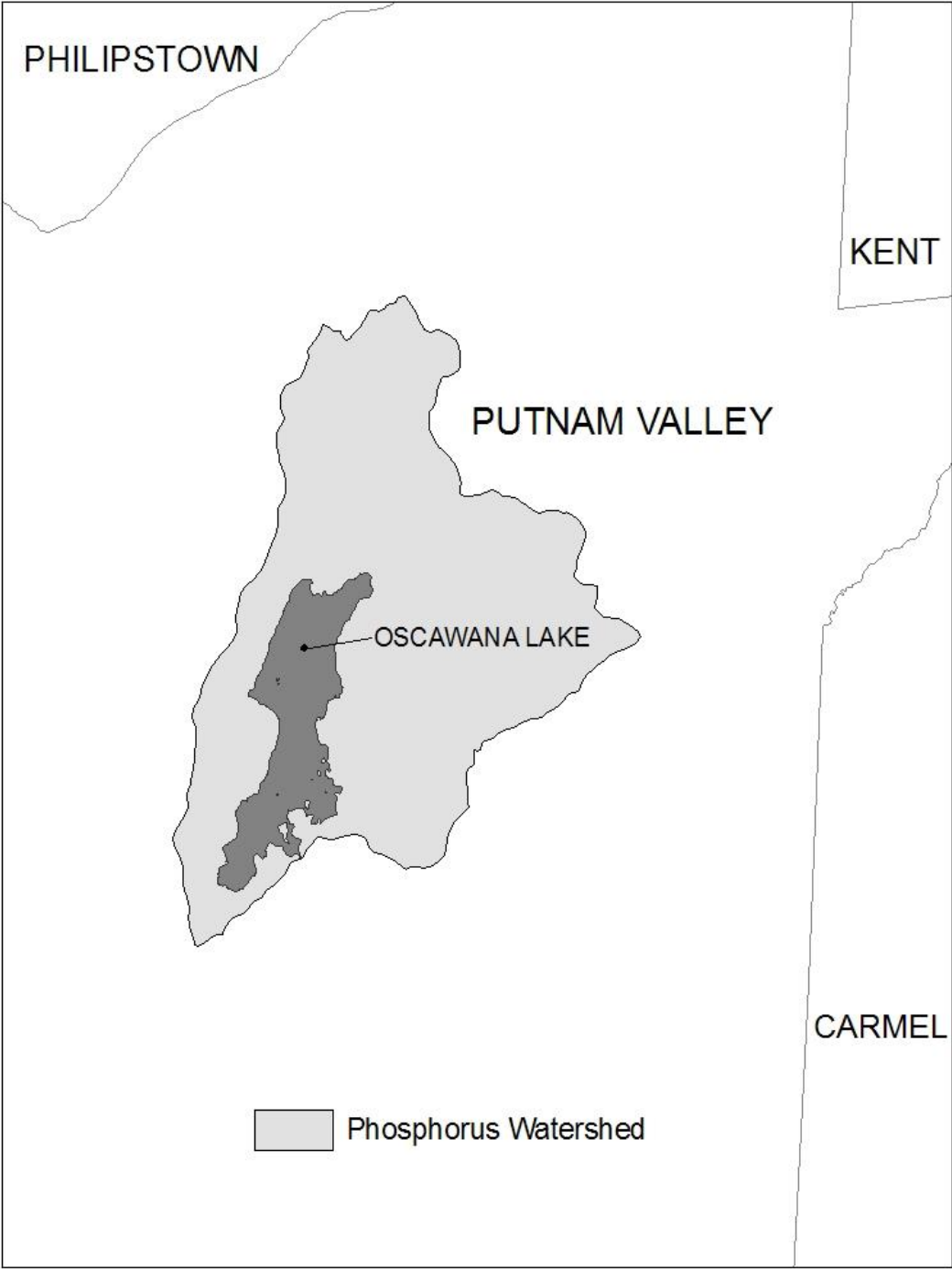
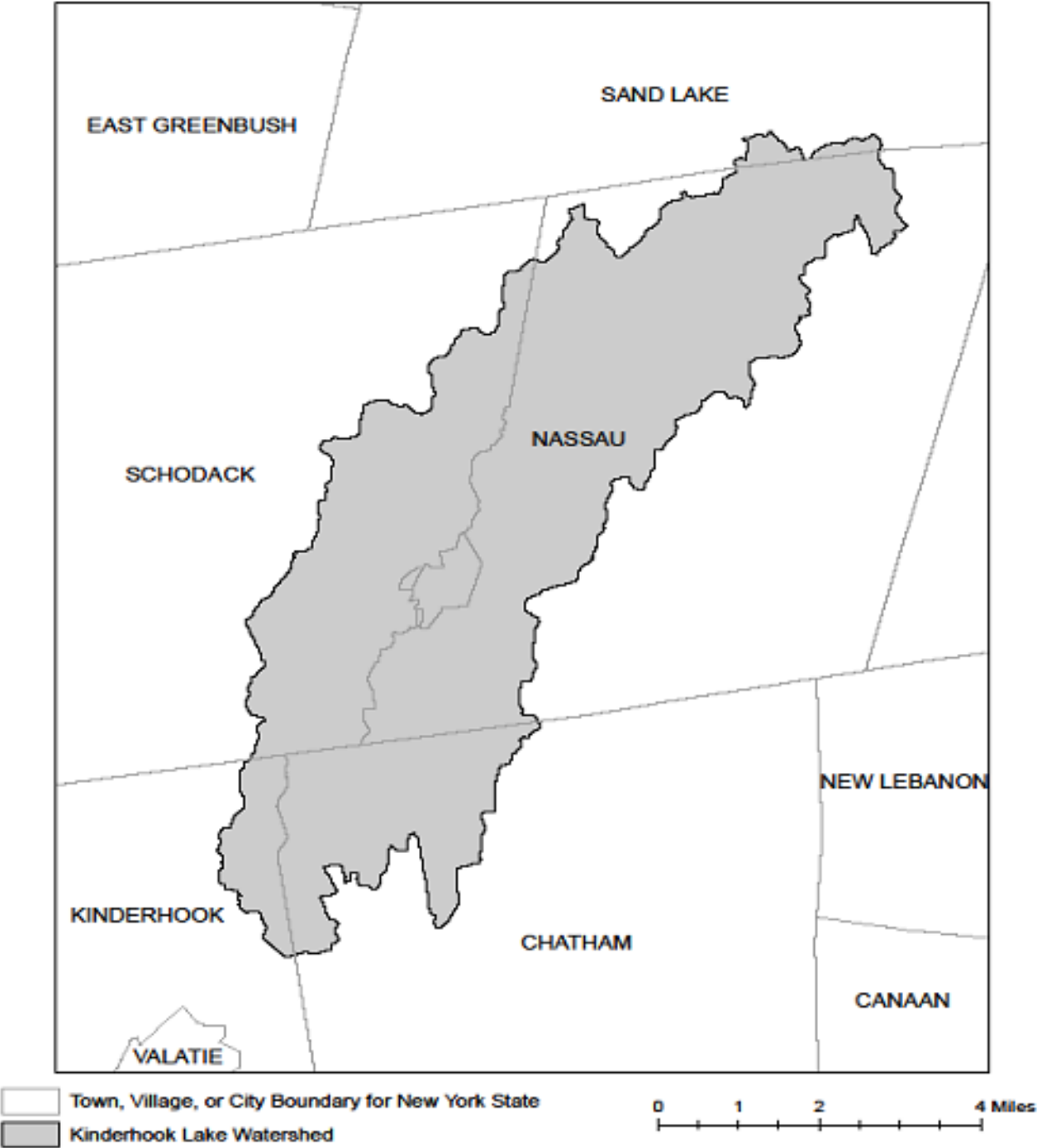


Figure 5 - Kinderhook Lake Watershed



APPENDIX D – Watersheds with Lower Disturbance Threshold

Watersheds where *owners or operators* of construction activities that involve soil disturbances between five thousand (5000) square feet and one (1) acre of land must obtain coverage under this permit.

Entire New York City Watershed that is located east of the Hudson River - See Figure 1 in Appendix C
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APPENDIX E – 303(d) Segments Impaired by Construction Related Pollutant(s)

List of 303(d) segments impaired by pollutants related to *construction activity* (e.g. silt, sediment or nutrients). The list was developed using "The Final New York State 2016 Section 303(d) List of Impaired Waters Requiring a TMDL/Other Strategy" dated November 2016. *Owners or operators* of single family home and single family residential subdivisions with 25% or less total impervious cover at total site build-out that involve soil disturbances of one or more acres of land, but less than 5 acres, and *directly discharge* to one of the listed segments below shall prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the New York State Stormwater Management Design Manual ("Design Manual"), dated January 2015.

COUNTY	WATERBODY	POLLUTANT
Albany	Ann Lee (Shakers) Pond, Stump Pond	Nutrients
Albany	Basic Creek Reservoir	Nutrients
Allegany	Amity Lake, Saunders Pond	Nutrients
Bronx	Long Island Sound, Bronx	Nutrients
Bronx	Van Cortlandt Lake	Nutrients
Broome	Fly Pond, Deer Lake, Sky Lake	Nutrients
Broome	Minor Tribs to Lower Susquehanna (north)	Nutrients
Broome	Whitney Point Lake/Reservoir	Nutrients
Cattaraugus	Allegheny River/Reservoir	Nutrients
Cattaraugus	Beaver (Alma) Lake	Nutrients
Cattaraugus	Case Lake	Nutrients
Cattaraugus	Linlyco/Club Pond	Nutrients
Cayuga	Duck Lake	Nutrients
Cayuga	Little Sodus Bay	Nutrients
Chautauqua	Bear Lake	Nutrients
Chautauqua	Chadakoin River and tribs	Nutrients
Chautauqua	Chautauqua Lake, North	Nutrients
Chautauqua	Chautauqua Lake, South	Nutrients
Chautauqua	Findley Lake	Nutrients
Chautauqua	Hulburt/Clymer Pond	Nutrients
Clinton	Great Chazy River, Lower, Main Stem	Silt/Sediment
Clinton	Lake Champlain, Main Lake, Middle	Nutrients
Clinton	Lake Champlain, Main Lake, North	Nutrients
Columbia	Kinderhook Lake	Nutrients
Columbia	Robinson Pond	Nutrients
Cortland	Dean Pond	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Dutchess	Fall Kill and tribs	Nutrients
Dutchess	Hillside Lake	Nutrients
Dutchess	Wappingers Lake	Nutrients
Dutchess	Wappingers Lake	Silt/Sediment
Erie	Beeman Creek and tribs	Nutrients
Erie	Ellicott Creek, Lower, and tribs	Silt/Sediment
Erie	Ellicott Creek, Lower, and tribs	Nutrients
Erie	Green Lake	Nutrients
Erie	Little Sister Creek, Lower, and tribs	Nutrients
Erie	Murder Creek, Lower, and tribs	Nutrients
Erie	Rush Creek and tribs	Nutrients
Erie	Scajaquada Creek, Lower, and tribs	Nutrients
Erie	Scajaquada Creek, Middle, and tribs	Nutrients
Erie	Scajaquada Creek, Upper, and tribs	Nutrients
Erie	South Branch Smoke Cr, Lower, and tribs	Silt/Sediment
Erie	South Branch Smoke Cr, Lower, and tribs	Nutrients
Essex	Lake Champlain, Main Lake, South	Nutrients
Essex	Lake Champlain, South Lake	Nutrients
Essex	Willsboro Bay	Nutrients
Genesee	Bigelow Creek and tribs	Nutrients
Genesee	Black Creek, Middle, and minor tribs	Nutrients
Genesee	Black Creek, Upper, and minor tribs	Nutrients
Genesee	Bowen Brook and tribs	Nutrients
Genesee	LeRoy Reservoir	Nutrients
Genesee	Oak Orchard Cr, Upper, and tribs	Nutrients
Genesee	Tonawanda Creek, Middle, Main Stem	Nutrients
Greene	Schoharie Reservoir	Silt/Sediment
Greene	Sleepy Hollow Lake	Silt/Sediment
Herkimer	Steele Creek tribs	Silt/Sediment
Herkimer	Steele Creek tribs	Nutrients
Jefferson	Moon Lake	Nutrients
Kings	Hendrix Creek	Nutrients
Kings	Prospect Park Lake	Nutrients
Lewis	Mill Creek/South Branch, and tribs	Nutrients
Livingston	Christie Creek and tribs	Nutrients
Livingston	Conesus Lake	Nutrients
Livingston	Mill Creek and minor tribs	Silt/Sediment
Monroe	Black Creek, Lower, and minor tribs	Nutrients
Monroe	Buck Pond	Nutrients
Monroe	Cranberry Pond	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Monroe	Lake Ontario Shoreline, Western	Nutrients
Monroe	Long Pond	Nutrients
Monroe	Mill Creek and tribs	Nutrients
Monroe	Mill Creek/Blue Pond Outlet and tribs	Nutrients
Monroe	Minor Tribs to Irondequoit Bay	Nutrients
Monroe	Rochester Embayment - East	Nutrients
Monroe	Rochester Embayment - West	Nutrients
Monroe	Shipbuilders Creek and tribs	Nutrients
Monroe	Thomas Creek/White Brook and tribs	Nutrients
Nassau	Beaver Lake	Nutrients
Nassau	Camaans Pond	Nutrients
Nassau	East Meadow Brook, Upper, and tribs	Silt/Sediment
Nassau	East Rockaway Channel	Nutrients
Nassau	Grant Park Pond	Nutrients
Nassau	Hempstead Bay	Nutrients
Nassau	Hempstead Lake	Nutrients
Nassau	Hewlett Bay	Nutrients
Nassau	Hog Island Channel	Nutrients
Nassau	Long Island Sound, Nassau County Waters	Nutrients
Nassau	Massapequa Creek and tribs	Nutrients
Nassau	Milburn/Parsonage Creeks, Upp, and tribs	Nutrients
Nassau	Reynolds Channel, west	Nutrients
Nassau	Tidal Tribs to Hempstead Bay	Nutrients
Nassau	Tribs (fresh) to East Bay	Nutrients
Nassau	Tribs (fresh) to East Bay	Silt/Sediment
Nassau	Tribs to Smith/Halls Ponds	Nutrients
Nassau	Woodmere Channel	Nutrients
New York	Harlem Meer	Nutrients
New York	The Lake in Central Park	Nutrients
Niagara	Bergholtz Creek and tribs	Nutrients
Niagara	Hyde Park Lake	Nutrients
Niagara	Lake Ontario Shoreline, Western	Nutrients
Niagara	Lake Ontario Shoreline, Western	Nutrients
Oneida	Ballou, Nail Creeks and tribs	Nutrients
Onondaga	Harbor Brook, Lower, and tribs	Nutrients
Onondaga	Ley Creek and tribs	Nutrients
Onondaga	Minor Tribs to Onondaga Lake	Nutrients
Onondaga	Ninemile Creek, Lower, and tribs	Nutrients
Onondaga	Onondaga Creek, Lower, and tribs	Nutrients
Onondaga	Onondaga Creek, Middle, and tribs	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Onondaga	Onondaga Lake, northern end	Nutrients
Onondaga	Onondaga Lake, southern end	Nutrients
Ontario	Great Brook and minor tribs	Silt/Sediment
Ontario	Great Brook and minor tribs	Nutrients
Ontario	Hemlock Lake Outlet and minor tribs	Nutrients
Ontario	Honeoye Lake	Nutrients
Orange	Greenwood Lake	Nutrients
Orange	Monhagen Brook and tribs	Nutrients
Orange	Orange Lake	Nutrients
Orleans	Lake Ontario Shoreline, Western	Nutrients
Orleans	Lake Ontario Shoreline, Western	Nutrients
Oswego	Lake Neatahwanta	Nutrients
Oswego	Pleasant Lake	Nutrients
Putnam	Bog Brook Reservoir	Nutrients
Putnam	Boyd Corners Reservoir	Nutrients
Putnam	Croton Falls Reservoir	Nutrients
Putnam	Diverting Reservoir	Nutrients
Putnam	East Branch Reservoir	Nutrients
Putnam	Lake Carmel	Nutrients
Putnam	Middle Branch Reservoir	Nutrients
Putnam	Oscawana Lake	Nutrients
Putnam	Palmer Lake	Nutrients
Putnam	West Branch Reservoir	Nutrients
Queens	Bergen Basin	Nutrients
Queens	Flushing Creek/Bay	Nutrients
Queens	Jamaica Bay, Eastern, and tribs (Queens)	Nutrients
Queens	Kissena Lake	Nutrients
Queens	Meadow Lake	Nutrients
Queens	Willow Lake	Nutrients
Rensselaer	Nassau Lake	Nutrients
Rensselaer	Snyders Lake	Nutrients
Richmond	Grasmere Lake/Bradys Pond	Nutrients
Rockland	Congers Lake, Swartout Lake	Nutrients
Rockland	Rockland Lake	Nutrients
Saratoga	Ballston Lake	Nutrients
Saratoga	Dwaas Kill and tribs	Silt/Sediment
Saratoga	Dwaas Kill and tribs	Nutrients
Saratoga	Lake Lonely	Nutrients
Saratoga	Round Lake	Nutrients
Saratoga	Tribs to Lake Lonely	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Schenectady	Collins Lake	Nutrients
Schenectady	Duane Lake	Nutrients
Schenectady	Mariaville Lake	Nutrients
Schoharie	Engleville Pond	Nutrients
Schoharie	Summit Lake	Nutrients
Seneca	Reeder Creek and tribs	Nutrients
St.Lawrence	Black Lake Outlet/Black Lake	Nutrients
St.Lawrence	Fish Creek and minor tribs	Nutrients
Steuben	Smith Pond	Nutrients
Suffolk	Agawam Lake	Nutrients
Suffolk	Big/Little Fresh Ponds	Nutrients
Suffolk	Canaan Lake	Silt/Sediment
Suffolk	Canaan Lake	Nutrients
Suffolk	Flanders Bay, West/Lower Sawmill Creek	Nutrients
Suffolk	Fresh Pond	Nutrients
Suffolk	Great South Bay, East	Nutrients
Suffolk	Great South Bay, Middle	Nutrients
Suffolk	Great South Bay, West	Nutrients
Suffolk	Lake Ronkonkoma	Nutrients
Suffolk	Long Island Sound, Suffolk County, West	Nutrients
Suffolk	Mattituck (Marratooka) Pond	Nutrients
Suffolk	Meetinghouse/Terrys Creeks and tribs	Nutrients
Suffolk	Mill and Seven Ponds	Nutrients
Suffolk	Millers Pond	Nutrients
Suffolk	Moriches Bay, East	Nutrients
Suffolk	Moriches Bay, West	Nutrients
Suffolk	Peconic River, Lower, and tidal tribs	Nutrients
Suffolk	Quantuck Bay	Nutrients
Suffolk	Shinnecock Bay and Inlet	Nutrients
Suffolk	Tidal tribs to West Moriches Bay	Nutrients
Sullivan	Bodine, Montgomery Lakes	Nutrients
Sullivan	Davies Lake	Nutrients
Sullivan	Evens Lake	Nutrients
Sullivan	Pleasure Lake	Nutrients
Tompkins	Cayuga Lake, Southern End	Nutrients
Tompkins	Cayuga Lake, Southern End	Silt/Sediment
Tompkins	Owasco Inlet, Upper, and tribs	Nutrients
Ulster	Ashokan Reservoir	Silt/Sediment
Ulster	Esopus Creek, Upper, and minor tribs	Silt/Sediment
Warren	Hague Brook and tribs	Silt/Sediment

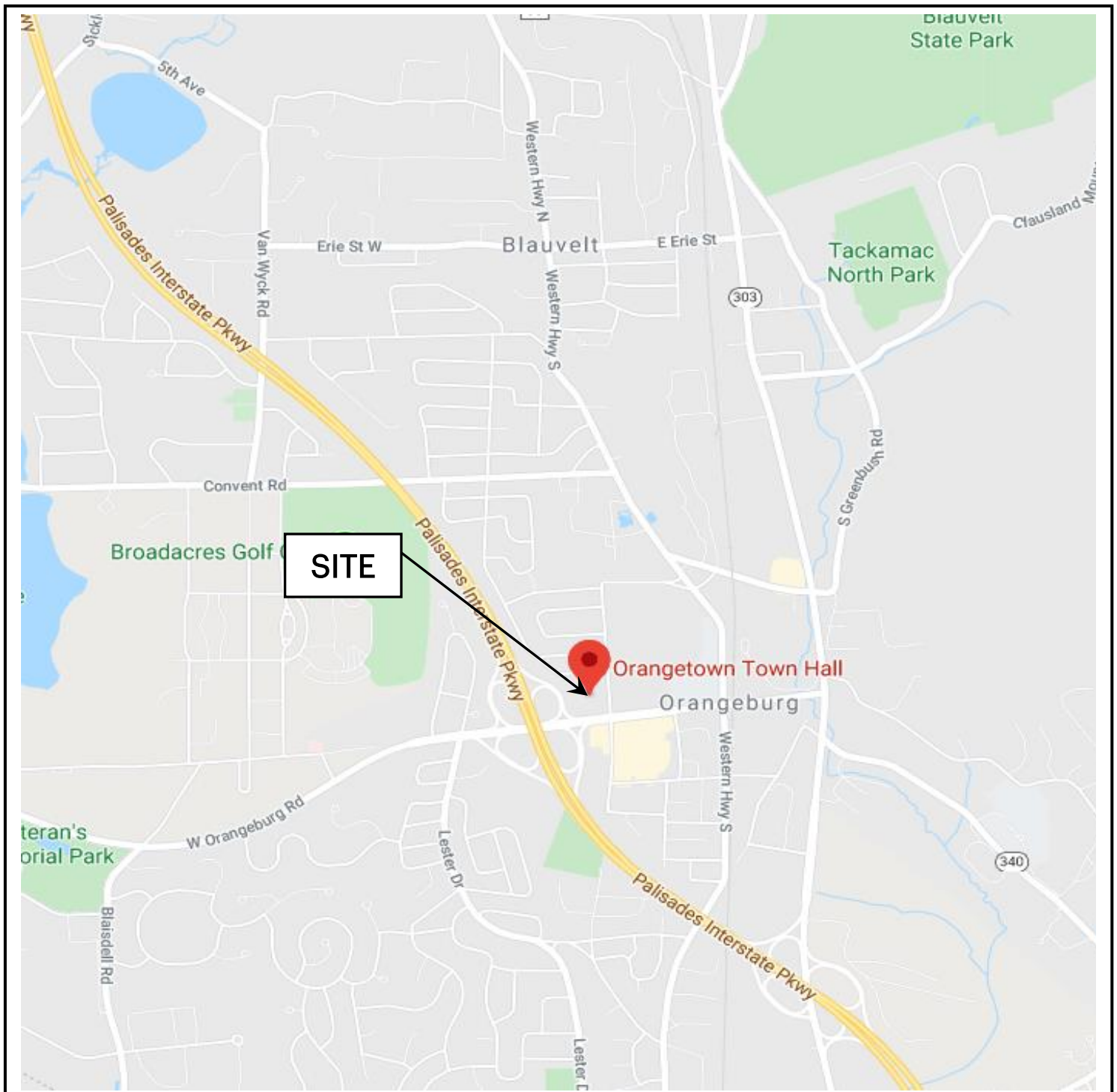
303(d) Segments Impaired by Construction Related Pollutant(s)

Warren	Huddle/Finkle Brooks and tribs	Silt/Sediment
Warren	Indian Brook and tribs	Silt/Sediment
Warren	Lake George	Silt/Sediment
Warren	Tribs to L.George, Village of L George	Silt/Sediment
Washington	Cossayuna Lake	Nutrients
Washington	Lake Champlain, South Bay	Nutrients
Washington	Tribs to L.George, East Shore	Silt/Sediment
Washington	Wood Cr/Champlain Canal and minor tribs	Nutrients
Wayne	Port Bay	Nutrients
Westchester	Amawalk Reservoir	Nutrients
Westchester	Blind Brook, Upper, and tribs	Silt/Sediment
Westchester	Cross River Reservoir	Nutrients
Westchester	Lake Katonah	Nutrients
Westchester	Lake Lincolndale	Nutrients
Westchester	Lake Meahagh	Nutrients
Westchester	Lake Mohegan	Nutrients
Westchester	Lake Shenorock	Nutrients
Westchester	Long Island Sound, Westchester (East)	Nutrients
Westchester	Mamaroneck River, Lower	Silt/Sediment
Westchester	Mamaroneck River, Upper, and minor tribs	Silt/Sediment
Westchester	Muscoot/Upper New Croton Reservoir	Nutrients
Westchester	New Croton Reservoir	Nutrients
Westchester	Peach Lake	Nutrients
Westchester	Reservoir No.1 (Lake Isle)	Nutrients
Westchester	Saw Mill River, Lower, and tribs	Nutrients
Westchester	Saw Mill River, Middle, and tribs	Nutrients
Westchester	Sheldrake River and tribs	Silt/Sediment
Westchester	Sheldrake River and tribs	Nutrients
Westchester	Silver Lake	Nutrients
Westchester	Teatown Lake	Nutrients
Westchester	Titicus Reservoir	Nutrients
Westchester	Truesdale Lake	Nutrients
Westchester	Wallace Pond	Nutrients
Wyoming	Java Lake	Nutrients
Wyoming	Silver Lake	Nutrients

APPENDIX F – List of NYS DEC Regional Offices

<u>Region</u>	<u>COVERING THE FOLLOWING COUNTIES:</u>	<u>DIVISION OF ENVIRONMENTAL PERMITS (DEP) PERMIT ADMINISTRATORS</u>	<u>DIVISION OF WATER (DOW) WATER (SPDES) PROGRAM</u>
1	NASSAU AND SUFFOLK	50 CIRCLE ROAD STONY BROOK, NY 11790 TEL. (631) 444-0365	50 CIRCLE ROAD STONY BROOK, NY 11790-3409 TEL. (631) 444-0405
2	BRONX, KINGS, NEW YORK, QUEENS AND RICHMOND	1 HUNTERS POINT PLAZA, 47-40 21ST ST. LONG ISLAND CITY, NY 11101-5407 TEL. (718) 482-4997	1 HUNTERS POINT PLAZA, 47-40 21ST ST. LONG ISLAND CITY, NY 11101-5407 TEL. (718) 482-4933
3	DUTCHESS, ORANGE, PUTNAM, ROCKLAND, SULLIVAN, ULSTER AND WESTCHESTER	21 SOUTH PUTT CORNERS ROAD NEW PALTZ, NY 12561-1696 TEL. (845) 256-3059	100 HILLSIDE AVENUE, SUITE 1W WHITE PLAINS, NY 10603 TEL. (914) 428 - 2505
4	ALBANY, COLUMBIA, DELAWARE, GREENE, MONTGOMERY, OTSEGO, RENSSELAER, SCHENECTADY AND SCHOHARIE	1150 NORTH WESTCOTT ROAD SCHENECTADY, NY 12306-2014 TEL. (518) 357-2069	1130 NORTH WESTCOTT ROAD SCHENECTADY, NY 12306-2014 TEL. (518) 357-2045
5	CLINTON, ESSEX, FRANKLIN, FULTON, HAMILTON, SARATOGA, WARREN AND WASHINGTON	1115 STATE ROUTE 86, Po Box 296 RAY BROOK, NY 12977-0296 TEL. (518) 897-1234	232 GOLF COURSE ROAD WARRENSBURG, NY 12885-1172 TEL. (518) 623-1200
6	HERKIMER, JEFFERSON, LEWIS, ONEIDA AND ST. LAWRENCE	STATE OFFICE BUILDING 317 WASHINGTON STREET WATERTOWN, NY 13601-3787 TEL. (315) 785-2245	STATE OFFICE BUILDING 207 GENESEE STREET UTICA, NY 13501-2885 TEL. (315) 793-2554
7	BROOME, CAYUGA, CHENANGO, CORTLAND, MADISON, ONONDAGA, OSWEGO, TIOGA AND TOMPKINS	615 ERIE BLVD. WEST SYRACUSE, NY 13204-2400 TEL. (315) 426-7438	615 ERIE BLVD. WEST SYRACUSE, NY 13204-2400 TEL. (315) 426-7500
8	CHEMUNG, GENESEE, LIVINGSTON, MONROE, ONTARIO, ORLEANS, SCHUYLER, SENECA, STEUBEN, WAYNE AND YATES	6274 EAST AVON-LIMA ROADAVON, NY 14414-9519 TEL. (585) 226-2466	6274 EAST AVON-LIMA RD. AVON, NY 14414-9519 TEL. (585) 226-2466
9	ALLEGANY, CATTARAUGUS, CHAUTAUQUA, ERIE, NIAGARA AND WYOMING	270 MICHIGAN AVENUE BUFFALO, NY 14203-2999 TEL. (716) 851-7165	270 MICHIGAN AVENUE BUFFALO, NY 14203-2999 TEL. (716) 851-7070

APPENDIX B



APPROXIMATE SITE LOCATION INDICATED ON THE STREET MAP

SW-101: LOCATION MAP



- PLANNING
- ENGINEERING
- SURVEYING
- CONSTRUCTION MANAGEMENT

TECTONIC Engineering, Consultants,
Geologists & Land Surveyors, D.P.C.
PO Box 37, 70 Pleasant Hill Road
Mountainville, NY 10953

T: (845) 534-5959
F: (845) 534-5999
www.tectonicengineering.com



**ORANGETOWN TOWN HALL
26 ORANEBURG ROAD
TOWN OF ORANGETOWN
ROCKLAND COUNTY
NEW YORK**

SCALE
N.T.S.

DATE
3/12/21

DRAWN BY
JM

WORK ORDER
10128.01



APPROXIMATE SITE LOCATION INDICATED ON
THE AERIAL MAP

SW-102: AERIAL SITE MAP



**ORANGETOWN TOWN HALL
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TOWN OF ORANGETOWN
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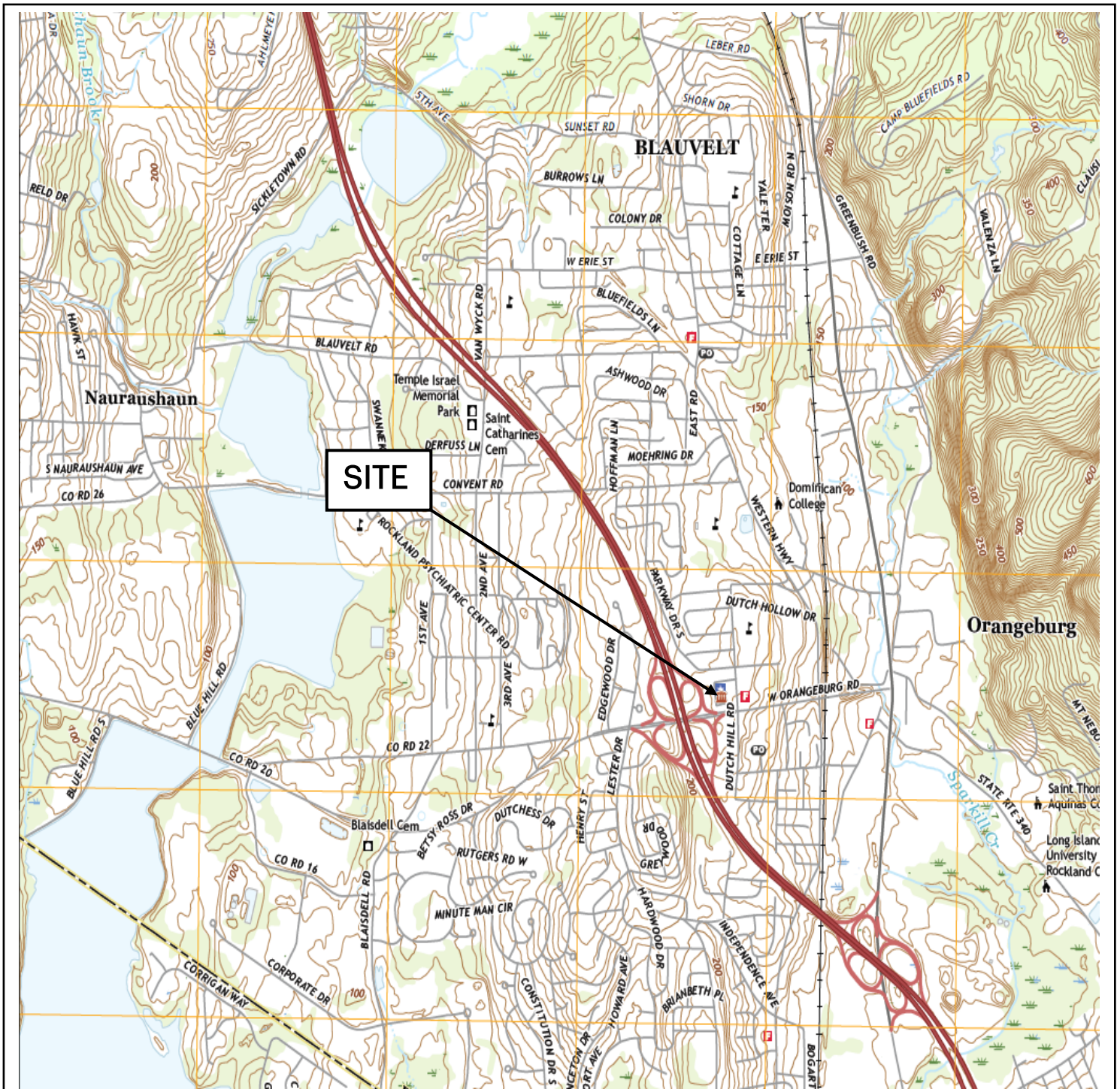
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APPROXIMATE SITE LOCATION INDICATED ON THE USGS MAP

SW-103: USGS MAP

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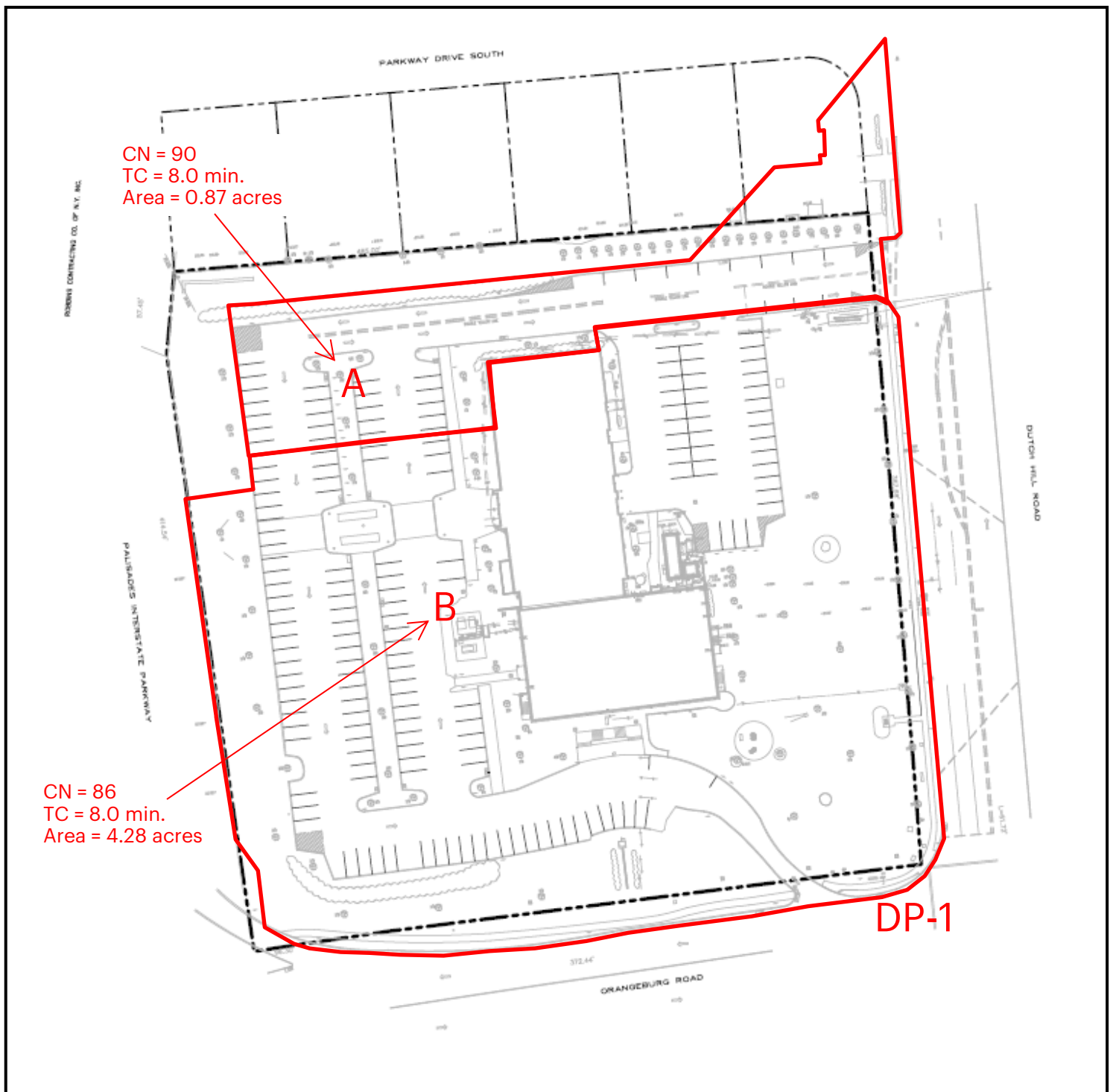
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DRAINAGE MAP INDICATING THE
SUBCATCHMENTS AND DESIGN POINTS FOR
THE EXISTING SITE.

EXISTING DRAINAGE MAP



- PLANNING
- ENGINEERING
- SURVEYING
- CONSTRUCTION MANAGEMENT

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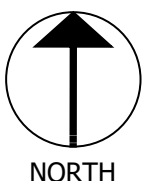
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DATE
3/31/20

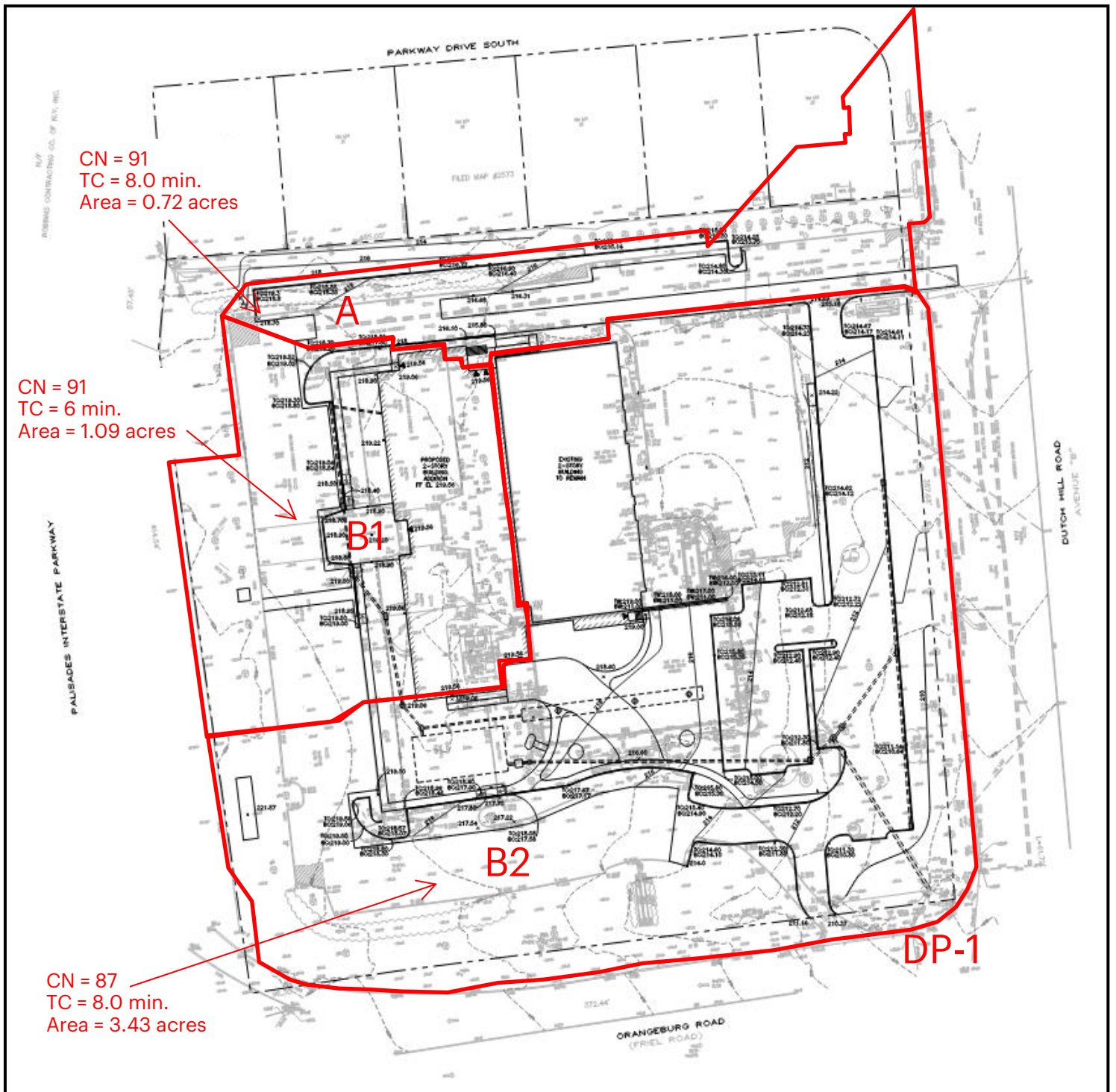
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NORTH

**ORANGETOWN TOWN HALL
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TOWN OF ORANGETOWN
ROCKLAND COUNTY
NEW YORK**



DRAINAGE MAP INDICATING THE SUBCATCHMENTS AND DESIGN POINTS FOR THE PROPOSED SITE.

PROPOSED DRAINAGE MAP

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APPENDIX C



The soil map shown was taken from the USDA Web Soil Survey.

SOILS MAP

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ux	Urban land		0.3	6.3%
WeB	Wethersfield gravelly silt loam, 3 to 8 percent slopes	C	4.8	91.9%
WuC	Wethersfield-Urban land complex, 8 to 15 percent slopes	C	0.1	1.8%
Totals for Area of Interest			5.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Map Unit Description

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named, soils that are similar to the named components, and some minor components that differ in use and management from the major soils.

Most of the soils similar to the major components have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Some minor components, however, have properties and behavior characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Rockland County, New York

Ux—Urban land

Map Unit Setting

National map unit symbol: 9v5g

Mean annual precipitation: 47 to 50 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 135 to 215 days

Farmland classification: Not prime farmland

Rockland County, New York

WeB—Wethersfield gravelly silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v5l

Mean annual precipitation: 47 to 50 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 135 to 215 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Wethersfield and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wethersfield

Setting

Landform: Hills, till plains

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Loamy acid till derived mainly from reddish sandstone, shale, and conglomerate, with some basalt

Typical profile

H1 - 0 to 13 inches: gravelly silt loam

H2 - 13 to 22 inches: gravelly loam

H3 - 22 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: 20 to 38 inches to densic material

Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat):

Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 18 to 30 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: C

Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 5 percent

Hydric soil rating: No

Wallington

Percent of map unit: 5 percent

Hydric soil rating: No

Cheshire

Percent of map unit: 5 percent

Hydric soil rating: No

Riverhead

Percent of map unit: 5 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Rockland County, New York

Survey Area Data: Version 17, Sep 16, 2019

Rockland County, New York

WuC—Wethersfield-Urban land complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v5q
Mean annual precipitation: 47 to 50 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Wethersfield and similar soils: 60 percent
Urban land: 20 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wethersfield

Setting

Landform: Hills, till plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy acid till derived mainly from reddish sandstone, shale, and conglomerate, with some basalt

Typical profile

H1 - 0 to 13 inches: gravelly silt loam
H2 - 13 to 22 inches: gravelly loam
H3 - 22 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 38 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat):
Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s

Hydric soil rating: Unranked

Minor Components

Riverhead

Percent of map unit: 5 percent

Hydric soil rating: No

Charlton

Percent of map unit: 5 percent

Hydric soil rating: No

Cheshire

Percent of map unit: 5 percent

Hydric soil rating: No

Udorthents

Percent of map unit: 3 percent

Hydric soil rating: No

Wallington

Percent of map unit: 2 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Rockland County, New York

Survey Area Data: Version 17, Sep 16, 2019

Rockland County, New York

Ux—Urban land

Map Unit Setting

National map unit symbol: 9v5g

Mean annual precipitation: 47 to 50 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 135 to 215 days

Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 75 percent

Minor components: 25 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s

Hydric soil rating: Unranked

Minor Components

Udorthents

Percent of map unit: 5 percent

Hydric soil rating: No

Holyoke

Percent of map unit: 5 percent

Hydric soil rating: No

Yalesville

Percent of map unit: 5 percent

Hydric soil rating: No

Riverhead

Percent of map unit: 5 percent

Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent

Hydric soil rating: No

Data Source Information

Soil Survey Area: Rockland County, New York

Survey Area Data: Version 17, Sep 16, 2019

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an oven-dry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and plasticity index (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk "*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007 (<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties—Rockland County, New York														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
Ux—Urban land														
Urban land	75		0-6	Variable	—	—	0- 0- 0	0- 0- 0	—	—	—	—	—	—
WeB—Wethersfield gravelly silt loam, 3 to 8 percent slopes														
Wethersfield	80	C	0-13	Gravelly silt loam	CL-ML, GM, ML, SM, CL	A-4	0- 0- 1	0- 2- 10	70-85-90	60-75-75	40-65-70	25-55-65	20-30-40	3-8 -12
			13-22	Gravelly loam, silt loam, gravelly fine sandy loam	CL-ML, GM, ML, SM, SC	A-4	0- 0- 1	0- 2- 15	70-85-95	60-75-92	40-60-90	25-45-80	20-30-40	3-8 -12
			22-60	Gravelly loam, silt loam, gravelly fine sandy loam	CL-ML, GM, ML, SM, SC-SM	A-4, A-2	0- 0- 5	0- 8- 15	65-85-95	50-75-92	35-55-90	20-35-80	15-28-40	NP-6 -12

Engineering Properties--Rockland County, New York														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
WuC—Wethersfield-Urban land complex, 8 to 15 percent slopes														
Wethersfield	60	C	0-13	Gravelly silt loam	CL-ML, GM, ML, SM, CL	A-4	0- 0- 1	0- 2- 10	70-85-90	60-75-75	40-65-70	25-55-65	20-30-40	3-8 -12
			13-22	Gravelly loam, silt loam, gravelly fine sandy loam	CL-ML, GM, ML, SM, SC	A-4	0- 0- 1	0- 2- 15	70-85-95	60-75-92	40-60-90	25-45-80	20-30-40	3-8 -12
			22-60	Gravelly loam, silt loam, gravelly fine sandy loam	CL-ML, GM, ML, SM, SC-SM	A-4, A-2	0- 0- 5	0- 8- 15	65-85-95	50-75-92	35-55-90	20-35-80	15-28-40	NP-6 -12
Urban land	20		0-6	Variable	—	—	0- 0- 0	0- 0- 0	—	—	—	—	—	—

Data Source Information

Soil Survey Area: Rockland County, New York

Survey Area Data: Version 17, Sep 16, 2019



Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ux	Urban land		0.3	6.3%
WeB	Wethersfield gravelly silt loam, 3 to 8 percent slopes	C	4.8	91.9%
WuC	Wethersfield-Urban land complex, 8 to 15 percent slopes	C	0.1	1.8%
Totals for Area of Interest			5.3	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX D-I

TIME OF CONCENTRATION WORKSHEET

WO. NO.
10128.01

DATE
3/25/2020

SHEET
1 OF 2

PROJECT TITLE
Orangetown Town Hall Expansion

LOCATION
Orangetown, Rockland County, NY

ESTIMATED BY
JM

APPROVED BY
CO

REF DRAWING(S)

☒ Present

☐ Developed

Area: A

1. Sheet Flow

- Surface Description (table 3-1)
- Manning's roughness coeff., 'n' (table 3-1)
- Flow length, L (total $L \leq 150\text{ft}$)
- Two-year 24-hour rainfall, P_2
- Land Slope, s
- $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} S^{0.4}}$

Segment ID

A-B	B-C	
Short Grass Prairie	Paved	
0.15	0.01	
47.04	104.47	
3.52	3.52	
0.043	0.019	
0.06	0.02	0.08

2. Shallow Concentrated Flow

- Surface description (paved or unpaved)
- Flow length, L
- Watercourse slope, s
- Average velocity, V (figure 3-1)
- $T_t = \frac{L}{3600 V}$

Segment ID

0.00		
#DIV/0!		

3. Channel Flow

- Cross sectional flow area, a
- Wetted perimeter, p_w
- Hydraulic radius, $r = a/p_w$
- Channel slope, s
- Manning's roughness coefficient, n
- $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$
- Flow Length, L
- $T_t = \frac{L}{3600 V}$

Segment ID

C-D		
0.013		
2.00		
439.42		
0.06		0.06

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr =

0.14

min =

8.00

TIME OF CONCENTRATION WORKSHEET

WO. NO.
10128.01

DATE
3/25/2020

SHEET
2 OF 1

PROJECT TITLE
Orangetown Town Hall Expansion

LOCATION
Orangetown, Rockland County, NY

ESTIMATED BY
JM

APPROVED BY
CO

REF DRAWING(S)

Present

Developed

Area: **B**

1. Sheet Flow

- Surface Description (table 3-1)
- Manning's roughness coeff., 'n' (table 3-1)
- Flow length, L (total L ≤ 150ft)
- Two-year 24-hour rainfall, P₂
- Land Slope, s
- $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$

Segment ID

ft
in
ft/ft
hr

A-B	B-C		
Short Grass Prairie	Paved		
0.15	0.01		
44.99	73.91		
3.52	3.52		
0.022	0.027		
0.08	0.01		0.09

2. Shallow Concentrated Flow

- Surface description (paved or unpaved)
- Flow length, L
- Watercourse slope, s
- Average velocity, V (figure 3-1)
- $T_t = \frac{L}{3600 V}$

Segment ID

ft
ft/ft
ft/s
hr

C-D			
unpaved			
149.64			
0.023			
2.47			
0.02			0.02

3. Channel Flow

- Cross sectional flow area, a
- Wetted perimeter, p_w
- Hydraulic radius, r = a/p_w
- Channel slope, s
- Manning's roughness coefficient, n
- $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$
- Flow Length, L
- $T_t = \frac{L}{3600 V}$

Segment ID

ft²
ft
ft
ft/ft
ft/s
ft
hr

D-E			
0.020			
5.00			
565.52			
0.03			0.03

20. Total Tc For Watershed or Subarea (Add Steps 6, 11, and 19)

hr = **0.14**

min = **8.00**



NOAA Atlas 14, Volume 10, Version 3
Location name: Orangeburg, New York, USA*
Latitude: 41.0471°, Longitude: -73.955°
Elevation: 215.63 ft**
* source: ESRI Maps
** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerals](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.367 (0.290-0.461)	0.432 (0.340-0.543)	0.538 (0.422-0.679)	0.626 (0.489-0.795)	0.747 (0.562-0.986)	0.839 (0.618-1.13)	0.933 (0.663-1.30)	1.03 (0.699-1.48)	1.17 (0.758-1.73)	1.27 (0.805-1.93)
10-min	0.519 (0.410-0.653)	0.611 (0.482-0.769)	0.761 (0.598-0.963)	0.886 (0.692-1.13)	1.06 (0.796-1.40)	1.19 (0.874-1.60)	1.32 (0.939-1.84)	1.46 (0.990-2.10)	1.65 (1.07-2.46)	1.80 (1.14-2.74)
15-min	0.611 (0.483-0.768)	0.719 (0.567-0.905)	0.896 (0.704-1.13)	1.04 (0.814-1.32)	1.24 (0.937-1.64)	1.40 (1.03-1.88)	1.56 (1.11-2.17)	1.72 (1.17-2.47)	1.95 (1.26-2.89)	2.12 (1.34-3.22)
30-min	0.846 (0.668-1.06)	0.993 (0.783-1.25)	1.23 (0.969-1.56)	1.43 (1.12-1.82)	1.71 (1.29-2.26)	1.92 (1.41-2.58)	2.13 (1.51-2.96)	2.35 (1.59-3.38)	2.66 (1.73-3.95)	2.89 (1.83-4.38)
60-min	1.08 (0.853-1.36)	1.27 (0.999-1.59)	1.57 (1.23-1.98)	1.82 (1.42-2.32)	2.17 (1.63-2.87)	2.44 (1.79-3.28)	2.71 (1.92-3.76)	2.99 (2.02-4.28)	3.36 (2.19-5.00)	3.66 (2.31-5.55)
2-hr	1.44 (1.15-1.80)	1.67 (1.33-2.09)	2.05 (1.62-2.57)	2.36 (1.86-2.98)	2.79 (2.11-3.66)	3.11 (2.31-4.17)	3.45 (2.46-4.77)	3.80 (2.59-5.42)	4.28 (2.79-6.32)	4.66 (2.96-7.02)
3-hr	1.67 (1.34-2.08)	1.94 (1.55-2.42)	2.38 (1.89-2.97)	2.74 (2.17-3.45)	3.24 (2.47-4.24)	3.62 (2.69-4.84)	4.01 (2.88-5.54)	4.43 (3.02-6.30)	5.02 (3.28-7.38)	5.48 (3.49-8.23)
6-hr	2.08 (1.67-2.57)	2.45 (1.97-3.03)	3.05 (2.44-3.79)	3.56 (2.83-4.44)	4.25 (3.26-5.53)	4.77 (3.57-6.34)	5.31 (3.85-7.33)	5.92 (4.05-8.36)	6.79 (4.45-9.92)	7.50 (4.78-11.2)
12-hr	2.47 (2.00-3.03)	2.99 (2.42-3.68)	3.84 (3.10-4.74)	4.55 (3.65-5.64)	5.52 (4.27-7.17)	6.25 (4.72-8.29)	7.02 (5.14-9.68)	7.91 (5.43-11.1)	9.22 (6.06-13.4)	10.3 (6.59-15.3)
24-hr	2.85 (2.33-3.48)	3.52 (2.87-4.29)	4.61 (3.74-5.64)	5.51 (4.45-6.78)	6.75 (5.25-8.71)	7.67 (5.84-10.1)	8.66 (6.38-11.9)	9.82 (6.76-13.7)	11.5 (7.60-16.6)	13.0 (8.32-19.1)
2-day	3.26 (2.69-3.95)	4.02 (3.30-4.87)	5.25 (4.30-6.39)	6.28 (5.11-7.68)	7.69 (6.02-9.85)	8.74 (6.69-11.5)	9.86 (7.30-13.4)	11.2 (7.73-15.5)	13.1 (8.69-18.8)	14.8 (9.51-21.6)
3-day	3.58 (2.96-4.31)	4.37 (3.61-5.28)	5.68 (4.67-6.88)	6.76 (5.53-8.24)	8.25 (6.49-10.5)	9.36 (7.20-12.2)	10.5 (7.85-14.3)	12.0 (8.29-16.5)	14.1 (9.31-20.1)	15.8 (10.2-23.0)
4-day	3.85 (3.19-4.63)	4.68 (3.88-5.63)	6.03 (4.98-7.29)	7.16 (5.87-8.70)	8.71 (6.88-11.1)	9.86 (7.60-12.8)	11.1 (8.28-15.1)	12.6 (8.73-17.3)	14.8 (9.80-21.0)	16.6 (10.7-24.1)
7-day	4.56 (3.81-5.46)	5.46 (4.56-6.54)	6.93 (5.76-8.32)	8.15 (6.72-9.84)	9.83 (7.80-12.4)	11.1 (8.58-14.3)	12.4 (9.29-16.7)	14.0 (9.76-19.1)	16.3 (10.9-23.1)	18.3 (11.8-26.4)
10-day	5.25 (4.40-6.25)	6.20 (5.19-7.39)	7.76 (6.47-9.28)	9.05 (7.49-10.9)	10.8 (8.61-13.6)	12.2 (9.43-15.6)	13.6 (10.1-18.1)	15.2 (10.6-20.7)	17.6 (11.7-24.8)	19.6 (12.7-28.2)
20-day	7.36 (6.22-8.70)	8.44 (7.12-9.99)	10.2 (8.58-12.1)	11.7 (9.74-13.9)	13.7 (11.0-17.0)	15.2 (11.8-19.3)	16.8 (12.6-22.1)	18.5 (13.0-25.0)	20.9 (14.0-29.2)	22.8 (14.8-32.5)
30-day	9.14 (7.76-10.8)	10.3 (8.74-12.2)	12.2 (10.3-14.5)	13.8 (11.6-16.4)	16.0 (12.8-19.8)	17.7 (13.8-22.3)	19.4 (14.5-25.2)	21.1 (14.9-28.4)	23.4 (15.8-32.6)	25.2 (16.4-35.9)
45-day	11.4 (9.70-13.3)	12.6 (10.8-14.9)	14.7 (12.5-17.4)	16.5 (13.9-19.5)	18.8 (15.2-23.1)	20.7 (16.2-25.9)	22.5 (16.8-29.0)	24.3 (17.2-32.5)	26.5 (17.9-36.8)	28.2 (18.4-39.9)
60-day	13.3 (11.3-15.5)	14.6 (12.5-17.1)	16.8 (14.3-19.8)	18.7 (15.8-22.0)	21.2 (17.1-25.9)	23.2 (18.1-28.8)	25.1 (18.7-32.1)	26.9 (19.1-35.8)	29.1 (19.7-40.2)	30.6 (20.0-43.3)
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.										

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PF graphical

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	No
State	New York
Location	
Longitude	73.956 degrees West
Latitude	41.046 degrees North
Elevation	0 feet
Date/Time	Thu, 08 Jul 2021 12:30:11 -0400

Extreme Precipitation Estimates

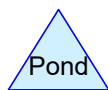
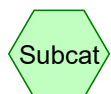
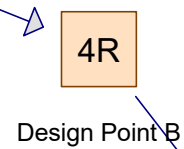
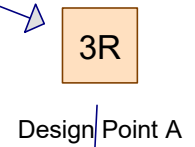
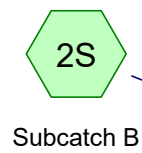
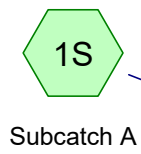
	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.33	0.51	0.62	0.84	1.03	1.26	1yr	0.89	1.23	1.47	1.88	2.27	2.79	3.19	1yr	2.47	3.07	3.55	4.27	4.91	1yr
2yr	0.40	0.62	0.76	1.03	1.27	1.52	2yr	1.09	1.49	1.75	2.26	2.80	3.40	3.83	2yr	3.01	3.69	4.24	5.02	5.71	2yr
5yr	0.47	0.72	0.89	1.23	1.56	1.88	5yr	1.35	1.84	2.15	2.79	3.49	4.26	4.85	5yr	3.77	4.66	5.39	6.26	7.02	5yr
10yr	0.53	0.82	1.01	1.41	1.83	2.21	10yr	1.58	2.16	2.53	3.27	4.13	5.05	5.80	10yr	4.47	5.57	6.47	7.41	8.22	10yr
25yr	0.63	0.96	1.20	1.71	2.25	2.73	25yr	1.94	2.67	3.12	4.03	5.16	6.33	7.35	25yr	5.60	7.06	8.23	9.25	10.12	25yr
50yr	0.72	1.10	1.37	1.96	2.64	3.21	50yr	2.28	3.14	3.66	4.74	6.10	7.52	8.79	50yr	6.65	8.45	9.89	10.94	11.86	50yr
100yr	0.83	1.25	1.57	2.27	3.11	3.78	100yr	2.68	3.70	4.30	5.58	7.22	8.93	10.53	100yr	7.90	10.12	11.88	12.94	13.90	100yr
200yr	0.95	1.43	1.81	2.62	3.65	4.46	200yr	3.15	4.36	5.05	6.58	8.55	10.61	12.61	200yr	9.39	12.12	14.28	15.32	16.31	200yr
500yr	1.15	1.71	2.20	3.19	4.54	5.54	500yr	3.91	5.41	6.25	8.20	10.71	13.35	16.01	500yr	11.81	15.40	18.23	19.16	20.15	500yr

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.44	0.53	0.72	0.88	1.14	1yr	0.76	1.11	1.22	1.64	2.11	2.31	2.88	1yr	2.04	2.77	3.34	3.88	4.26	1yr
2yr	0.38	0.59	0.73	0.99	1.22	1.47	2yr	1.05	1.44	1.68	2.17	2.70	3.31	3.74	2yr	2.93	3.59	4.12	4.87	5.55	2yr
5yr	0.43	0.66	0.82	1.12	1.42	1.72	5yr	1.23	1.68	1.97	2.57	3.15	3.99	4.53	5yr	3.53	4.35	5.02	5.87	6.57	5yr
10yr	0.47	0.71	0.89	1.24	1.60	1.93	10yr	1.38	1.89	2.21	2.87	3.52	4.59	5.22	10yr	4.06	5.02	5.83	6.63	7.31	10yr
25yr	0.52	0.79	0.98	1.40	1.85	2.25	25yr	1.59	2.20	2.59	3.36	4.09	5.53	6.32	25yr	4.89	6.08	7.08	7.92	8.46	25yr
50yr	0.57	0.86	1.07	1.54	2.08	2.54	50yr	1.79	2.48	2.92	3.81	4.58	6.36	7.29	50yr	5.63	7.01	8.20	9.05	9.45	50yr
100yr	0.62	0.94	1.17	1.69	2.32	2.86	100yr	2.00	2.80	3.29	4.34	5.14	7.34	8.41	100yr	6.50	8.08	9.51	10.33	10.53	100yr
200yr	0.67	1.01	1.28	1.86	2.59	3.23	200yr	2.24	3.15	3.72	4.96	5.79	8.50	9.72	200yr	7.53	9.34	11.03	11.81	11.71	200yr
500yr	0.76	1.13	1.46	2.12	3.01	3.80	500yr	2.60	3.71	4.39	5.97	6.81	10.33	11.78	500yr	9.14	11.33	13.42	14.09	13.43	500yr

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.37	0.57	0.70	0.94	1.15	1.38	1yr	1.00	1.35	1.63	2.14	2.44	2.99	3.42	1yr	2.64	3.28	3.83	4.57	5.23	1yr
2yr	0.42	0.64	0.79	1.07	1.32	1.59	2yr	1.14	1.55	1.82	2.34	2.94	3.51	3.98	2yr	3.11	3.83	4.37	5.19	5.93	2yr
5yr	0.51	0.78	0.97	1.33	1.69	2.03	5yr	1.46	1.98	2.34	3.02	3.82	4.54	5.17	5yr	4.02	4.97	5.77	6.67	7.44	5yr
10yr	0.60	0.92	1.14	1.59	2.05	2.46	10yr	1.77	2.40	2.83	3.65	4.67	5.53	6.35	10yr	4.89	6.11	7.12	8.24	9.07	10yr
25yr	0.75	1.14	1.41	2.02	2.65	3.16	25yr	2.29	3.09	3.66	4.71	6.13	7.17	8.33	25yr	6.35	8.01	9.42	10.74	11.62	25yr
50yr	0.88	1.34	1.67	2.40	3.24	3.84	50yr	2.79	3.75	4.44	5.72	7.48	8.72	10.23	50yr	7.72	9.84	11.66	13.13	14.03	50yr
100yr	1.05	1.59	2.00	2.88	3.96	4.65	100yr	3.41	4.55	5.39	6.95	9.16	10.62	12.56	100yr	9.39	12.08	14.45	16.04	16.96	100yr
200yr	1.26	1.89	2.39	3.47	4.83	5.65	200yr	4.17	5.52	6.54	8.43	11.22	12.92	15.44	200yr	11.43	14.84	17.90	19.63	20.52	200yr
500yr	1.60	2.39	3.07	4.46	6.34	7.31	500yr	5.47	7.14	8.45	10.90	14.66	16.76	20.26	500yr	14.83	19.48	23.78	25.64	26.45	500yr



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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.469	74	>75% Grass cover, Good, HSG C (1S, 2S)
2.679	98	Paved roads w/curbs & sewers, HSG C (1S, 2S)
5.148	86	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
5.148	HSG C	1S, 2S
0.000	HSG D	
0.000	Other	
5.148		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	2.469	0.000	0.000	2.469	>75% Grass cover, Good	1S, 2S
0.000	0.000	2.679	0.000	0.000	2.679	Paved roads w/curbs & sewers	1S, 2S
0.000	0.000	5.148	0.000	0.000	5.148	TOTAL AREA	

2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatch A

Runoff Area=0.868 ac 66.47% Impervious Runoff Depth=1.85"
Tc=8.0 min CN=90 Runoff=1.72 cfs 0.134 af

Subcatchment 2S: Subcatch B

Runoff Area=4.280 ac 49.11% Impervious Runoff Depth=1.53"
Tc=8.0 min CN=86 Runoff=7.09 cfs 0.547 af

Reach 3R: Design Point A

Inflow=1.72 cfs 0.134 af
Outflow=1.72 cfs 0.134 af

Reach 4R: Design Point B

Inflow=7.09 cfs 0.547 af
Outflow=7.09 cfs 0.547 af

Link 5L: DP-1

Inflow=8.82 cfs 0.681 af
Primary=8.82 cfs 0.681 af

Total Runoff Area = 5.148 ac Runoff Volume = 0.681 af Average Runoff Depth = 1.59"
47.96% Pervious = 2.469 ac 52.04% Impervious = 2.679 ac

Summary for Subcatchment 1S: Subcatch A

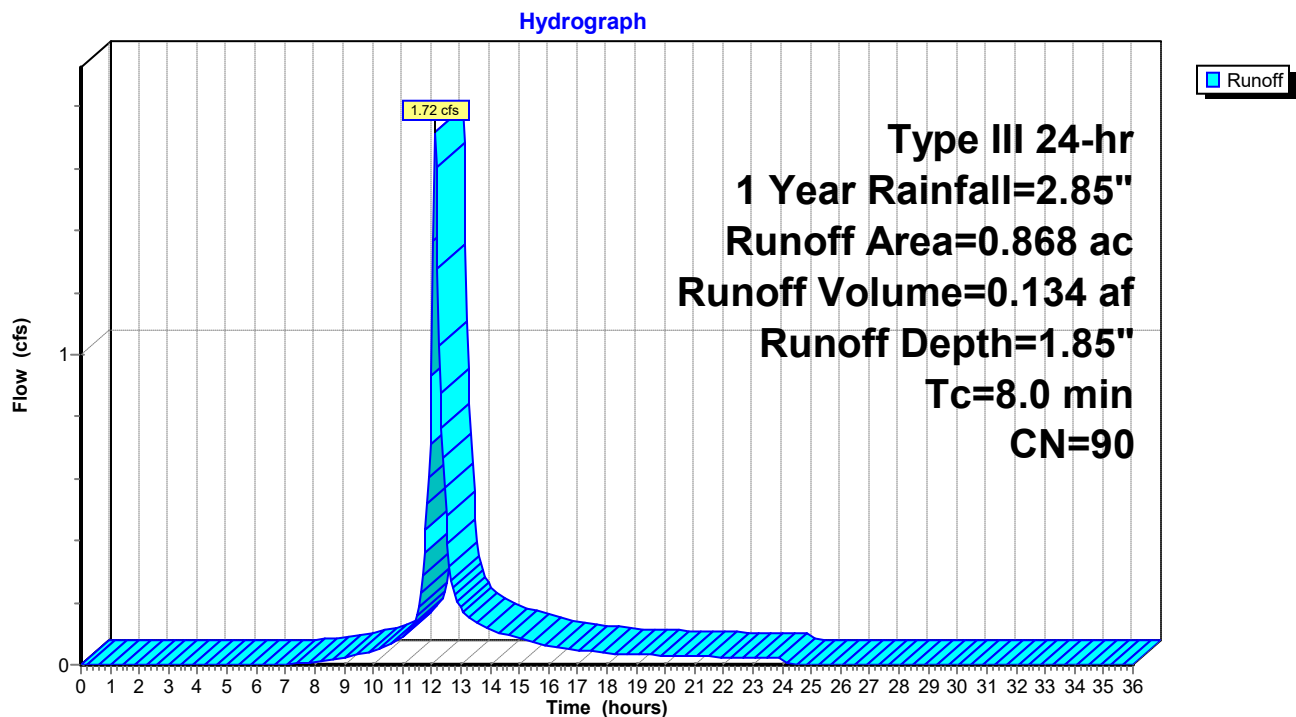
Runoff = 1.72 cfs @ 12.11 hrs, Volume= 0.134 af, Depth= 1.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Year Rainfall=2.85"

Area (ac)	CN	Description
0.577	98	Paved roads w/curbs & sewers, HSG C
0.291	74	>75% Grass cover, Good, HSG C
0.868	90	Weighted Average
0.291		33.53% Pervious Area
0.577		66.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry, See TC Worksheet

Subcatchment 1S: Subcatch A



2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

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Hydrograph for Subcatchment 1S: Subcatch A

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.00	2.85	1.85	0.00
0.50	0.01	0.00	0.00	26.50	2.85	1.85	0.00
1.00	0.03	0.00	0.00	27.00	2.85	1.85	0.00
1.50	0.04	0.00	0.00	27.50	2.85	1.85	0.00
2.00	0.06	0.00	0.00	28.00	2.85	1.85	0.00
2.50	0.07	0.00	0.00	28.50	2.85	1.85	0.00
3.00	0.09	0.00	0.00	29.00	2.85	1.85	0.00
3.50	0.10	0.00	0.00	29.50	2.85	1.85	0.00
4.00	0.12	0.00	0.00	30.00	2.85	1.85	0.00
4.50	0.14	0.00	0.00	30.50	2.85	1.85	0.00
5.00	0.16	0.00	0.00	31.00	2.85	1.85	0.00
5.50	0.18	0.00	0.00	31.50	2.85	1.85	0.00
6.00	0.21	0.00	0.00	32.00	2.85	1.85	0.00
6.50	0.23	0.00	0.00	32.50	2.85	1.85	0.00
7.00	0.26	0.00	0.00	33.00	2.85	1.85	0.00
7.50	0.29	0.00	0.01	33.50	2.85	1.85	0.00
8.00	0.32	0.01	0.01	34.00	2.85	1.85	0.00
8.50	0.37	0.02	0.02	34.50	2.85	1.85	0.00
9.00	0.42	0.03	0.02	35.00	2.85	1.85	0.00
9.50	0.47	0.05	0.03	35.50	2.85	1.85	0.00
10.00	0.54	0.07	0.05	36.00	2.85	1.85	0.00
10.50	0.62	0.10	0.06				
11.00	0.71	0.15	0.09				
11.50	0.85	0.23	0.15				
12.00	1.42	0.63	0.93				
12.50	2.00	1.09	0.48				
13.00	2.14	1.21	0.18				
13.50	2.23	1.30	0.14				
14.00	2.31	1.36	0.11				
14.50	2.38	1.42	0.10				
15.00	2.43	1.47	0.09				
15.50	2.48	1.52	0.07				
16.00	2.53	1.55	0.06				
16.50	2.56	1.58	0.05				
17.00	2.59	1.61	0.05				
17.50	2.62	1.64	0.04				
18.00	2.64	1.66	0.04				
18.50	2.67	1.68	0.03				
19.00	2.69	1.70	0.03				
19.50	2.71	1.72	0.03				
20.00	2.73	1.74	0.03				
20.50	2.75	1.75	0.03				
21.00	2.76	1.77	0.03				
21.50	2.78	1.78	0.03				
22.00	2.80	1.80	0.02				
22.50	2.81	1.81	0.02				
23.00	2.82	1.82	0.02				
23.50	2.84	1.84	0.02				
24.00	2.85	1.85	0.02				
24.50	2.85	1.85	0.00				
25.00	2.85	1.85	0.00				
25.50	2.85	1.85	0.00				

Summary for Subcatchment 2S: Subcatch B

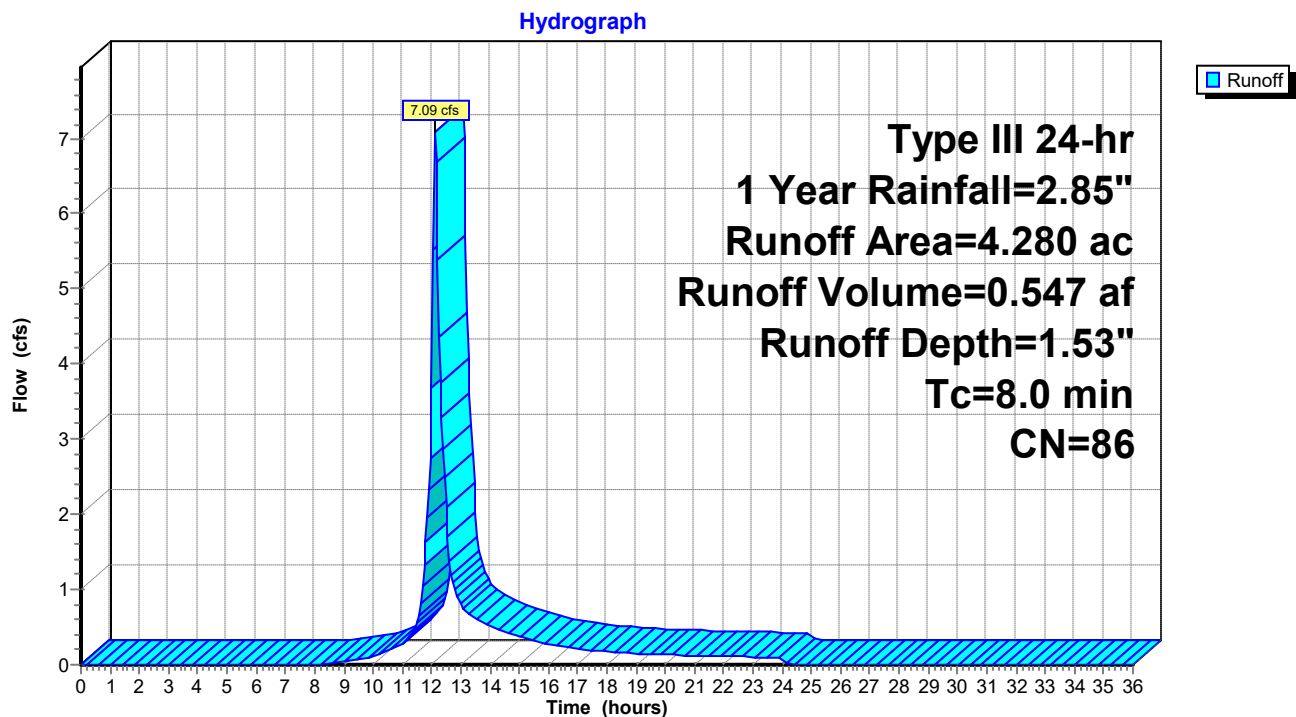
Runoff = 7.09 cfs @ 12.12 hrs, Volume= 0.547 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 1 Year Rainfall=2.85"

Area (ac)	CN	Description
2.102	98	Paved roads w/curbs & sewers, HSG C
2.178	74	>75% Grass cover, Good, HSG C
4.280	86	Weighted Average
2.178		50.89% Pervious Area
2.102		49.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry, See TC Worksheet

Subcatchment 2S: Subcatch B



2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

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Hydrograph for Subcatchment 2S: Subcatch B

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.00	2.85	1.53	0.00
0.50	0.01	0.00	0.00	26.50	2.85	1.53	0.00
1.00	0.03	0.00	0.00	27.00	2.85	1.53	0.00
1.50	0.04	0.00	0.00	27.50	2.85	1.53	0.00
2.00	0.06	0.00	0.00	28.00	2.85	1.53	0.00
2.50	0.07	0.00	0.00	28.50	2.85	1.53	0.00
3.00	0.09	0.00	0.00	29.00	2.85	1.53	0.00
3.50	0.10	0.00	0.00	29.50	2.85	1.53	0.00
4.00	0.12	0.00	0.00	30.00	2.85	1.53	0.00
4.50	0.14	0.00	0.00	30.50	2.85	1.53	0.00
5.00	0.16	0.00	0.00	31.00	2.85	1.53	0.00
5.50	0.18	0.00	0.00	31.50	2.85	1.53	0.00
6.00	0.21	0.00	0.00	32.00	2.85	1.53	0.00
6.50	0.23	0.00	0.00	32.50	2.85	1.53	0.00
7.00	0.26	0.00	0.00	33.00	2.85	1.53	0.00
7.50	0.29	0.00	0.00	33.50	2.85	1.53	0.00
8.00	0.32	0.00	0.00	34.00	2.85	1.53	0.00
8.50	0.37	0.00	0.01	34.50	2.85	1.53	0.00
9.00	0.42	0.00	0.04	35.00	2.85	1.53	0.00
9.50	0.47	0.01	0.07	35.50	2.85	1.53	0.00
10.00	0.54	0.02	0.12	36.00	2.85	1.53	0.00
10.50	0.62	0.04	0.19				
11.00	0.71	0.07	0.28				
11.50	0.85	0.13	0.54				
12.00	1.42	0.44	3.69				
12.50	2.00	0.85	2.09				
13.00	2.14	0.95	0.80				
13.50	2.23	1.03	0.62				
14.00	2.31	1.09	0.51				
14.50	2.38	1.14	0.44				
15.00	2.43	1.19	0.39				
15.50	2.48	1.23	0.33				
16.00	2.53	1.26	0.28				
16.50	2.56	1.29	0.24				
17.00	2.59	1.32	0.22				
17.50	2.62	1.34	0.19				
18.00	2.64	1.36	0.17				
18.50	2.67	1.38	0.16				
19.00	2.69	1.40	0.15				
19.50	2.71	1.42	0.14				
20.00	2.73	1.43	0.14				
20.50	2.75	1.45	0.13				
21.00	2.76	1.46	0.12				
21.50	2.78	1.48	0.12				
22.00	2.80	1.49	0.11				
22.50	2.81	1.50	0.11				
23.00	2.82	1.51	0.10				
23.50	2.84	1.52	0.10				
24.00	2.85	1.53	0.09				
24.50	2.85	1.53	0.00				
25.00	2.85	1.53	0.00				
25.50	2.85	1.53	0.00				

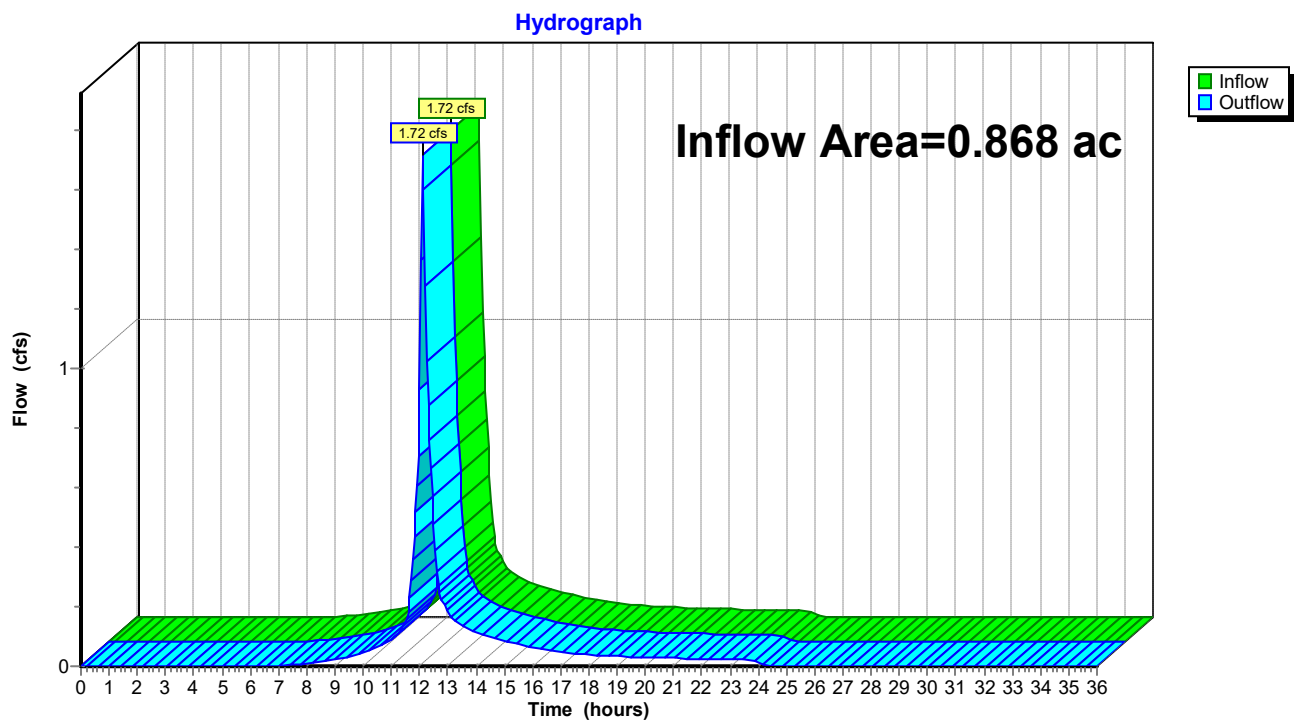
Summary for Reach 3R: Design Point A

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.868 ac, 66.47% Impervious, Inflow Depth = 1.85" for 1 Year event
 Inflow = 1.72 cfs @ 12.11 hrs, Volume= 0.134 af
 Outflow = 1.72 cfs @ 12.11 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 3R: Design Point A



Hydrograph for Reach 3R: Design Point A

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	26.00	0.00		0.00
0.50	0.00		0.00	26.50	0.00		0.00
1.00	0.00		0.00	27.00	0.00		0.00
1.50	0.00		0.00	27.50	0.00		0.00
2.00	0.00		0.00	28.00	0.00		0.00
2.50	0.00		0.00	28.50	0.00		0.00
3.00	0.00		0.00	29.00	0.00		0.00
3.50	0.00		0.00	29.50	0.00		0.00
4.00	0.00		0.00	30.00	0.00		0.00
4.50	0.00		0.00	30.50	0.00		0.00
5.00	0.00		0.00	31.00	0.00		0.00
5.50	0.00		0.00	31.50	0.00		0.00
6.00	0.00		0.00	32.00	0.00		0.00
6.50	0.00		0.00	32.50	0.00		0.00
7.00	0.00		0.00	33.00	0.00		0.00
7.50	0.01		0.01	33.50	0.00		0.00
8.00	0.01		0.01	34.00	0.00		0.00
8.50	0.02		0.02	34.50	0.00		0.00
9.00	0.02		0.02	35.00	0.00		0.00
9.50	0.03		0.03	35.50	0.00		0.00
10.00	0.05		0.05	36.00	0.00		0.00
10.50	0.06		0.06				
11.00	0.09		0.09				
11.50	0.15		0.15				
12.00	0.93		0.93				
12.50	0.48		0.48				
13.00	0.18		0.18				
13.50	0.14		0.14				
14.00	0.11		0.11				
14.50	0.10		0.10				
15.00	0.09		0.09				
15.50	0.07		0.07				
16.00	0.06		0.06				
16.50	0.05		0.05				
17.00	0.05		0.05				
17.50	0.04		0.04				
18.00	0.04		0.04				
18.50	0.03		0.03				
19.00	0.03		0.03				
19.50	0.03		0.03				
20.00	0.03		0.03				
20.50	0.03		0.03				
21.00	0.03		0.03				
21.50	0.03		0.03				
22.00	0.02		0.02				
22.50	0.02		0.02				
23.00	0.02		0.02				
23.50	0.02		0.02				
24.00	0.02		0.02				
24.50	0.00		0.00				
25.00	0.00		0.00				
25.50	0.00		0.00				

Summary for Reach 4R: Design Point B

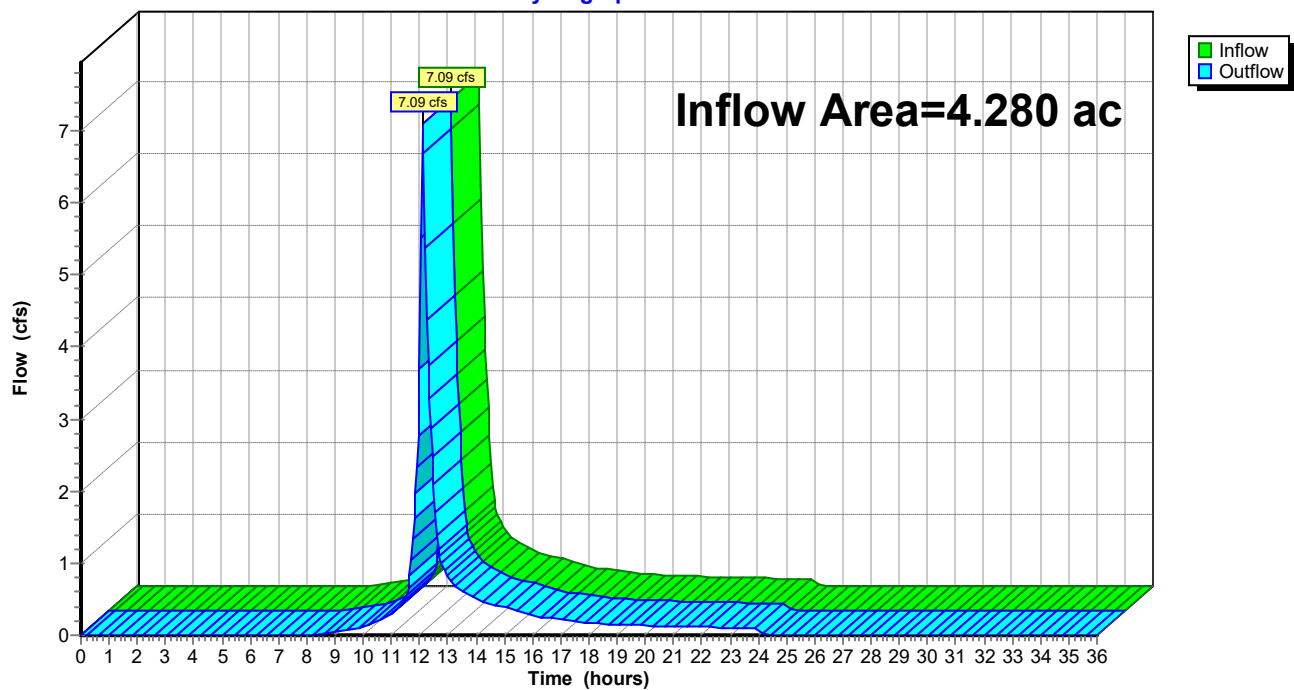
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.280 ac, 49.11% Impervious, Inflow Depth = 1.53" for 1 Year event
 Inflow = 7.09 cfs @ 12.12 hrs, Volume= 0.547 af
 Outflow = 7.09 cfs @ 12.12 hrs, Volume= 0.547 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 4R: Design Point B

Hydrograph



Hydrograph for Reach 4R: Design Point B

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	26.00	0.00		0.00
0.50	0.00		0.00	26.50	0.00		0.00
1.00	0.00		0.00	27.00	0.00		0.00
1.50	0.00		0.00	27.50	0.00		0.00
2.00	0.00		0.00	28.00	0.00		0.00
2.50	0.00		0.00	28.50	0.00		0.00
3.00	0.00		0.00	29.00	0.00		0.00
3.50	0.00		0.00	29.50	0.00		0.00
4.00	0.00		0.00	30.00	0.00		0.00
4.50	0.00		0.00	30.50	0.00		0.00
5.00	0.00		0.00	31.00	0.00		0.00
5.50	0.00		0.00	31.50	0.00		0.00
6.00	0.00		0.00	32.00	0.00		0.00
6.50	0.00		0.00	32.50	0.00		0.00
7.00	0.00		0.00	33.00	0.00		0.00
7.50	0.00		0.00	33.50	0.00		0.00
8.00	0.00		0.00	34.00	0.00		0.00
8.50	0.01		0.01	34.50	0.00		0.00
9.00	0.04		0.04	35.00	0.00		0.00
9.50	0.07		0.07	35.50	0.00		0.00
10.00	0.12		0.12	36.00	0.00		0.00
10.50	0.19		0.19				
11.00	0.28		0.28				
11.50	0.54		0.54				
12.00	3.69		3.69				
12.50	2.09		2.09				
13.00	0.80		0.80				
13.50	0.62		0.62				
14.00	0.51		0.51				
14.50	0.44		0.44				
15.00	0.39		0.39				
15.50	0.33		0.33				
16.00	0.28		0.28				
16.50	0.24		0.24				
17.00	0.22		0.22				
17.50	0.19		0.19				
18.00	0.17		0.17				
18.50	0.16		0.16				
19.00	0.15		0.15				
19.50	0.14		0.14				
20.00	0.14		0.14				
20.50	0.13		0.13				
21.00	0.12		0.12				
21.50	0.12		0.12				
22.00	0.11		0.11				
22.50	0.11		0.11				
23.00	0.10		0.10				
23.50	0.10		0.10				
24.00	0.09		0.09				
24.50	0.00		0.00				
25.00	0.00		0.00				
25.50	0.00		0.00				

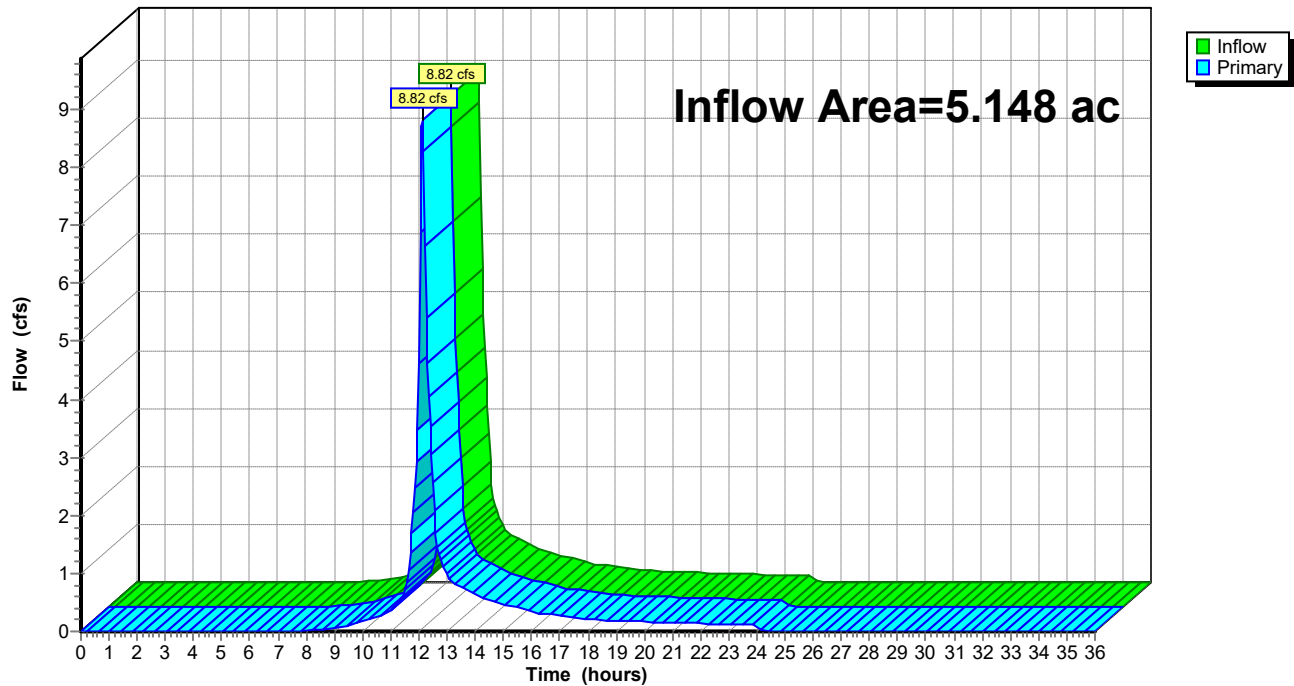
Summary for Link 5L: DP-1

Inflow Area = 5.148 ac, 52.04% Impervious, Inflow Depth = 1.59" for 1 Year event
Inflow = 8.82 cfs @ 12.12 hrs, Volume= 0.681 af
Primary = 8.82 cfs @ 12.12 hrs, Volume= 0.681 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link 5L: DP-1

Hydrograph



2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

Prepared by Tectonic Engineering

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Hydrograph for Link 5L: DP-1

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	26.00	0.00	0.00	0.00
0.50	0.00	0.00	0.00	26.50	0.00	0.00	0.00
1.00	0.00	0.00	0.00	27.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.00	0.00	0.00	0.00	28.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00	29.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.00	0.00	0.00	0.00	30.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.00	0.00	0.00	0.00	31.00	0.00	0.00	0.00
5.50	0.00	0.00	0.00	31.50	0.00	0.00	0.00
6.00	0.00	0.00	0.00	32.00	0.00	0.00	0.00
6.50	0.00	0.00	0.00	32.50	0.00	0.00	0.00
7.00	0.00	0.00	0.00	33.00	0.00	0.00	0.00
7.50	0.01	0.00	0.01	33.50	0.00	0.00	0.00
8.00	0.01	0.00	0.01	34.00	0.00	0.00	0.00
8.50	0.03	0.00	0.03	34.50	0.00	0.00	0.00
9.00	0.06	0.00	0.06	35.00	0.00	0.00	0.00
9.50	0.11	0.00	0.11	35.50	0.00	0.00	0.00
10.00	0.16	0.00	0.16	36.00	0.00	0.00	0.00
10.50	0.25	0.00	0.25				
11.00	0.37	0.00	0.37				
11.50	0.69	0.00	0.69				
12.00	4.63	0.00	4.63				
12.50	2.57	0.00	2.57				
13.00	0.98	0.00	0.98				
13.50	0.76	0.00	0.76				
14.00	0.62	0.00	0.62				
14.50	0.54	0.00	0.54				
15.00	0.47	0.00	0.47				
15.50	0.41	0.00	0.41				
16.00	0.34	0.00	0.34				
16.50	0.30	0.00	0.30				
17.00	0.27	0.00	0.27				
17.50	0.24	0.00	0.24				
18.00	0.21	0.00	0.21				
18.50	0.19	0.00	0.19				
19.00	0.18	0.00	0.18				
19.50	0.17	0.00	0.17				
20.00	0.17	0.00	0.17				
20.50	0.16	0.00	0.16				
21.00	0.15	0.00	0.15				
21.50	0.14	0.00	0.14				
22.00	0.14	0.00	0.14				
22.50	0.13	0.00	0.13				
23.00	0.12	0.00	0.12				
23.50	0.12	0.00	0.12				
24.00	0.11	0.00	0.11				
24.50	0.00	0.00	0.00				
25.00	0.00	0.00	0.00				
25.50	0.00	0.00	0.00				

2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

Prepared by Tectonic Engineering

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatch A

Runoff Area=0.868 ac 66.47% Impervious Runoff Depth=4.37"
Tc=8.0 min CN=90 Runoff=3.94 cfs 0.316 af

Subcatchment 2S: Subcatch B

Runoff Area=4.280 ac 49.11% Impervious Runoff Depth=3.95"
Tc=8.0 min CN=86 Runoff=17.92 cfs 1.407 af

Reach 3R: Design Point A

Inflow=3.94 cfs 0.316 af
Outflow=3.94 cfs 0.316 af

Reach 4R: Design Point B

Inflow=17.92 cfs 1.407 af
Outflow=17.92 cfs 1.407 af

Link 5L: DP-1

Inflow=21.86 cfs 1.723 af
Primary=21.86 cfs 1.723 af

Total Runoff Area = 5.148 ac Runoff Volume = 1.723 af Average Runoff Depth = 4.02"
47.96% Pervious = 2.469 ac 52.04% Impervious = 2.679 ac

Summary for Subcatchment 1S: Subcatch A

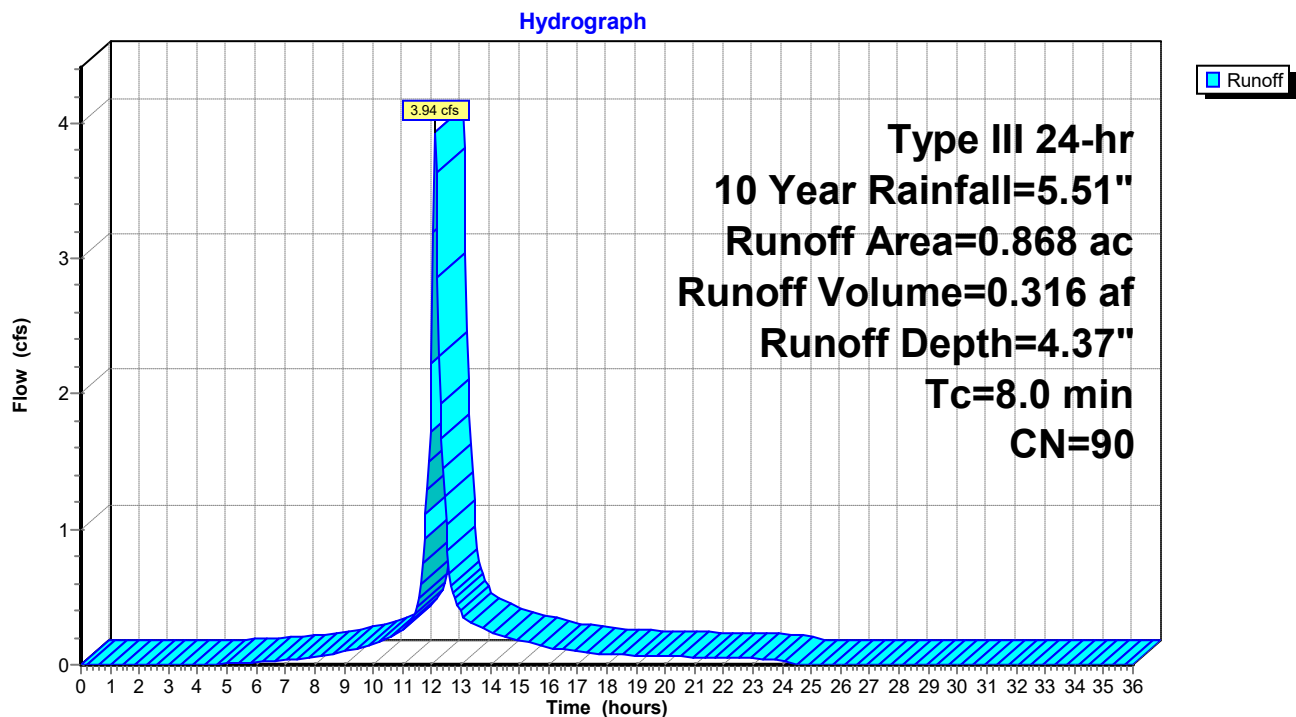
Runoff = 3.94 cfs @ 12.11 hrs, Volume= 0.316 af, Depth= 4.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.51"

Area (ac)	CN	Description
0.577	98	Paved roads w/curbs & sewers, HSG C
0.291	74	>75% Grass cover, Good, HSG C
0.868	90	Weighted Average
0.291		33.53% Pervious Area
0.577		66.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry, See TC Worksheet

Subcatchment 1S: Subcatch A



2021-07-8 Pre Orangetown Town Hall

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 1S: Subcatch A

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.00	5.51	4.37	0.00
0.50	0.03	0.00	0.00	26.50	5.51	4.37	0.00
1.00	0.06	0.00	0.00	27.00	5.51	4.37	0.00
1.50	0.08	0.00	0.00	27.50	5.51	4.37	0.00
2.00	0.11	0.00	0.00	28.00	5.51	4.37	0.00
2.50	0.14	0.00	0.00	28.50	5.51	4.37	0.00
3.00	0.17	0.00	0.00	29.00	5.51	4.37	0.00
3.50	0.20	0.00	0.00	29.50	5.51	4.37	0.00
4.00	0.24	0.00	0.00	30.00	5.51	4.37	0.00
4.50	0.27	0.00	0.00	30.50	5.51	4.37	0.00
5.00	0.31	0.01	0.01	31.00	5.51	4.37	0.00
5.50	0.35	0.01	0.01	31.50	5.51	4.37	0.00
6.00	0.40	0.02	0.02	32.00	5.51	4.37	0.00
6.50	0.44	0.04	0.03	32.50	5.51	4.37	0.00
7.00	0.50	0.06	0.03	33.00	5.51	4.37	0.00
7.50	0.56	0.08	0.04	33.50	5.51	4.37	0.00
8.00	0.63	0.11	0.06	34.00	5.51	4.37	0.00
8.50	0.71	0.15	0.07	34.50	5.51	4.37	0.00
9.00	0.80	0.20	0.10	35.00	5.51	4.37	0.00
9.50	0.91	0.27	0.12	35.50	5.51	4.37	0.00
10.00	1.04	0.35	0.15	36.00	5.51	4.37	0.00
10.50	1.19	0.45	0.20				
11.00	1.38	0.59	0.25				
11.50	1.64	0.80	0.41				
12.00	2.75	1.76	2.22				
12.50	3.87	2.79	1.04				
13.00	4.13	3.05	0.39				
13.50	4.32	3.22	0.29				
14.00	4.47	3.37	0.24				
14.50	4.60	3.49	0.21				
15.00	4.71	3.59	0.18				
15.50	4.80	3.69	0.15				
16.00	4.88	3.76	0.13				
16.50	4.95	3.83	0.11				
17.00	5.01	3.89	0.10				
17.50	5.07	3.94	0.09				
18.00	5.11	3.99	0.08				
18.50	5.16	4.03	0.07				
19.00	5.20	4.07	0.07				
19.50	5.24	4.10	0.06				
20.00	5.27	4.14	0.06				
20.50	5.31	4.17	0.06				
21.00	5.34	4.21	0.06				
21.50	5.37	4.24	0.05				
22.00	5.40	4.27	0.05				
22.50	5.43	4.29	0.05				
23.00	5.46	4.32	0.05				
23.50	5.49	4.35	0.04				
24.00	5.51	4.37	0.04				
24.50	5.51	4.37	0.00				
25.00	5.51	4.37	0.00				
25.50	5.51	4.37	0.00				

Summary for Subcatchment 2S: Subcatch B

Runoff = 17.92 cfs @ 12.11 hrs, Volume= 1.407 af, Depth= 3.95"

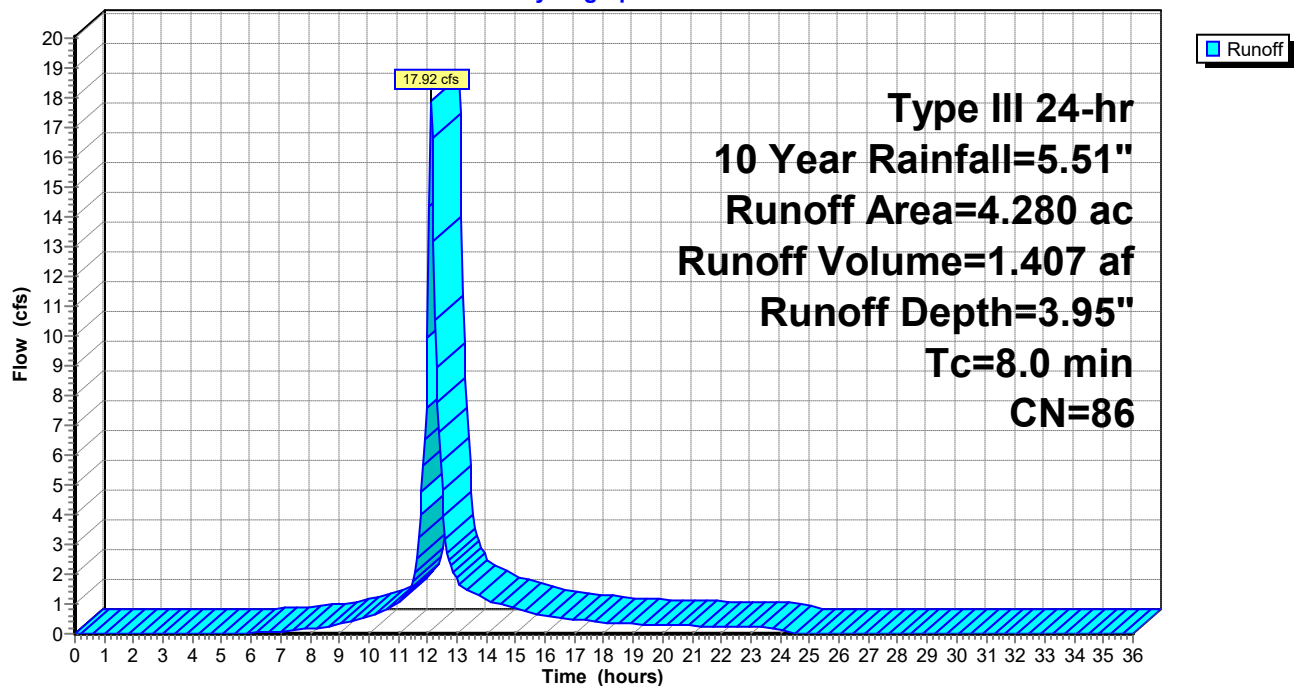
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=5.51"

Area (ac)	CN	Description
2.102	98	Paved roads w/curbs & sewers, HSG C
2.178	74	>75% Grass cover, Good, HSG C
4.280	86	Weighted Average
2.178		50.89% Pervious Area
2.102		49.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry, See TC Worksheet

Subcatchment 2S: Subcatch B

Hydrograph



2021-07-8 Pre Orangetown Town Hall

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 2S: Subcatch B

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.00	5.51	3.95	0.00
0.50	0.03	0.00	0.00	26.50	5.51	3.95	0.00
1.00	0.06	0.00	0.00	27.00	5.51	3.95	0.00
1.50	0.08	0.00	0.00	27.50	5.51	3.95	0.00
2.00	0.11	0.00	0.00	28.00	5.51	3.95	0.00
2.50	0.14	0.00	0.00	28.50	5.51	3.95	0.00
3.00	0.17	0.00	0.00	29.00	5.51	3.95	0.00
3.50	0.20	0.00	0.00	29.50	5.51	3.95	0.00
4.00	0.24	0.00	0.00	30.00	5.51	3.95	0.00
4.50	0.27	0.00	0.00	30.50	5.51	3.95	0.00
5.00	0.31	0.00	0.00	31.00	5.51	3.95	0.00
5.50	0.35	0.00	0.01	31.50	5.51	3.95	0.00
6.00	0.40	0.00	0.03	32.00	5.51	3.95	0.00
6.50	0.44	0.01	0.05	32.50	5.51	3.95	0.00
7.00	0.50	0.02	0.08	33.00	5.51	3.95	0.00
7.50	0.56	0.03	0.12	33.50	5.51	3.95	0.00
8.00	0.63	0.05	0.17	34.00	5.51	3.95	0.00
8.50	0.71	0.07	0.24	34.50	5.51	3.95	0.00
9.00	0.80	0.11	0.33	35.00	5.51	3.95	0.00
9.50	0.91	0.16	0.44	35.50	5.51	3.95	0.00
10.00	1.04	0.22	0.57	36.00	5.51	3.95	0.00
10.50	1.19	0.30	0.77				
11.00	1.38	0.41	1.03				
11.50	1.64	0.59	1.74				
12.00	2.75	1.45	9.93				
12.50	3.87	2.43	4.85				
13.00	4.13	2.67	1.82				
13.50	4.32	2.84	1.39				
14.00	4.47	2.97	1.14				
14.50	4.60	3.09	0.98				
15.00	4.71	3.19	0.86				
15.50	4.80	3.28	0.73				
16.00	4.88	3.36	0.61				
16.50	4.95	3.42	0.53				
17.00	5.01	3.48	0.48				
17.50	5.07	3.53	0.42				
18.00	5.11	3.57	0.37				
18.50	5.16	3.61	0.34				
19.00	5.20	3.65	0.33				
19.50	5.24	3.69	0.31				
20.00	5.27	3.72	0.29				
20.50	5.31	3.76	0.28				
21.00	5.34	3.79	0.27				
21.50	5.37	3.82	0.26				
22.00	5.40	3.85	0.24				
22.50	5.43	3.87	0.23				
23.00	5.46	3.90	0.22				
23.50	5.49	3.92	0.21				
24.00	5.51	3.95	0.19				
24.50	5.51	3.95	0.00				
25.00	5.51	3.95	0.00				
25.50	5.51	3.95	0.00				

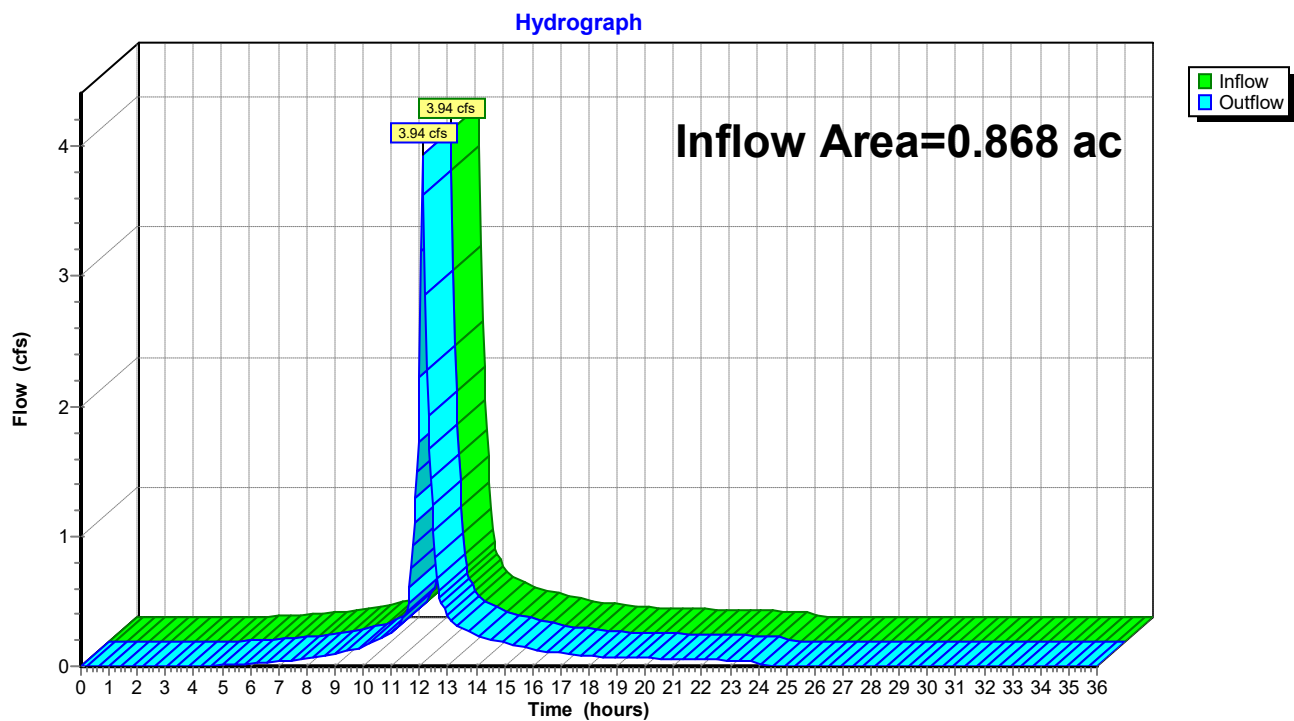
Summary for Reach 3R: Design Point A

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.868 ac, 66.47% Impervious, Inflow Depth = 4.37" for 10 Year event
 Inflow = 3.94 cfs @ 12.11 hrs, Volume= 0.316 af
 Outflow = 3.94 cfs @ 12.11 hrs, Volume= 0.316 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 3R: Design Point A



2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

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Hydrograph for Reach 3R: Design Point A

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	26.00	0.00		0.00
0.50	0.00		0.00	26.50	0.00		0.00
1.00	0.00		0.00	27.00	0.00		0.00
1.50	0.00		0.00	27.50	0.00		0.00
2.00	0.00		0.00	28.00	0.00		0.00
2.50	0.00		0.00	28.50	0.00		0.00
3.00	0.00		0.00	29.00	0.00		0.00
3.50	0.00		0.00	29.50	0.00		0.00
4.00	0.00		0.00	30.00	0.00		0.00
4.50	0.00		0.00	30.50	0.00		0.00
5.00	0.01		0.01	31.00	0.00		0.00
5.50	0.01		0.01	31.50	0.00		0.00
6.00	0.02		0.02	32.00	0.00		0.00
6.50	0.03		0.03	32.50	0.00		0.00
7.00	0.03		0.03	33.00	0.00		0.00
7.50	0.04		0.04	33.50	0.00		0.00
8.00	0.06		0.06	34.00	0.00		0.00
8.50	0.07		0.07	34.50	0.00		0.00
9.00	0.10		0.10	35.00	0.00		0.00
9.50	0.12		0.12	35.50	0.00		0.00
10.00	0.15		0.15	36.00	0.00		0.00
10.50	0.20		0.20				
11.00	0.25		0.25				
11.50	0.41		0.41				
12.00	2.22		2.22				
12.50	1.04		1.04				
13.00	0.39		0.39				
13.50	0.29		0.29				
14.00	0.24		0.24				
14.50	0.21		0.21				
15.00	0.18		0.18				
15.50	0.15		0.15				
16.00	0.13		0.13				
16.50	0.11		0.11				
17.00	0.10		0.10				
17.50	0.09		0.09				
18.00	0.08		0.08				
18.50	0.07		0.07				
19.00	0.07		0.07				
19.50	0.06		0.06				
20.00	0.06		0.06				
20.50	0.06		0.06				
21.00	0.06		0.06				
21.50	0.05		0.05				
22.00	0.05		0.05				
22.50	0.05		0.05				
23.00	0.05		0.05				
23.50	0.04		0.04				
24.00	0.04		0.04				
24.50	0.00		0.00				
25.00	0.00		0.00				
25.50	0.00		0.00				

Summary for Reach 4R: Design Point B

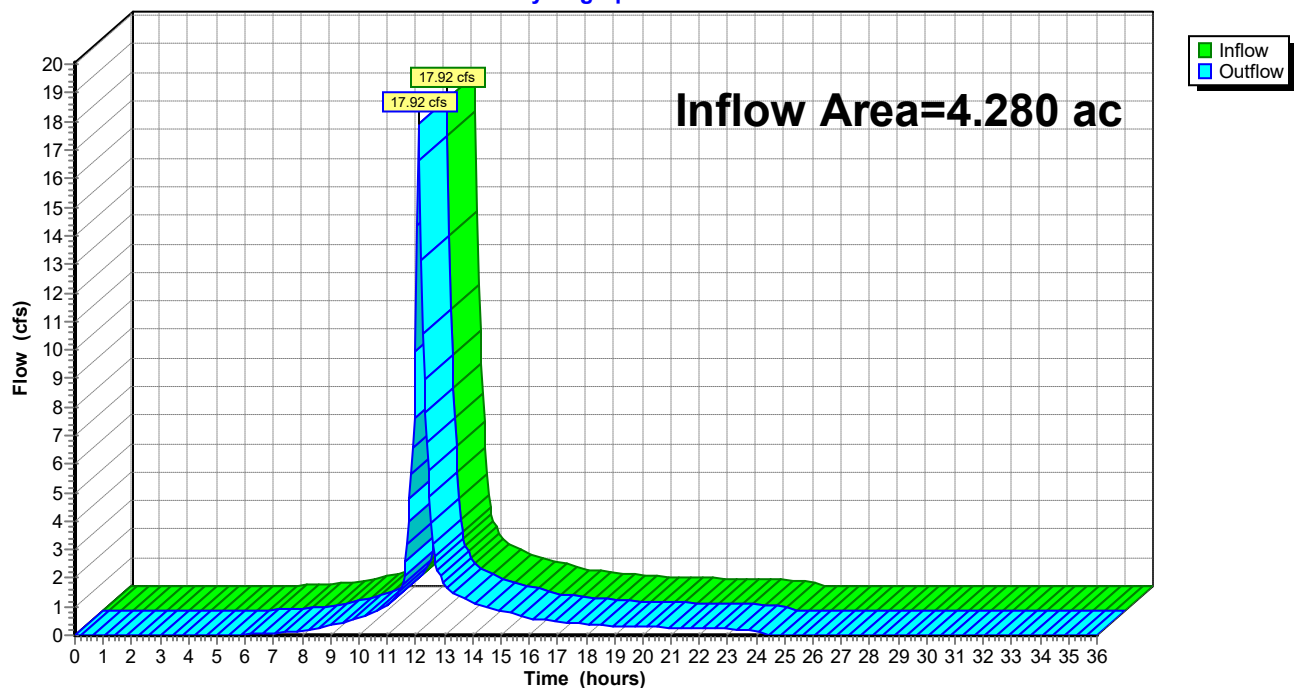
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.280 ac, 49.11% Impervious, Inflow Depth = 3.95" for 10 Year event
 Inflow = 17.92 cfs @ 12.11 hrs, Volume= 1.407 af
 Outflow = 17.92 cfs @ 12.11 hrs, Volume= 1.407 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 4R: Design Point B

Hydrograph



2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

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Hydrograph for Reach 4R: Design Point B

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	26.00	0.00		0.00
0.50	0.00		0.00	26.50	0.00		0.00
1.00	0.00		0.00	27.00	0.00		0.00
1.50	0.00		0.00	27.50	0.00		0.00
2.00	0.00		0.00	28.00	0.00		0.00
2.50	0.00		0.00	28.50	0.00		0.00
3.00	0.00		0.00	29.00	0.00		0.00
3.50	0.00		0.00	29.50	0.00		0.00
4.00	0.00		0.00	30.00	0.00		0.00
4.50	0.00		0.00	30.50	0.00		0.00
5.00	0.00		0.00	31.00	0.00		0.00
5.50	0.01		0.01	31.50	0.00		0.00
6.00	0.03		0.03	32.00	0.00		0.00
6.50	0.05		0.05	32.50	0.00		0.00
7.00	0.08		0.08	33.00	0.00		0.00
7.50	0.12		0.12	33.50	0.00		0.00
8.00	0.17		0.17	34.00	0.00		0.00
8.50	0.24		0.24	34.50	0.00		0.00
9.00	0.33		0.33	35.00	0.00		0.00
9.50	0.44		0.44	35.50	0.00		0.00
10.00	0.57		0.57	36.00	0.00		0.00
10.50	0.77		0.77				
11.00	1.03		1.03				
11.50	1.74		1.74				
12.00	9.93		9.93				
12.50	4.85		4.85				
13.00	1.82		1.82				
13.50	1.39		1.39				
14.00	1.14		1.14				
14.50	0.98		0.98				
15.00	0.86		0.86				
15.50	0.73		0.73				
16.00	0.61		0.61				
16.50	0.53		0.53				
17.00	0.48		0.48				
17.50	0.42		0.42				
18.00	0.37		0.37				
18.50	0.34		0.34				
19.00	0.33		0.33				
19.50	0.31		0.31				
20.00	0.29		0.29				
20.50	0.28		0.28				
21.00	0.27		0.27				
21.50	0.26		0.26				
22.00	0.24		0.24				
22.50	0.23		0.23				
23.00	0.22		0.22				
23.50	0.21		0.21				
24.00	0.19		0.19				
24.50	0.00		0.00				
25.00	0.00		0.00				
25.50	0.00		0.00				

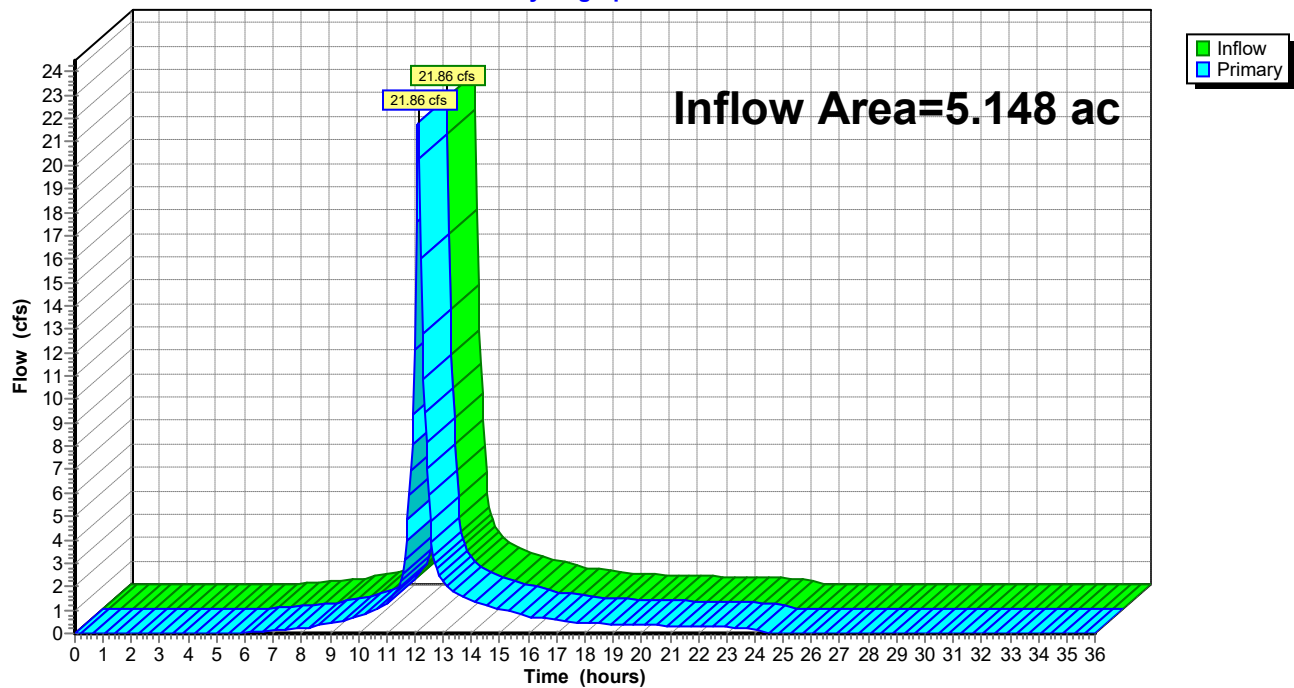
Summary for Link 5L: DP-1

Inflow Area = 5.148 ac, 52.04% Impervious, Inflow Depth = 4.02" for 10 Year event
 Inflow = 21.86 cfs @ 12.11 hrs, Volume= 1.723 af
 Primary = 21.86 cfs @ 12.11 hrs, Volume= 1.723 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link 5L: DP-1

Hydrograph



2021-07-8 Pre Orangetown Town Hall

Type III 24-hr 10 Year Rainfall=5.51"

Prepared by Tectonic Engineering

Printed 7/21/2021

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Hydrograph for Link 5L: DP-1

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	26.00	0.00	0.00	0.00
0.50	0.00	0.00	0.00	26.50	0.00	0.00	0.00
1.00	0.00	0.00	0.00	27.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.00	0.00	0.00	0.00	28.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.00	0.00	0.00	0.00	29.00	0.00	0.00	0.00
3.50	0.00	0.00	0.00	29.50	0.00	0.00	0.00
4.00	0.00	0.00	0.00	30.00	0.00	0.00	0.00
4.50	0.00	0.00	0.00	30.50	0.00	0.00	0.00
5.00	0.01	0.00	0.01	31.00	0.00	0.00	0.00
5.50	0.02	0.00	0.02	31.50	0.00	0.00	0.00
6.00	0.04	0.00	0.04	32.00	0.00	0.00	0.00
6.50	0.08	0.00	0.08	32.50	0.00	0.00	0.00
7.00	0.12	0.00	0.12	33.00	0.00	0.00	0.00
7.50	0.17	0.00	0.17	33.50	0.00	0.00	0.00
8.00	0.22	0.00	0.22	34.00	0.00	0.00	0.00
8.50	0.31	0.00	0.31	34.50	0.00	0.00	0.00
9.00	0.43	0.00	0.43	35.00	0.00	0.00	0.00
9.50	0.57	0.00	0.57	35.50	0.00	0.00	0.00
10.00	0.72	0.00	0.72	36.00	0.00	0.00	0.00
10.50	0.97	0.00	0.97				
11.00	1.28	0.00	1.28				
11.50	2.15	0.00	2.15				
12.00	12.15	0.00	12.15				
12.50	5.89	0.00	5.89				
13.00	2.21	0.00	2.21				
13.50	1.69	0.00	1.69				
14.00	1.38	0.00	1.38				
14.50	1.19	0.00	1.19				
15.00	1.04	0.00	1.04				
15.50	0.89	0.00	0.89				
16.00	0.73	0.00	0.73				
16.50	0.65	0.00	0.65				
17.00	0.58	0.00	0.58				
17.50	0.51	0.00	0.51				
18.00	0.45	0.00	0.45				
18.50	0.42	0.00	0.42				
19.00	0.40	0.00	0.40				
19.50	0.38	0.00	0.38				
20.00	0.36	0.00	0.36				
20.50	0.34	0.00	0.34				
21.00	0.32	0.00	0.32				
21.50	0.31	0.00	0.31				
22.00	0.29	0.00	0.29				
22.50	0.28	0.00	0.28				
23.00	0.26	0.00	0.26				
23.50	0.25	0.00	0.25				
24.00	0.23	0.00	0.23				
24.50	0.00	0.00	0.00				
25.00	0.00	0.00	0.00				
25.50	0.00	0.00	0.00				

2021-07-8 Pre Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

Prepared by Tectonic Engineering

Printed 7/21/2021

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatch ARunoff Area=0.868 ac 66.47% Impervious Runoff Depth=7.86"
Tc=8.0 min CN=90 Runoff=6.85 cfs 0.569 af**Subcatchment 2S: Subcatch B**Runoff Area=4.280 ac 49.11% Impervious Runoff Depth=7.37"
Tc=8.0 min CN=86 Runoff=32.49 cfs 2.629 af**Reach 3R: Design Point A**Inflow=6.85 cfs 0.569 af
Outflow=6.85 cfs 0.569 af**Reach 4R: Design Point B**Inflow=32.49 cfs 2.629 af
Outflow=32.49 cfs 2.629 af**Link 5L: DP-1**Inflow=39.34 cfs 3.198 af
Primary=39.34 cfs 3.198 af**Total Runoff Area = 5.148 ac Runoff Volume = 3.198 af Average Runoff Depth = 7.45"**
47.96% Pervious = 2.469 ac 52.04% Impervious = 2.679 ac

Summary for Subcatchment 1S: Subcatch A

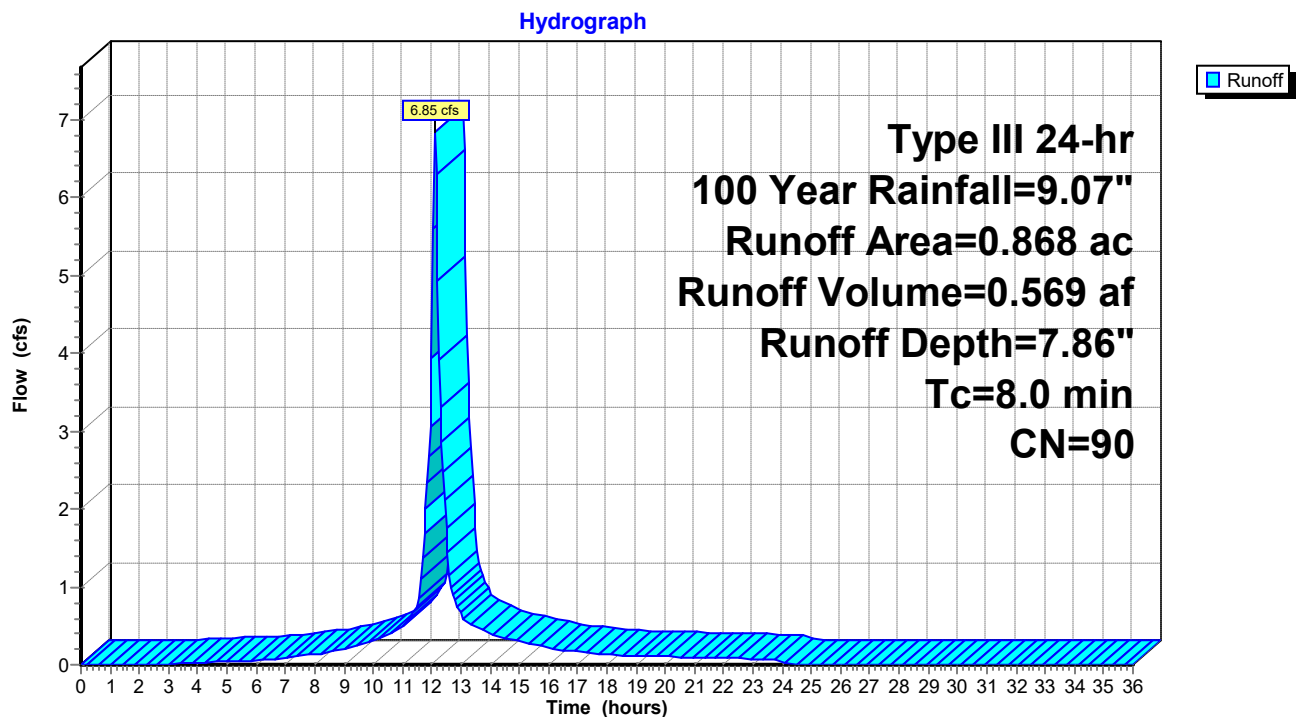
Runoff = 6.85 cfs @ 12.11 hrs, Volume= 0.569 af, Depth= 7.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=9.07"

Area (ac)	CN	Description
0.577	98	Paved roads w/curbs & sewers, HSG C
0.291	74	>75% Grass cover, Good, HSG C
0.868	90	Weighted Average
0.291		33.53% Pervious Area
0.577		66.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry, See TC Worksheet

Subcatchment 1S: Subcatch A



Hydrograph for Subcatchment 1S: Subcatch A

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.00	9.07	7.86	0.00
0.50	0.05	0.00	0.00	26.50	9.07	7.86	0.00
1.00	0.09	0.00	0.00	27.00	9.07	7.86	0.00
1.50	0.14	0.00	0.00	27.50	9.07	7.86	0.00
2.00	0.18	0.00	0.00	28.00	9.07	7.86	0.00
2.50	0.23	0.00	0.00	28.50	9.07	7.86	0.00
3.00	0.28	0.00	0.01	29.00	9.07	7.86	0.00
3.50	0.33	0.01	0.01	29.50	9.07	7.86	0.00
4.00	0.39	0.02	0.02	30.00	9.07	7.86	0.00
4.50	0.45	0.04	0.03	30.50	9.07	7.86	0.00
5.00	0.51	0.06	0.04	31.00	9.07	7.86	0.00
5.50	0.58	0.09	0.05	31.50	9.07	7.86	0.00
6.00	0.65	0.12	0.06	32.00	9.07	7.86	0.00
6.50	0.73	0.16	0.07	32.50	9.07	7.86	0.00
7.00	0.82	0.21	0.09	33.00	9.07	7.86	0.00
7.50	0.92	0.27	0.11	33.50	9.07	7.86	0.00
8.00	1.03	0.34	0.13	34.00	9.07	7.86	0.00
8.50	1.16	0.43	0.17	34.50	9.07	7.86	0.00
9.00	1.32	0.55	0.21	35.00	9.07	7.86	0.00
9.50	1.51	0.69	0.26	35.50	9.07	7.86	0.00
10.00	1.71	0.86	0.31	36.00	9.07	7.86	0.00
10.50	1.96	1.06	0.39				
11.00	2.27	1.33	0.48				
11.50	2.70	1.71	0.77				
12.00	4.53	3.43	3.93				
12.50	6.37	5.20	1.76				
13.00	6.80	5.63	0.66				
13.50	7.11	5.93	0.50				
14.00	7.36	6.17	0.40				
14.50	7.56	6.38	0.35				
15.00	7.75	6.56	0.30				
15.50	7.91	6.71	0.26				
16.00	8.04	6.84	0.21				
16.50	8.15	6.95	0.19				
17.00	8.25	7.05	0.17				
17.50	8.34	7.14	0.15				
18.00	8.42	7.22	0.13				
18.50	8.49	7.29	0.12				
19.00	8.56	7.35	0.11				
19.50	8.62	7.42	0.11				
20.00	8.68	7.48	0.10				
20.50	8.74	7.53	0.10				
21.00	8.79	7.59	0.09				
21.50	8.85	7.64	0.09				
22.00	8.90	7.69	0.09				
22.50	8.94	7.74	0.08				
23.00	8.99	7.78	0.08				
23.50	9.03	7.82	0.07				
24.00	9.07	7.86	0.07				
24.50	9.07	7.86	0.00				
25.00	9.07	7.86	0.00				
25.50	9.07	7.86	0.00				

Summary for Subcatchment 2S: Subcatch B

Runoff = 32.49 cfs @ 12.11 hrs, Volume= 2.629 af, Depth= 7.37"

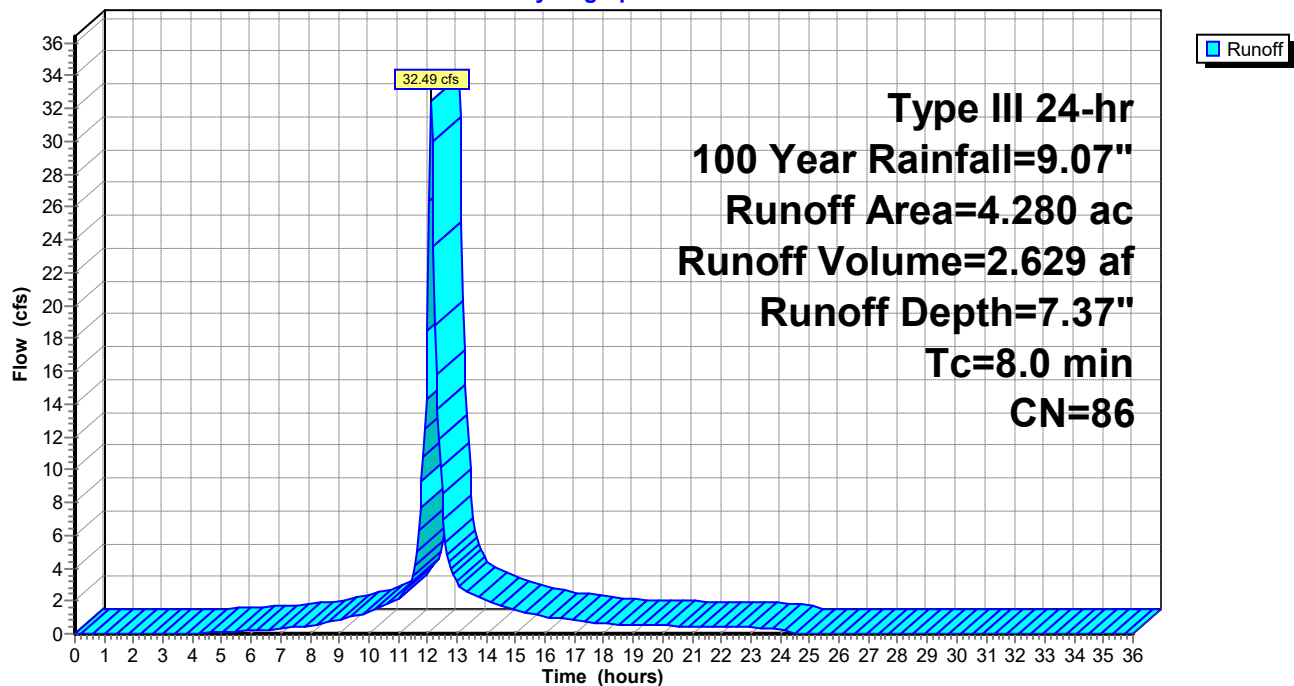
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=9.07"

Area (ac)	CN	Description
2.102	98	Paved roads w/curbs & sewers, HSG C
2.178	74	>75% Grass cover, Good, HSG C
4.280	86	Weighted Average
2.178		50.89% Pervious Area
2.102		49.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry, See TC Worksheet

Subcatchment 2S: Subcatch B

Hydrograph



Hydrograph for Subcatchment 2S: Subcatch B

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	26.00	9.07	7.37	0.00
0.50	0.05	0.00	0.00	26.50	9.07	7.37	0.00
1.00	0.09	0.00	0.00	27.00	9.07	7.37	0.00
1.50	0.14	0.00	0.00	27.50	9.07	7.37	0.00
2.00	0.18	0.00	0.00	28.00	9.07	7.37	0.00
2.50	0.23	0.00	0.00	28.50	9.07	7.37	0.00
3.00	0.28	0.00	0.00	29.00	9.07	7.37	0.00
3.50	0.33	0.00	0.00	29.50	9.07	7.37	0.00
4.00	0.39	0.00	0.03	30.00	9.07	7.37	0.00
4.50	0.45	0.01	0.06	30.50	9.07	7.37	0.00
5.00	0.51	0.02	0.10	31.00	9.07	7.37	0.00
5.50	0.58	0.03	0.14	31.50	9.07	7.37	0.00
6.00	0.65	0.05	0.18	32.00	9.07	7.37	0.00
6.50	0.73	0.08	0.24	32.50	9.07	7.37	0.00
7.00	0.82	0.12	0.32	33.00	9.07	7.37	0.00
7.50	0.92	0.16	0.40	33.50	9.07	7.37	0.00
8.00	1.03	0.21	0.50	34.00	9.07	7.37	0.00
8.50	1.16	0.29	0.66	34.50	9.07	7.37	0.00
9.00	1.32	0.38	0.85	35.00	9.07	7.37	0.00
9.50	1.51	0.50	1.07	35.50	9.07	7.37	0.00
10.00	1.71	0.64	1.30	36.00	9.07	7.37	0.00
10.50	1.96	0.82	1.68				
11.00	2.27	1.06	2.14				
11.50	2.70	1.41	3.47				
12.00	4.53	3.04	18.45				
12.50	6.37	4.76	8.49				
13.00	6.80	5.18	3.17				
13.50	7.11	5.47	2.41				
14.00	7.36	5.71	1.96				
14.50	7.56	5.91	1.69				
15.00	7.75	6.09	1.47				
15.50	7.91	6.24	1.26				
16.00	8.04	6.37	1.04				
16.50	8.15	6.48	0.92				
17.00	8.25	6.57	0.82				
17.50	8.34	6.66	0.73				
18.00	8.42	6.74	0.63				
18.50	8.49	6.81	0.59				
19.00	8.56	6.87	0.56				
19.50	8.62	6.93	0.53				
20.00	8.68	6.99	0.50				
20.50	8.74	7.05	0.48				
21.00	8.79	7.10	0.46				
21.50	8.85	7.15	0.44				
22.00	8.90	7.20	0.42				
22.50	8.94	7.25	0.39				
23.00	8.99	7.29	0.37				
23.50	9.03	7.33	0.35				
24.00	9.07	7.37	0.33				
24.50	9.07	7.37	0.00				
25.00	9.07	7.37	0.00				
25.50	9.07	7.37	0.00				

Summary for Reach 3R: Design Point A

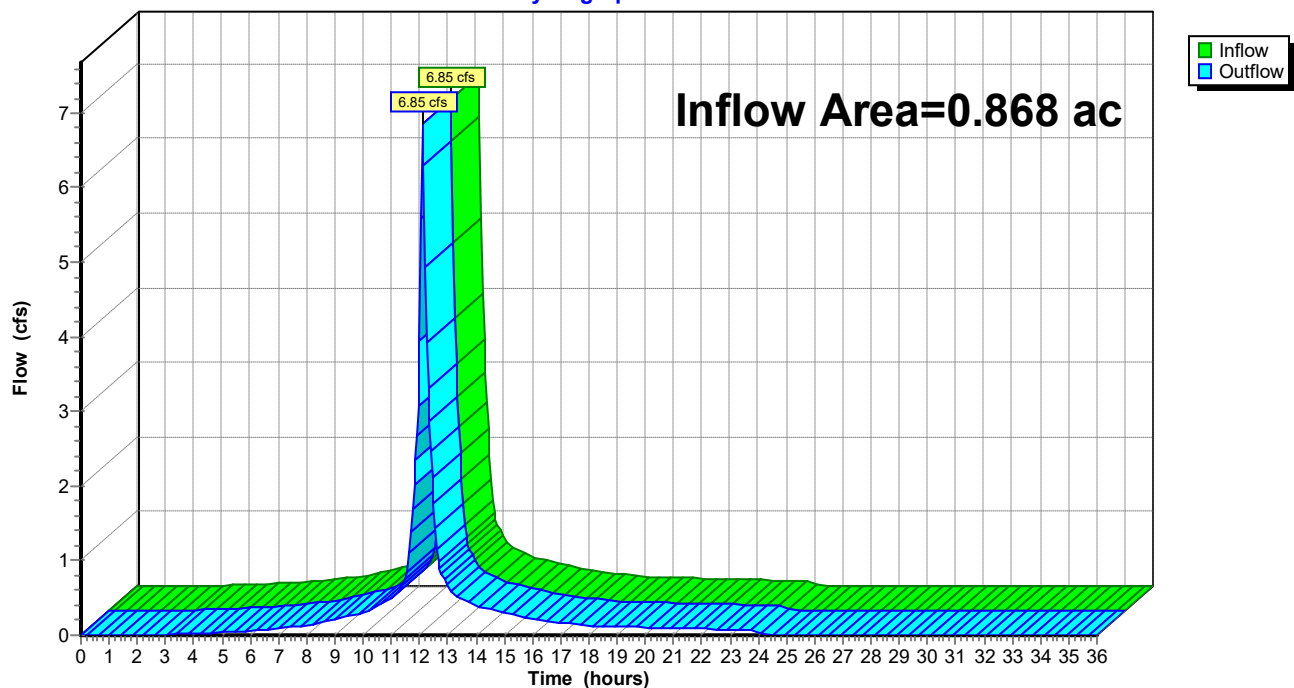
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.868 ac, 66.47% Impervious, Inflow Depth = 7.86" for 100 Year event
 Inflow = 6.85 cfs @ 12.11 hrs, Volume= 0.569 af
 Outflow = 6.85 cfs @ 12.11 hrs, Volume= 0.569 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 3R: Design Point A

Hydrograph



Hydrograph for Reach 3R: Design Point A

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	26.00	0.00		0.00
0.50	0.00		0.00	26.50	0.00		0.00
1.00	0.00		0.00	27.00	0.00		0.00
1.50	0.00		0.00	27.50	0.00		0.00
2.00	0.00		0.00	28.00	0.00		0.00
2.50	0.00		0.00	28.50	0.00		0.00
3.00	0.01		0.01	29.00	0.00		0.00
3.50	0.01		0.01	29.50	0.00		0.00
4.00	0.02		0.02	30.00	0.00		0.00
4.50	0.03		0.03	30.50	0.00		0.00
5.00	0.04		0.04	31.00	0.00		0.00
5.50	0.05		0.05	31.50	0.00		0.00
6.00	0.06		0.06	32.00	0.00		0.00
6.50	0.07		0.07	32.50	0.00		0.00
7.00	0.09		0.09	33.00	0.00		0.00
7.50	0.11		0.11	33.50	0.00		0.00
8.00	0.13		0.13	34.00	0.00		0.00
8.50	0.17		0.17	34.50	0.00		0.00
9.00	0.21		0.21	35.00	0.00		0.00
9.50	0.26		0.26	35.50	0.00		0.00
10.00	0.31		0.31	36.00	0.00		0.00
10.50	0.39		0.39				
11.00	0.48		0.48				
11.50	0.77		0.77				
12.00	3.93		3.93				
12.50	1.76		1.76				
13.00	0.66		0.66				
13.50	0.50		0.50				
14.00	0.40		0.40				
14.50	0.35		0.35				
15.00	0.30		0.30				
15.50	0.26		0.26				
16.00	0.21		0.21				
16.50	0.19		0.19				
17.00	0.17		0.17				
17.50	0.15		0.15				
18.00	0.13		0.13				
18.50	0.12		0.12				
19.00	0.11		0.11				
19.50	0.11		0.11				
20.00	0.10		0.10				
20.50	0.10		0.10				
21.00	0.09		0.09				
21.50	0.09		0.09				
22.00	0.09		0.09				
22.50	0.08		0.08				
23.00	0.08		0.08				
23.50	0.07		0.07				
24.00	0.07		0.07				
24.50	0.00		0.00				
25.00	0.00		0.00				
25.50	0.00		0.00				

Summary for Reach 4R: Design Point B

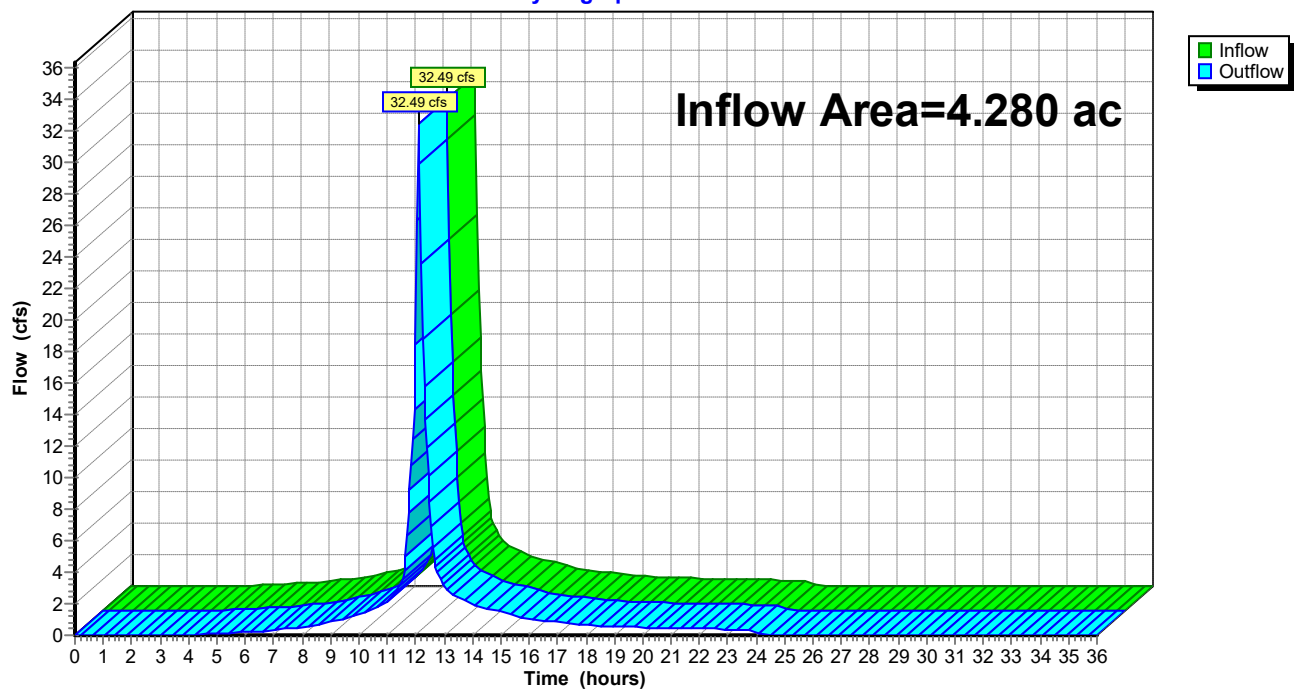
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 4.280 ac, 49.11% Impervious, Inflow Depth = 7.37" for 100 Year event
 Inflow = 32.49 cfs @ 12.11 hrs, Volume= 2.629 af
 Outflow = 32.49 cfs @ 12.11 hrs, Volume= 2.629 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 4R: Design Point B

Hydrograph



Hydrograph for Reach 4R: Design Point B

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	26.00	0.00		0.00
0.50	0.00		0.00	26.50	0.00		0.00
1.00	0.00		0.00	27.00	0.00		0.00
1.50	0.00		0.00	27.50	0.00		0.00
2.00	0.00		0.00	28.00	0.00		0.00
2.50	0.00		0.00	28.50	0.00		0.00
3.00	0.00		0.00	29.00	0.00		0.00
3.50	0.00		0.00	29.50	0.00		0.00
4.00	0.03		0.03	30.00	0.00		0.00
4.50	0.06		0.06	30.50	0.00		0.00
5.00	0.10		0.10	31.00	0.00		0.00
5.50	0.14		0.14	31.50	0.00		0.00
6.00	0.18		0.18	32.00	0.00		0.00
6.50	0.24		0.24	32.50	0.00		0.00
7.00	0.32		0.32	33.00	0.00		0.00
7.50	0.40		0.40	33.50	0.00		0.00
8.00	0.50		0.50	34.00	0.00		0.00
8.50	0.66		0.66	34.50	0.00		0.00
9.00	0.85		0.85	35.00	0.00		0.00
9.50	1.07		1.07	35.50	0.00		0.00
10.00	1.30		1.30	36.00	0.00		0.00
10.50	1.68		1.68				
11.00	2.14		2.14				
11.50	3.47		3.47				
12.00	18.45		18.45				
12.50	8.49		8.49				
13.00	3.17		3.17				
13.50	2.41		2.41				
14.00	1.96		1.96				
14.50	1.69		1.69				
15.00	1.47		1.47				
15.50	1.26		1.26				
16.00	1.04		1.04				
16.50	0.92		0.92				
17.00	0.82		0.82				
17.50	0.73		0.73				
18.00	0.63		0.63				
18.50	0.59		0.59				
19.00	0.56		0.56				
19.50	0.53		0.53				
20.00	0.50		0.50				
20.50	0.48		0.48				
21.00	0.46		0.46				
21.50	0.44		0.44				
22.00	0.42		0.42				
22.50	0.39		0.39				
23.00	0.37		0.37				
23.50	0.35		0.35				
24.00	0.33		0.33				
24.50	0.00		0.00				
25.00	0.00		0.00				
25.50	0.00		0.00				

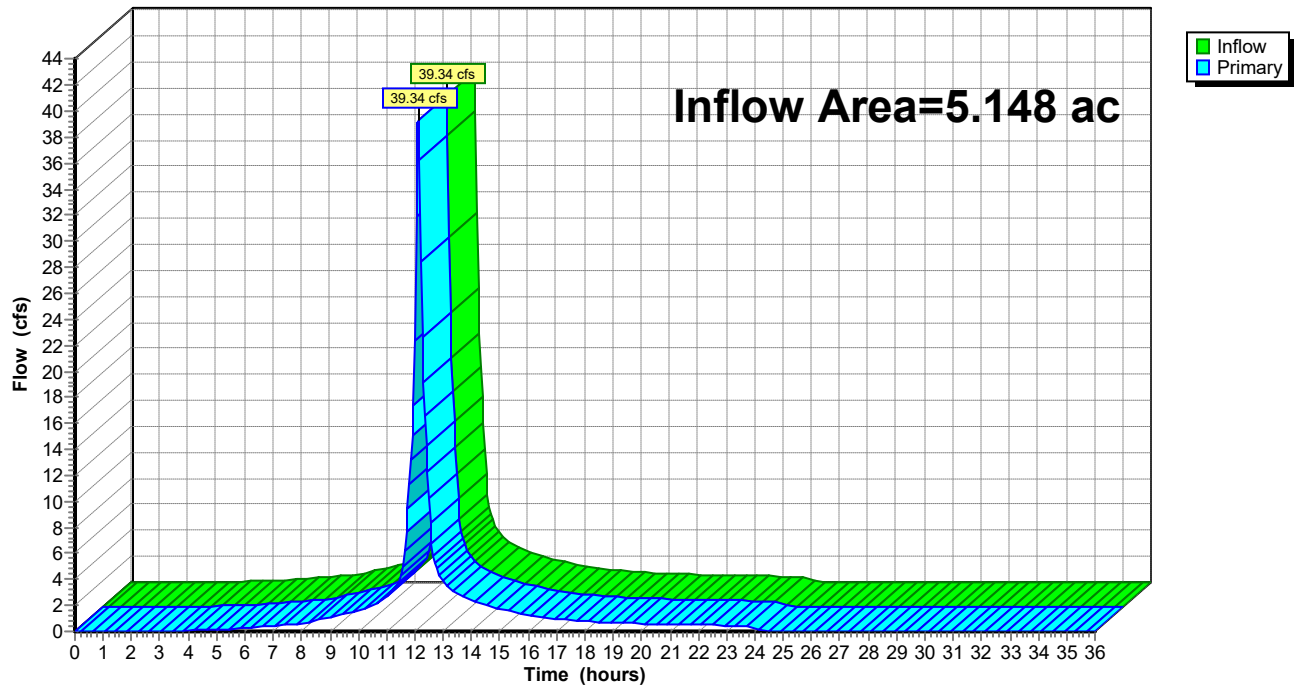
Summary for Link 5L: DP-1

Inflow Area = 5.148 ac, 52.04% Impervious, Inflow Depth = 7.45" for 100 Year event
 Inflow = 39.34 cfs @ 12.11 hrs, Volume= 3.198 af
 Primary = 39.34 cfs @ 12.11 hrs, Volume= 3.198 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link 5L: DP-1

Hydrograph

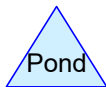
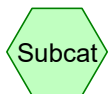
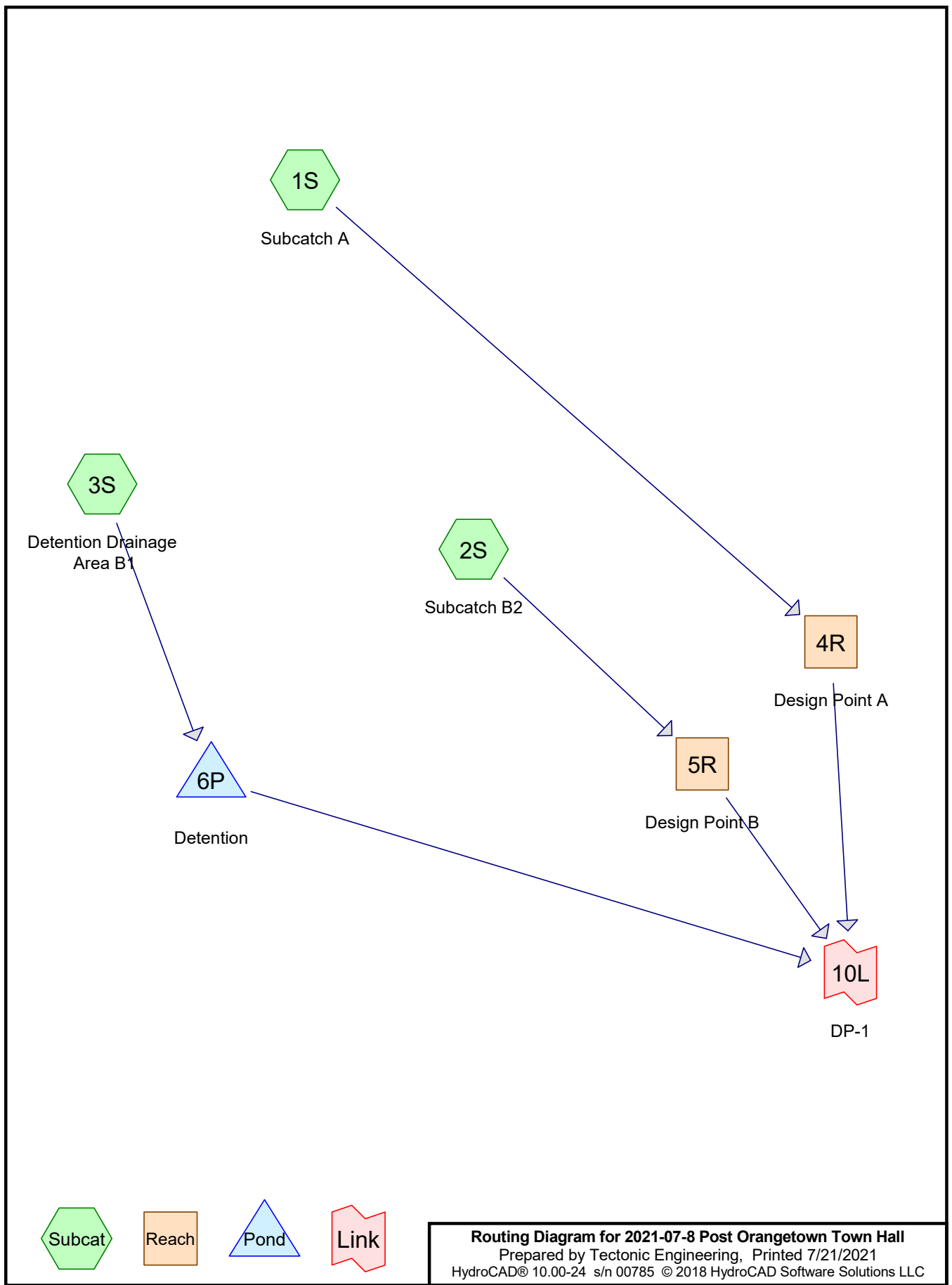


Hydrograph for Link 5L: DP-1

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	26.00	0.00	0.00	0.00
0.50	0.00	0.00	0.00	26.50	0.00	0.00	0.00
1.00	0.00	0.00	0.00	27.00	0.00	0.00	0.00
1.50	0.00	0.00	0.00	27.50	0.00	0.00	0.00
2.00	0.00	0.00	0.00	28.00	0.00	0.00	0.00
2.50	0.00	0.00	0.00	28.50	0.00	0.00	0.00
3.00	0.01	0.00	0.01	29.00	0.00	0.00	0.00
3.50	0.01	0.00	0.01	29.50	0.00	0.00	0.00
4.00	0.05	0.00	0.05	30.00	0.00	0.00	0.00
4.50	0.10	0.00	0.10	30.50	0.00	0.00	0.00
5.00	0.14	0.00	0.14	31.00	0.00	0.00	0.00
5.50	0.19	0.00	0.19	31.50	0.00	0.00	0.00
6.00	0.24	0.00	0.24	32.00	0.00	0.00	0.00
6.50	0.32	0.00	0.32	32.50	0.00	0.00	0.00
7.00	0.41	0.00	0.41	33.00	0.00	0.00	0.00
7.50	0.52	0.00	0.52	33.50	0.00	0.00	0.00
8.00	0.63	0.00	0.63	34.00	0.00	0.00	0.00
8.50	0.82	0.00	0.82	34.50	0.00	0.00	0.00
9.00	1.06	0.00	1.06	35.00	0.00	0.00	0.00
9.50	1.33	0.00	1.33	35.50	0.00	0.00	0.00
10.00	1.61	0.00	1.61	36.00	0.00	0.00	0.00
10.50	2.07	0.00	2.07				
11.00	2.63	0.00	2.63				
11.50	4.24	0.00	4.24				
12.00	22.38	0.00	22.38				
12.50	10.26	0.00	10.26				
13.00	3.82	0.00	3.82				
13.50	2.91	0.00	2.91				
14.00	2.37	0.00	2.37				
14.50	2.04	0.00	2.04				
15.00	1.78	0.00	1.78				
15.50	1.52	0.00	1.52				
16.00	1.25	0.00	1.25				
16.50	1.10	0.00	1.10				
17.00	0.99	0.00	0.99				
17.50	0.88	0.00	0.88				
18.00	0.76	0.00	0.76				
18.50	0.71	0.00	0.71				
19.00	0.67	0.00	0.67				
19.50	0.64	0.00	0.64				
20.00	0.61	0.00	0.61				
20.50	0.58	0.00	0.58				
21.00	0.55	0.00	0.55				
21.50	0.53	0.00	0.53				
22.00	0.50	0.00	0.50				
22.50	0.47	0.00	0.47				
23.00	0.45	0.00	0.45				
23.50	0.42	0.00	0.42				
24.00	0.40	0.00	0.40				
24.50	0.00	0.00	0.00				
25.00	0.00	0.00	0.00				
25.50	0.00	0.00	0.00				

APPENDIX D-II

G:\Mountainville\Civil\10128-Orangetown Town Hall Expansion\10128-01\Calcs\Strm\MT-CV-10128.01-Cn Worksheet-2.xlsx



2021-07-8 Post Orangetown Town Hall

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.031	74	>75% Grass cover, Good, HSG C (1S, 2S, 3S)
2.453	98	Paved roads w/curbs & sewers, HSG C (1S, 2S)
0.764	98	Roofs, HSG C (3S)
5.248	89	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
5.248	HSG C	1S, 2S, 3S
0.000	HSG D	
0.000	Other	
5.248		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	2.031	0.000	0.000	2.031	>75% Grass cover, Good	1S,
							2S,
							3S
0.000	0.000	2.453	0.000	0.000	2.453	Paved roads w/curbs & sewers	1S,
							2S
0.000	0.000	0.764	0.000	0.000	0.764	Roofs	3S
0.000	0.000	5.248	0.000	0.000	5.248	TOTAL AREA	

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

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Time span=0.00-24.00 hrs, dt=0.06 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatch A Runoff Area=0.724 ac 72.79% Impervious Runoff Depth>1.93"
Tc=8.0 min CN=91 Runoff=1.48 cfs 0.116 af

Subcatchment 2S: Subcatch B2 Runoff Area=3.430 ac 56.15% Impervious Runoff Depth>1.61"
Tc=8.0 min CN=87 Runoff=5.93 cfs 0.459 af

Subcatchment 3S: Detention Drainage Area Runoff Area=1.094 ac 69.84% Impervious Runoff Depth>1.93"
Tc=6.0 min CN=91 Runoff=2.36 cfs 0.176 af

Reach 4R: Design Point A Inflow=1.48 cfs 0.116 af
Outflow=1.48 cfs 0.116 af

Reach 5R: Design Point B Inflow=5.93 cfs 0.459 af
Outflow=5.93 cfs 0.459 af

Pond 6P: Detention Peak Elev=214.16' Storage=1,996 cf Inflow=2.36 cfs 0.176 af
Outflow=1.40 cfs 0.172 af

Link 10L: DP-1 Inflow=8.54 cfs 0.748 af
Primary=8.54 cfs 0.748 af

Total Runoff Area = 5.248 ac Runoff Volume = 0.752 af Average Runoff Depth = 1.72"
38.70% Pervious = 2.031 ac 61.30% Impervious = 3.217 ac

Summary for Subcatchment 1S: Subcatch A

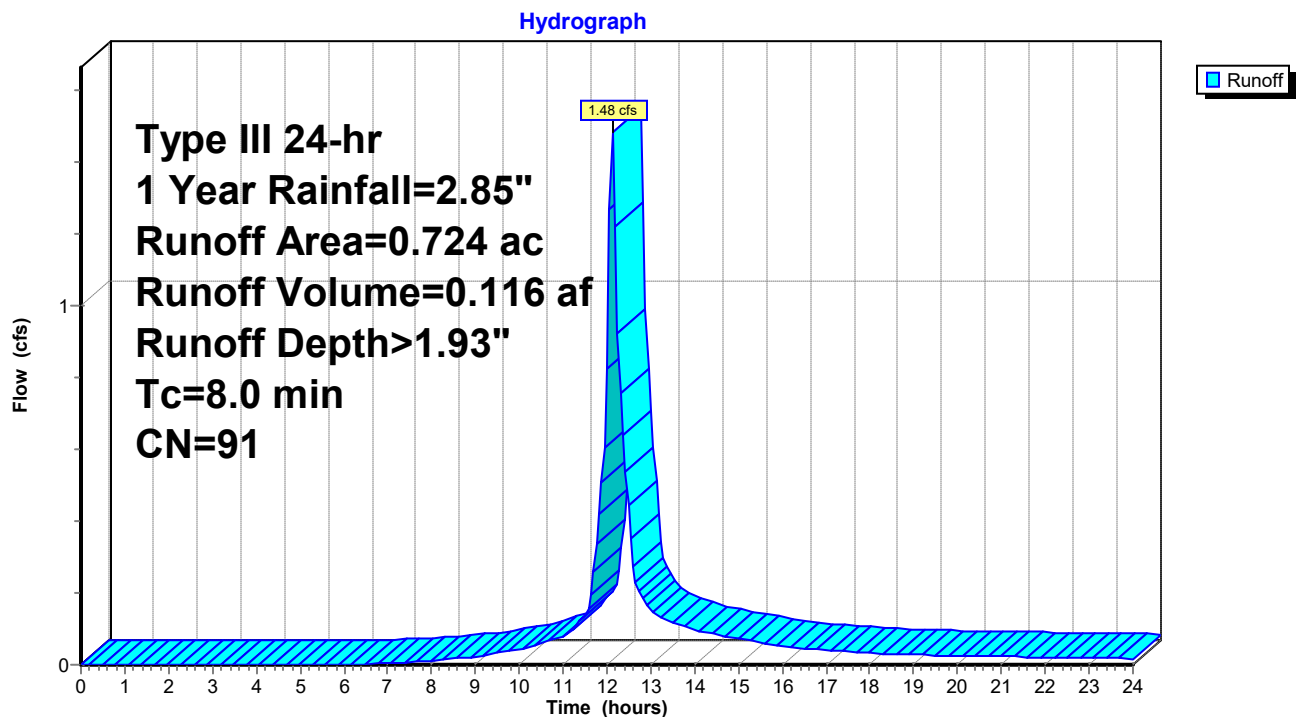
Runoff = 1.48 cfs @ 12.12 hrs, Volume= 0.116 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
Type III 24-hr 1 Year Rainfall=2.85"

Area (ac)	CN	Description
0.527	98	Paved roads w/curbs & sewers, HSG C
0.197	74	>75% Grass cover, Good, HSG C
0.724	91	Weighted Average
0.197		27.21% Pervious Area
0.527		72.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Subcatchment 1S: Subcatch A



2021-07-8 Post Orangetown Town Hall

Type III 24-hr 1 Year Rainfall=2.85"

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Hydrograph for Subcatchment 1S: Subcatch A

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.09	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.09	0.00	0.00
0.12	0.00	0.00	0.00	3.24	0.10	0.00	0.00
0.18	0.01	0.00	0.00	3.30	0.10	0.00	0.00
0.24	0.01	0.00	0.00	3.36	0.10	0.00	0.00
0.30	0.01	0.00	0.00	3.42	0.10	0.00	0.00
0.36	0.01	0.00	0.00	3.48	0.10	0.00	0.00
0.42	0.01	0.00	0.00	3.54	0.11	0.00	0.00
0.48	0.01	0.00	0.00	3.60	0.11	0.00	0.00
0.54	0.02	0.00	0.00	3.66	0.11	0.00	0.00
0.60	0.02	0.00	0.00	3.72	0.11	0.00	0.00
0.66	0.02	0.00	0.00	3.78	0.11	0.00	0.00
0.72	0.02	0.00	0.00	3.84	0.12	0.00	0.00
0.78	0.02	0.00	0.00	3.90	0.12	0.00	0.00
0.84	0.02	0.00	0.00	3.96	0.12	0.00	0.00
0.90	0.03	0.00	0.00	4.02	0.12	0.00	0.00
0.96	0.03	0.00	0.00	4.08	0.13	0.00	0.00
1.02	0.03	0.00	0.00	4.14	0.13	0.00	0.00
1.08	0.03	0.00	0.00	4.20	0.13	0.00	0.00
1.14	0.03	0.00	0.00	4.26	0.13	0.00	0.00
1.20	0.03	0.00	0.00	4.32	0.13	0.00	0.00
1.26	0.04	0.00	0.00	4.38	0.14	0.00	0.00
1.32	0.04	0.00	0.00	4.44	0.14	0.00	0.00
1.38	0.04	0.00	0.00	4.50	0.14	0.00	0.00
1.44	0.04	0.00	0.00	4.56	0.14	0.00	0.00
1.50	0.04	0.00	0.00	4.62	0.15	0.00	0.00
1.56	0.04	0.00	0.00	4.68	0.15	0.00	0.00
1.62	0.05	0.00	0.00	4.74	0.15	0.00	0.00
1.68	0.05	0.00	0.00	4.80	0.15	0.00	0.00
1.74	0.05	0.00	0.00	4.86	0.16	0.00	0.00
1.80	0.05	0.00	0.00	4.92	0.16	0.00	0.00
1.86	0.05	0.00	0.00	4.98	0.16	0.00	0.00
1.92	0.05	0.00	0.00	5.04	0.16	0.00	0.00
1.98	0.06	0.00	0.00	5.10	0.17	0.00	0.00
2.04	0.06	0.00	0.00	5.16	0.17	0.00	0.00
2.10	0.06	0.00	0.00	5.22	0.17	0.00	0.00
2.16	0.06	0.00	0.00	5.28	0.17	0.00	0.00
2.22	0.06	0.00	0.00	5.34	0.18	0.00	0.00
2.28	0.07	0.00	0.00	5.40	0.18	0.00	0.00
2.34	0.07	0.00	0.00	5.46	0.18	0.00	0.00
2.40	0.07	0.00	0.00	5.52	0.18	0.00	0.00
2.46	0.07	0.00	0.00	5.58	0.19	0.00	0.00
2.52	0.07	0.00	0.00	5.64	0.19	0.00	0.00
2.58	0.07	0.00	0.00	5.70	0.19	0.00	0.00
2.64	0.08	0.00	0.00	5.76	0.19	0.00	0.00
2.70	0.08	0.00	0.00	5.82	0.20	0.00	0.00
2.76	0.08	0.00	0.00	5.88	0.20	0.00	0.00
2.82	0.08	0.00	0.00	5.94	0.20	0.00	0.00
2.88	0.08	0.00	0.00	6.00	0.21	0.00	0.00
2.94	0.09	0.00	0.00	6.06	0.21	0.00	0.00
3.00	0.09	0.00	0.00	6.12	0.21	0.00	0.00
3.06	0.09	0.00	0.00	6.18	0.21	0.00	0.00

2021-07-8 Post Orangetown Town Hall

Type III 24-hr 1 Year Rainfall=2.85"

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.22	0.00	0.00	9.36	0.46	0.05	0.03
6.30	0.22	0.00	0.00	9.42	0.46	0.06	0.03
6.36	0.22	0.00	0.00	9.48	0.47	0.06	0.03
6.42	0.23	0.00	0.00	9.54	0.48	0.06	0.03
6.48	0.23	0.00	0.00	9.60	0.49	0.06	0.03
6.54	0.23	0.00	0.00	9.66	0.49	0.07	0.04
6.60	0.24	0.00	0.00	9.72	0.50	0.07	0.04
6.66	0.24	0.00	0.00	9.78	0.51	0.07	0.04
6.72	0.24	0.00	0.00	9.84	0.52	0.08	0.04
6.78	0.25	0.00	0.00	9.90	0.52	0.08	0.04
6.84	0.25	0.00	0.00	9.96	0.53	0.08	0.04
6.90	0.25	0.00	0.00	10.02	0.54	0.09	0.04
6.96	0.26	0.00	0.00	10.08	0.55	0.09	0.04
7.02	0.26	0.00	0.00	10.14	0.56	0.10	0.05
7.08	0.26	0.00	0.00	10.20	0.57	0.10	0.05
7.14	0.27	0.00	0.00	10.26	0.58	0.11	0.05
7.20	0.27	0.00	0.01	10.32	0.59	0.11	0.05
7.26	0.27	0.01	0.01	10.38	0.60	0.11	0.05
7.32	0.28	0.01	0.01	10.44	0.61	0.12	0.06
7.38	0.28	0.01	0.01	10.50	0.62	0.12	0.06
7.44	0.29	0.01	0.01	10.56	0.63	0.13	0.06
7.50	0.29	0.01	0.01	10.62	0.64	0.14	0.06
7.56	0.29	0.01	0.01	10.68	0.65	0.14	0.07
7.62	0.30	0.01	0.01	10.74	0.66	0.15	0.07
7.68	0.30	0.01	0.01	10.80	0.67	0.15	0.07
7.74	0.31	0.01	0.01	10.86	0.68	0.16	0.07
7.80	0.31	0.01	0.01	10.92	0.70	0.17	0.08
7.86	0.31	0.01	0.01	10.98	0.71	0.17	0.08
7.92	0.32	0.01	0.01	11.04	0.72	0.18	0.08
7.98	0.32	0.01	0.01	11.10	0.73	0.19	0.09
8.04	0.33	0.02	0.01	11.16	0.75	0.20	0.09
8.10	0.33	0.02	0.01	11.22	0.76	0.21	0.10
8.16	0.34	0.02	0.01	11.28	0.78	0.22	0.11
8.22	0.34	0.02	0.01	11.34	0.80	0.23	0.12
8.28	0.35	0.02	0.01	11.40	0.82	0.24	0.12
8.34	0.35	0.02	0.01	11.46	0.84	0.25	0.13
8.40	0.36	0.02	0.01	11.52	0.86	0.26	0.14
8.46	0.36	0.02	0.02	11.58	0.88	0.28	0.16
8.52	0.37	0.02	0.02	11.64	0.92	0.31	0.20
8.58	0.37	0.03	0.02	11.70	0.97	0.34	0.26
8.64	0.38	0.03	0.02	11.76	1.02	0.37	0.33
8.70	0.38	0.03	0.02	11.82	1.09	0.42	0.42
8.76	0.39	0.03	0.02	11.88	1.16	0.47	0.51
8.82	0.40	0.03	0.02	11.94	1.26	0.55	0.61
8.88	0.40	0.04	0.02	12.00	1.42	0.68	0.82
8.94	0.41	0.04	0.02	12.06	1.59	0.82	1.27
9.00	0.42	0.04	0.02	12.12	1.69	0.90	1.48
9.06	0.42	0.04	0.02	12.18	1.76	0.96	1.22
9.12	0.43	0.04	0.03	12.24	1.83	1.01	0.92
9.18	0.44	0.05	0.03	12.30	1.88	1.06	0.75
9.24	0.44	0.05	0.03	12.36	1.93	1.10	0.64
9.30	0.45	0.05	0.03	12.42	1.97	1.13	0.54

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	1.99	1.16	0.44	15.60	2.49	1.60	0.06
12.54	2.01	1.18	0.35	15.66	2.50	1.61	0.06
12.60	2.03	1.19	0.27	15.72	2.50	1.61	0.06
12.66	2.05	1.21	0.23	15.78	2.51	1.62	0.06
12.72	2.07	1.22	0.21	15.84	2.51	1.62	0.06
12.78	2.09	1.24	0.19	15.90	2.52	1.63	0.05
12.84	2.10	1.25	0.18	15.96	2.52	1.63	0.05
12.90	2.12	1.27	0.17	16.02	2.53	1.63	0.05
12.96	2.13	1.28	0.16	16.08	2.53	1.64	0.05
13.02	2.14	1.29	0.15	16.14	2.54	1.64	0.05
13.08	2.15	1.30	0.14	16.20	2.54	1.65	0.05
13.14	2.17	1.31	0.14	16.26	2.54	1.65	0.05
13.20	2.18	1.32	0.13	16.32	2.55	1.65	0.05
13.26	2.19	1.33	0.13	16.38	2.55	1.66	0.05
13.32	2.20	1.34	0.13	16.44	2.56	1.66	0.05
13.38	2.21	1.35	0.12	16.50	2.56	1.67	0.05
13.44	2.22	1.36	0.12	16.56	2.56	1.67	0.05
13.50	2.23	1.37	0.12	16.62	2.57	1.67	0.04
13.56	2.24	1.38	0.12	16.68	2.57	1.68	0.04
13.62	2.25	1.39	0.11	16.74	2.58	1.68	0.04
13.68	2.26	1.40	0.11	16.80	2.58	1.68	0.04
13.74	2.27	1.41	0.11	16.86	2.58	1.69	0.04
13.80	2.28	1.41	0.11	16.92	2.59	1.69	0.04
13.86	2.29	1.42	0.10	16.98	2.59	1.69	0.04
13.92	2.30	1.43	0.10	17.04	2.59	1.70	0.04
13.98	2.31	1.44	0.10	17.10	2.60	1.70	0.04
14.04	2.32	1.44	0.10	17.16	2.60	1.70	0.04
14.10	2.33	1.45	0.09	17.22	2.60	1.71	0.04
14.16	2.33	1.46	0.09	17.28	2.61	1.71	0.04
14.22	2.34	1.47	0.09	17.34	2.61	1.71	0.04
14.28	2.35	1.47	0.09	17.40	2.61	1.72	0.04
14.34	2.36	1.48	0.09	17.46	2.62	1.72	0.04
14.40	2.36	1.49	0.09	17.52	2.62	1.72	0.04
14.46	2.37	1.49	0.08	17.58	2.62	1.72	0.04
14.52	2.38	1.50	0.08	17.64	2.63	1.73	0.04
14.58	2.39	1.51	0.08	17.70	2.63	1.73	0.03
14.64	2.39	1.51	0.08	17.76	2.63	1.73	0.03
14.70	2.40	1.52	0.08	17.82	2.64	1.73	0.03
14.76	2.41	1.53	0.08	17.88	2.64	1.74	0.03
14.82	2.41	1.53	0.08	17.94	2.64	1.74	0.03
14.88	2.42	1.54	0.08	18.00	2.64	1.74	0.03
14.94	2.43	1.55	0.07	18.06	2.65	1.75	0.03
15.00	2.43	1.55	0.07	18.12	2.65	1.75	0.03
15.06	2.44	1.56	0.07	18.18	2.65	1.75	0.03
15.12	2.45	1.56	0.07	18.24	2.66	1.75	0.03
15.18	2.45	1.57	0.07	18.30	2.66	1.76	0.03
15.24	2.46	1.57	0.07	18.36	2.66	1.76	0.03
15.30	2.47	1.58	0.07	18.42	2.66	1.76	0.03
15.36	2.47	1.58	0.07	18.48	2.67	1.76	0.03
15.42	2.48	1.59	0.06	18.54	2.67	1.76	0.03
15.48	2.48	1.59	0.06	18.60	2.67	1.77	0.03
15.54	2.49	1.60	0.06	18.66	2.67	1.77	0.03

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	2.68	1.77	0.03	21.84	2.79	1.88	0.02
18.78	2.68	1.77	0.03	21.90	2.79	1.88	0.02
18.84	2.68	1.78	0.03	21.96	2.79	1.88	0.02
18.90	2.68	1.78	0.03	22.02	2.80	1.88	0.02
18.96	2.69	1.78	0.03	22.08	2.80	1.88	0.02
19.02	2.69	1.78	0.03	22.14	2.80	1.88	0.02
19.08	2.69	1.79	0.03	22.20	2.80	1.89	0.02
19.14	2.69	1.79	0.03	22.26	2.80	1.89	0.02
19.20	2.70	1.79	0.03	22.32	2.80	1.89	0.02
19.26	2.70	1.79	0.03	22.38	2.81	1.89	0.02
19.32	2.70	1.79	0.03	22.44	2.81	1.89	0.02
19.38	2.70	1.80	0.03	22.50	2.81	1.89	0.02
19.44	2.71	1.80	0.03	22.56	2.81	1.90	0.02
19.50	2.71	1.80	0.03	22.62	2.81	1.90	0.02
19.56	2.71	1.80	0.03	22.68	2.82	1.90	0.02
19.62	2.71	1.81	0.03	22.74	2.82	1.90	0.02
19.68	2.72	1.81	0.03	22.80	2.82	1.90	0.02
19.74	2.72	1.81	0.03	22.86	2.82	1.90	0.02
19.80	2.72	1.81	0.03	22.92	2.82	1.91	0.02
19.86	2.72	1.81	0.03	22.98	2.82	1.91	0.02
19.92	2.72	1.82	0.03	23.04	2.83	1.91	0.02
19.98	2.73	1.82	0.03	23.10	2.83	1.91	0.02
20.04	2.73	1.82	0.03	23.16	2.83	1.91	0.02
20.10	2.73	1.82	0.02	23.22	2.83	1.91	0.02
20.16	2.73	1.82	0.02	23.28	2.83	1.91	0.02
20.22	2.74	1.83	0.02	23.34	2.83	1.92	0.02
20.28	2.74	1.83	0.02	23.40	2.83	1.92	0.02
20.34	2.74	1.83	0.02	23.46	2.84	1.92	0.02
20.40	2.74	1.83	0.02	23.52	2.84	1.92	0.02
20.46	2.74	1.83	0.02	23.58	2.84	1.92	0.02
20.52	2.75	1.84	0.02	23.64	2.84	1.92	0.02
20.58	2.75	1.84	0.02	23.70	2.84	1.92	0.02
20.64	2.75	1.84	0.02	23.76	2.84	1.93	0.02
20.70	2.75	1.84	0.02	23.82	2.85	1.93	0.02
20.76	2.75	1.84	0.02	23.88	2.85	1.93	0.02
20.82	2.76	1.85	0.02	23.94	2.85	1.93	0.02
20.88	2.76	1.85	0.02	24.00	2.85	1.93	0.02
20.94	2.76	1.85	0.02				
21.00	2.76	1.85	0.02				
21.06	2.76	1.85	0.02				
21.12	2.77	1.86	0.02				
21.18	2.77	1.86	0.02				
21.24	2.77	1.86	0.02				
21.30	2.77	1.86	0.02				
21.36	2.77	1.86	0.02				
21.42	2.78	1.86	0.02				
21.48	2.78	1.87	0.02				
21.54	2.78	1.87	0.02				
21.60	2.78	1.87	0.02				
21.66	2.78	1.87	0.02				
21.72	2.79	1.87	0.02				
21.78	2.79	1.87	0.02				

Summary for Subcatchment 2S: Subcatch B2

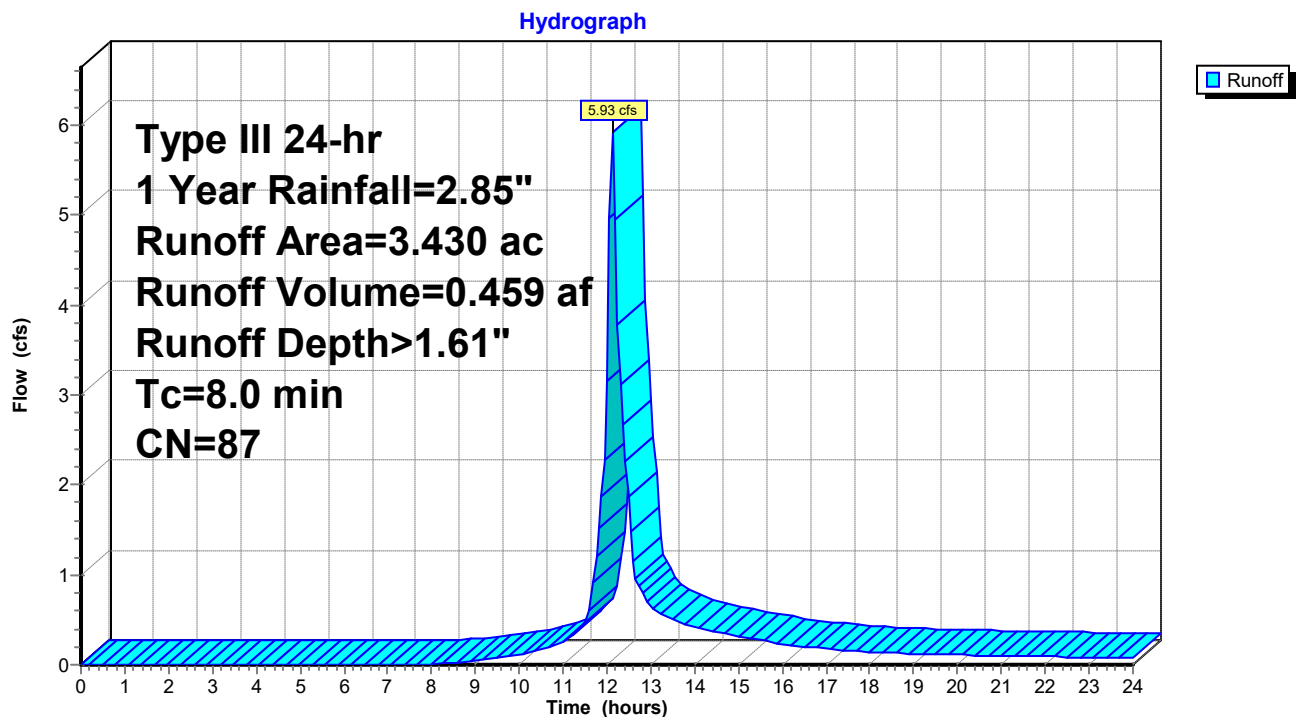
Runoff = 5.93 cfs @ 12.12 hrs, Volume= 0.459 af, Depth> 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
Type III 24-hr 1 Year Rainfall=2.85"

Area (ac)	CN	Description
1.926	98	Paved roads w/curbs & sewers, HSG C
* 1.504	74	>75% Grass cover, Good, HSG C
3.430	87	Weighted Average
1.504		43.85% Pervious Area
1.926		56.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Subcatchment 2S: Subcatch B2



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Hydrograph for Subcatchment 2S: Subcatch B2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.09	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.09	0.00	0.00
0.12	0.00	0.00	0.00	3.24	0.10	0.00	0.00
0.18	0.01	0.00	0.00	3.30	0.10	0.00	0.00
0.24	0.01	0.00	0.00	3.36	0.10	0.00	0.00
0.30	0.01	0.00	0.00	3.42	0.10	0.00	0.00
0.36	0.01	0.00	0.00	3.48	0.10	0.00	0.00
0.42	0.01	0.00	0.00	3.54	0.11	0.00	0.00
0.48	0.01	0.00	0.00	3.60	0.11	0.00	0.00
0.54	0.02	0.00	0.00	3.66	0.11	0.00	0.00
0.60	0.02	0.00	0.00	3.72	0.11	0.00	0.00
0.66	0.02	0.00	0.00	3.78	0.11	0.00	0.00
0.72	0.02	0.00	0.00	3.84	0.12	0.00	0.00
0.78	0.02	0.00	0.00	3.90	0.12	0.00	0.00
0.84	0.02	0.00	0.00	3.96	0.12	0.00	0.00
0.90	0.03	0.00	0.00	4.02	0.12	0.00	0.00
0.96	0.03	0.00	0.00	4.08	0.13	0.00	0.00
1.02	0.03	0.00	0.00	4.14	0.13	0.00	0.00
1.08	0.03	0.00	0.00	4.20	0.13	0.00	0.00
1.14	0.03	0.00	0.00	4.26	0.13	0.00	0.00
1.20	0.03	0.00	0.00	4.32	0.13	0.00	0.00
1.26	0.04	0.00	0.00	4.38	0.14	0.00	0.00
1.32	0.04	0.00	0.00	4.44	0.14	0.00	0.00
1.38	0.04	0.00	0.00	4.50	0.14	0.00	0.00
1.44	0.04	0.00	0.00	4.56	0.14	0.00	0.00
1.50	0.04	0.00	0.00	4.62	0.15	0.00	0.00
1.56	0.04	0.00	0.00	4.68	0.15	0.00	0.00
1.62	0.05	0.00	0.00	4.74	0.15	0.00	0.00
1.68	0.05	0.00	0.00	4.80	0.15	0.00	0.00
1.74	0.05	0.00	0.00	4.86	0.16	0.00	0.00
1.80	0.05	0.00	0.00	4.92	0.16	0.00	0.00
1.86	0.05	0.00	0.00	4.98	0.16	0.00	0.00
1.92	0.05	0.00	0.00	5.04	0.16	0.00	0.00
1.98	0.06	0.00	0.00	5.10	0.17	0.00	0.00
2.04	0.06	0.00	0.00	5.16	0.17	0.00	0.00
2.10	0.06	0.00	0.00	5.22	0.17	0.00	0.00
2.16	0.06	0.00	0.00	5.28	0.17	0.00	0.00
2.22	0.06	0.00	0.00	5.34	0.18	0.00	0.00
2.28	0.07	0.00	0.00	5.40	0.18	0.00	0.00
2.34	0.07	0.00	0.00	5.46	0.18	0.00	0.00
2.40	0.07	0.00	0.00	5.52	0.18	0.00	0.00
2.46	0.07	0.00	0.00	5.58	0.19	0.00	0.00
2.52	0.07	0.00	0.00	5.64	0.19	0.00	0.00
2.58	0.07	0.00	0.00	5.70	0.19	0.00	0.00
2.64	0.08	0.00	0.00	5.76	0.19	0.00	0.00
2.70	0.08	0.00	0.00	5.82	0.20	0.00	0.00
2.76	0.08	0.00	0.00	5.88	0.20	0.00	0.00
2.82	0.08	0.00	0.00	5.94	0.20	0.00	0.00
2.88	0.08	0.00	0.00	6.00	0.21	0.00	0.00
2.94	0.09	0.00	0.00	6.06	0.21	0.00	0.00
3.00	0.09	0.00	0.00	6.12	0.21	0.00	0.00
3.06	0.09	0.00	0.00	6.18	0.21	0.00	0.00

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Type III 24-hr 1 Year Rainfall=2.85"

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.22	0.00	0.00	9.36	0.46	0.01	0.07
6.30	0.22	0.00	0.00	9.42	0.46	0.02	0.07
6.36	0.22	0.00	0.00	9.48	0.47	0.02	0.07
6.42	0.23	0.00	0.00	9.54	0.48	0.02	0.08
6.48	0.23	0.00	0.00	9.60	0.49	0.02	0.08
6.54	0.23	0.00	0.00	9.66	0.49	0.02	0.09
6.60	0.24	0.00	0.00	9.72	0.50	0.02	0.09
6.66	0.24	0.00	0.00	9.78	0.51	0.03	0.10
6.72	0.24	0.00	0.00	9.84	0.52	0.03	0.10
6.78	0.25	0.00	0.00	9.90	0.52	0.03	0.11
6.84	0.25	0.00	0.00	9.96	0.53	0.03	0.11
6.90	0.25	0.00	0.00	10.02	0.54	0.03	0.12
6.96	0.26	0.00	0.00	10.08	0.55	0.04	0.12
7.02	0.26	0.00	0.00	10.14	0.56	0.04	0.13
7.08	0.26	0.00	0.00	10.20	0.57	0.04	0.13
7.14	0.27	0.00	0.00	10.26	0.58	0.04	0.14
7.20	0.27	0.00	0.00	10.32	0.59	0.05	0.15
7.26	0.27	0.00	0.00	10.38	0.60	0.05	0.16
7.32	0.28	0.00	0.00	10.44	0.61	0.05	0.17
7.38	0.28	0.00	0.00	10.50	0.62	0.06	0.17
7.44	0.29	0.00	0.00	10.56	0.63	0.06	0.18
7.50	0.29	0.00	0.00	10.62	0.64	0.06	0.19
7.56	0.29	0.00	0.00	10.68	0.65	0.07	0.20
7.62	0.30	0.00	0.00	10.74	0.66	0.07	0.21
7.68	0.30	0.00	0.00	10.80	0.67	0.07	0.22
7.74	0.31	0.00	0.00	10.86	0.68	0.08	0.23
7.80	0.31	0.00	0.00	10.92	0.70	0.08	0.24
7.86	0.31	0.00	0.00	10.98	0.71	0.09	0.25
7.92	0.32	0.00	0.00	11.04	0.72	0.09	0.26
7.98	0.32	0.00	0.01	11.10	0.73	0.10	0.28
8.04	0.33	0.00	0.01	11.16	0.75	0.10	0.30
8.10	0.33	0.00	0.01	11.22	0.76	0.11	0.32
8.16	0.34	0.00	0.01	11.28	0.78	0.12	0.35
8.22	0.34	0.00	0.01	11.34	0.80	0.13	0.38
8.28	0.35	0.00	0.01	11.40	0.82	0.13	0.42
8.34	0.35	0.00	0.02	11.46	0.84	0.14	0.45
8.40	0.36	0.00	0.02	11.52	0.86	0.15	0.48
8.46	0.36	0.00	0.02	11.58	0.88	0.16	0.54
8.52	0.37	0.00	0.02	11.64	0.92	0.18	0.69
8.58	0.37	0.00	0.02	11.70	0.97	0.21	0.92
8.64	0.38	0.00	0.03	11.76	1.02	0.24	1.20
8.70	0.38	0.00	0.03	11.82	1.09	0.27	1.52
8.76	0.39	0.01	0.03	11.88	1.16	0.31	1.87
8.82	0.40	0.01	0.04	11.94	1.26	0.37	2.27
8.88	0.40	0.01	0.04	12.00	1.42	0.48	3.15
8.94	0.41	0.01	0.04	12.06	1.59	0.60	4.97
9.00	0.42	0.01	0.04	12.12	1.69	0.67	5.93
9.06	0.42	0.01	0.05	12.18	1.76	0.73	4.94
9.12	0.43	0.01	0.05	12.24	1.83	0.77	3.79
9.18	0.44	0.01	0.05	12.30	1.88	0.81	3.12
9.24	0.44	0.01	0.06	12.36	1.93	0.85	2.66
9.30	0.45	0.01	0.06	12.42	1.97	0.88	2.26

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	1.99	0.90	1.86	15.60	2.49	1.31	0.26
12.54	2.01	0.92	1.47	15.66	2.50	1.31	0.26
12.60	2.03	0.93	1.15	15.72	2.50	1.31	0.25
12.66	2.05	0.95	0.96	15.78	2.51	1.32	0.25
12.72	2.07	0.96	0.88	15.84	2.51	1.32	0.24
12.78	2.09	0.97	0.82	15.90	2.52	1.33	0.24
12.84	2.10	0.99	0.77	15.96	2.52	1.33	0.23
12.90	2.12	1.00	0.73	16.02	2.53	1.33	0.22
12.96	2.13	1.01	0.69	16.08	2.53	1.34	0.22
13.02	2.14	1.02	0.65	16.14	2.54	1.34	0.22
13.08	2.15	1.03	0.61	16.20	2.54	1.34	0.21
13.14	2.17	1.04	0.58	16.26	2.54	1.35	0.21
13.20	2.18	1.05	0.56	16.32	2.55	1.35	0.21
13.26	2.19	1.06	0.55	16.38	2.55	1.35	0.20
13.32	2.20	1.06	0.54	16.44	2.56	1.36	0.20
13.38	2.21	1.07	0.53	16.50	2.56	1.36	0.20
13.44	2.22	1.08	0.52	16.56	2.56	1.37	0.20
13.50	2.23	1.09	0.51	16.62	2.57	1.37	0.20
13.56	2.24	1.10	0.50	16.68	2.57	1.37	0.19
13.62	2.25	1.11	0.49	16.74	2.58	1.37	0.19
13.68	2.26	1.12	0.48	16.80	2.58	1.38	0.19
13.74	2.27	1.12	0.47	16.86	2.58	1.38	0.19
13.80	2.28	1.13	0.46	16.92	2.59	1.38	0.18
13.86	2.29	1.14	0.44	16.98	2.59	1.39	0.18
13.92	2.30	1.15	0.43	17.04	2.59	1.39	0.18
13.98	2.31	1.15	0.42	17.10	2.60	1.39	0.18
14.04	2.32	1.16	0.41	17.16	2.60	1.40	0.17
14.10	2.33	1.17	0.40	17.22	2.60	1.40	0.17
14.16	2.33	1.17	0.39	17.28	2.61	1.40	0.17
14.22	2.34	1.18	0.39	17.34	2.61	1.40	0.17
14.28	2.35	1.19	0.38	17.40	2.61	1.41	0.16
14.34	2.36	1.19	0.38	17.46	2.62	1.41	0.16
14.40	2.36	1.20	0.37	17.52	2.62	1.41	0.16
14.46	2.37	1.20	0.37	17.58	2.62	1.42	0.16
14.52	2.38	1.21	0.36	17.64	2.63	1.42	0.15
14.58	2.39	1.22	0.36	17.70	2.63	1.42	0.15
14.64	2.39	1.22	0.35	17.76	2.63	1.42	0.15
14.70	2.40	1.23	0.34	17.82	2.64	1.43	0.15
14.76	2.41	1.23	0.34	17.88	2.64	1.43	0.14
14.82	2.41	1.24	0.33	17.94	2.64	1.43	0.14
14.88	2.42	1.25	0.33	18.00	2.64	1.43	0.14
14.94	2.43	1.25	0.32	18.06	2.65	1.44	0.14
15.00	2.43	1.26	0.32	18.12	2.65	1.44	0.13
15.06	2.44	1.26	0.31	18.18	2.65	1.44	0.13
15.12	2.45	1.27	0.31	18.24	2.66	1.44	0.13
15.18	2.45	1.27	0.30	18.30	2.66	1.44	0.13
15.24	2.46	1.28	0.30	18.36	2.66	1.45	0.13
15.30	2.47	1.28	0.29	18.42	2.66	1.45	0.13
15.36	2.47	1.29	0.29	18.48	2.67	1.45	0.13
15.42	2.48	1.29	0.28	18.54	2.67	1.45	0.13
15.48	2.48	1.30	0.27	18.60	2.67	1.46	0.13
15.54	2.49	1.30	0.27	18.66	2.67	1.46	0.13

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	2.68	1.46	0.13	21.84	2.79	1.56	0.09
18.78	2.68	1.46	0.13	21.90	2.79	1.56	0.09
18.84	2.68	1.46	0.13	21.96	2.79	1.56	0.09
18.90	2.68	1.47	0.12	22.02	2.80	1.56	0.09
18.96	2.69	1.47	0.12	22.08	2.80	1.56	0.09
19.02	2.69	1.47	0.12	22.14	2.80	1.57	0.09
19.08	2.69	1.47	0.12	22.20	2.80	1.57	0.09
19.14	2.69	1.47	0.12	22.26	2.80	1.57	0.09
19.20	2.70	1.48	0.12	22.32	2.80	1.57	0.09
19.26	2.70	1.48	0.12	22.38	2.81	1.57	0.09
19.32	2.70	1.48	0.12	22.44	2.81	1.57	0.09
19.38	2.70	1.48	0.12	22.50	2.81	1.57	0.09
19.44	2.71	1.49	0.12	22.56	2.81	1.58	0.09
19.50	2.71	1.49	0.12	22.62	2.81	1.58	0.09
19.56	2.71	1.49	0.12	22.68	2.82	1.58	0.09
19.62	2.71	1.49	0.12	22.74	2.82	1.58	0.09
19.68	2.72	1.49	0.11	22.80	2.82	1.58	0.08
19.74	2.72	1.50	0.11	22.86	2.82	1.58	0.08
19.80	2.72	1.50	0.11	22.92	2.82	1.58	0.08
19.86	2.72	1.50	0.11	22.98	2.82	1.59	0.08
19.92	2.72	1.50	0.11	23.04	2.83	1.59	0.08
19.98	2.73	1.50	0.11	23.10	2.83	1.59	0.08
20.04	2.73	1.50	0.11	23.16	2.83	1.59	0.08
20.10	2.73	1.51	0.11	23.22	2.83	1.59	0.08
20.16	2.73	1.51	0.11	23.28	2.83	1.59	0.08
20.22	2.74	1.51	0.11	23.34	2.83	1.59	0.08
20.28	2.74	1.51	0.11	23.40	2.83	1.60	0.08
20.34	2.74	1.51	0.11	23.46	2.84	1.60	0.08
20.40	2.74	1.52	0.11	23.52	2.84	1.60	0.08
20.46	2.74	1.52	0.11	23.58	2.84	1.60	0.08
20.52	2.75	1.52	0.11	23.64	2.84	1.60	0.08
20.58	2.75	1.52	0.11	23.70	2.84	1.60	0.08
20.64	2.75	1.52	0.10	23.76	2.84	1.60	0.08
20.70	2.75	1.53	0.10	23.82	2.85	1.61	0.08
20.76	2.75	1.53	0.10	23.88	2.85	1.61	0.07
20.82	2.76	1.53	0.10	23.94	2.85	1.61	0.07
20.88	2.76	1.53	0.10	24.00	2.85	1.61	0.07
20.94	2.76	1.53	0.10				
21.00	2.76	1.53	0.10				
21.06	2.76	1.54	0.10				
21.12	2.77	1.54	0.10				
21.18	2.77	1.54	0.10				
21.24	2.77	1.54	0.10				
21.30	2.77	1.54	0.10				
21.36	2.77	1.54	0.10				
21.42	2.78	1.55	0.10				
21.48	2.78	1.55	0.10				
21.54	2.78	1.55	0.10				
21.60	2.78	1.55	0.10				
21.66	2.78	1.55	0.10				
21.72	2.79	1.55	0.09				
21.78	2.79	1.56	0.09				

Summary for Subcatchment 3S: Detention Drainage Area B1

[49] Hint: $T_c < 2dt$ may require smaller dt

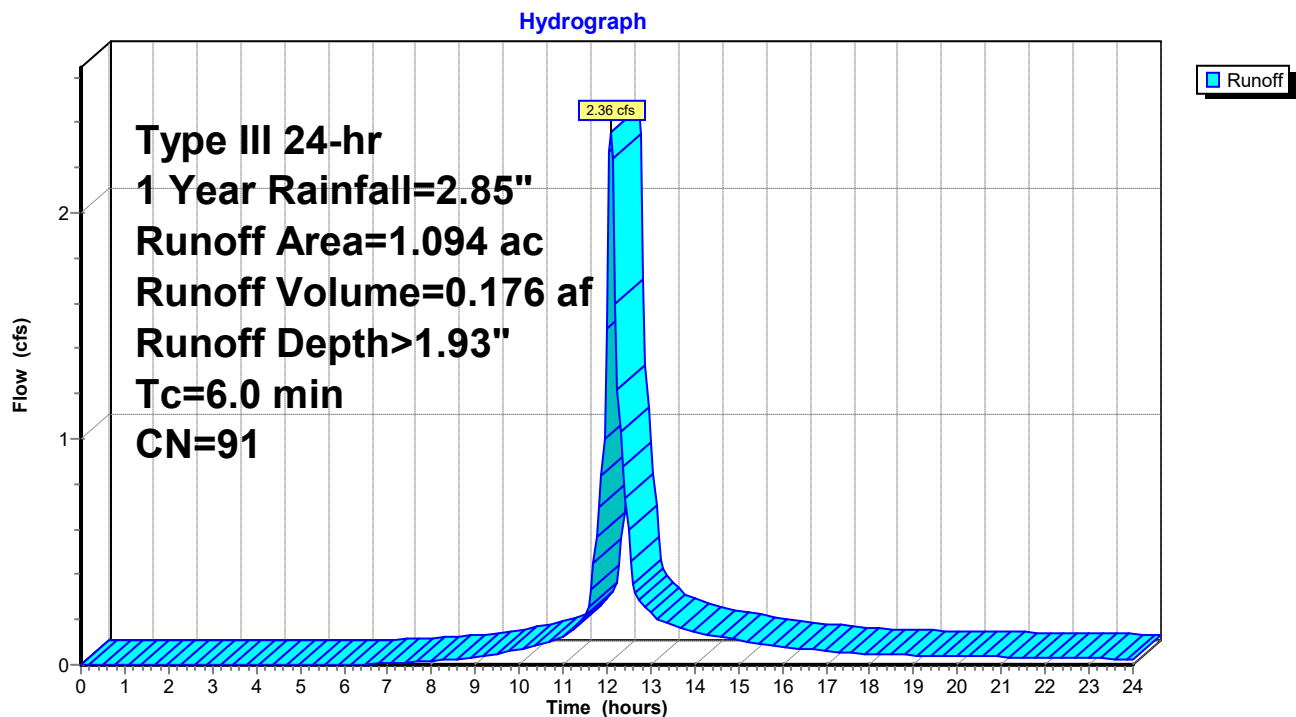
Runoff = 2.36 cfs @ 12.09 hrs, Volume= 0.176 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, $dt=0.06$ hrs
Type III 24-hr 1 Year Rainfall=2.85"

Area (ac)	CN	Description
0.764	98	Roofs, HSG C
0.330	74	>75% Grass cover, Good, HSG C
1.094	91	Weighted Average
0.330		30.16% Pervious Area
0.764		69.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, minimum

Subcatchment 3S: Detention Drainage Area B1



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Hydrograph for Subcatchment 3S: Detention Drainage Area B1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.09	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.09	0.00	0.00
0.12	0.00	0.00	0.00	3.24	0.10	0.00	0.00
0.18	0.01	0.00	0.00	3.30	0.10	0.00	0.00
0.24	0.01	0.00	0.00	3.36	0.10	0.00	0.00
0.30	0.01	0.00	0.00	3.42	0.10	0.00	0.00
0.36	0.01	0.00	0.00	3.48	0.10	0.00	0.00
0.42	0.01	0.00	0.00	3.54	0.11	0.00	0.00
0.48	0.01	0.00	0.00	3.60	0.11	0.00	0.00
0.54	0.02	0.00	0.00	3.66	0.11	0.00	0.00
0.60	0.02	0.00	0.00	3.72	0.11	0.00	0.00
0.66	0.02	0.00	0.00	3.78	0.11	0.00	0.00
0.72	0.02	0.00	0.00	3.84	0.12	0.00	0.00
0.78	0.02	0.00	0.00	3.90	0.12	0.00	0.00
0.84	0.02	0.00	0.00	3.96	0.12	0.00	0.00
0.90	0.03	0.00	0.00	4.02	0.12	0.00	0.00
0.96	0.03	0.00	0.00	4.08	0.13	0.00	0.00
1.02	0.03	0.00	0.00	4.14	0.13	0.00	0.00
1.08	0.03	0.00	0.00	4.20	0.13	0.00	0.00
1.14	0.03	0.00	0.00	4.26	0.13	0.00	0.00
1.20	0.03	0.00	0.00	4.32	0.13	0.00	0.00
1.26	0.04	0.00	0.00	4.38	0.14	0.00	0.00
1.32	0.04	0.00	0.00	4.44	0.14	0.00	0.00
1.38	0.04	0.00	0.00	4.50	0.14	0.00	0.00
1.44	0.04	0.00	0.00	4.56	0.14	0.00	0.00
1.50	0.04	0.00	0.00	4.62	0.15	0.00	0.00
1.56	0.04	0.00	0.00	4.68	0.15	0.00	0.00
1.62	0.05	0.00	0.00	4.74	0.15	0.00	0.00
1.68	0.05	0.00	0.00	4.80	0.15	0.00	0.00
1.74	0.05	0.00	0.00	4.86	0.16	0.00	0.00
1.80	0.05	0.00	0.00	4.92	0.16	0.00	0.00
1.86	0.05	0.00	0.00	4.98	0.16	0.00	0.00
1.92	0.05	0.00	0.00	5.04	0.16	0.00	0.00
1.98	0.06	0.00	0.00	5.10	0.17	0.00	0.00
2.04	0.06	0.00	0.00	5.16	0.17	0.00	0.00
2.10	0.06	0.00	0.00	5.22	0.17	0.00	0.00
2.16	0.06	0.00	0.00	5.28	0.17	0.00	0.00
2.22	0.06	0.00	0.00	5.34	0.18	0.00	0.00
2.28	0.07	0.00	0.00	5.40	0.18	0.00	0.00
2.34	0.07	0.00	0.00	5.46	0.18	0.00	0.00
2.40	0.07	0.00	0.00	5.52	0.18	0.00	0.00
2.46	0.07	0.00	0.00	5.58	0.19	0.00	0.00
2.52	0.07	0.00	0.00	5.64	0.19	0.00	0.00
2.58	0.07	0.00	0.00	5.70	0.19	0.00	0.00
2.64	0.08	0.00	0.00	5.76	0.19	0.00	0.00
2.70	0.08	0.00	0.00	5.82	0.20	0.00	0.00
2.76	0.08	0.00	0.00	5.88	0.20	0.00	0.00
2.82	0.08	0.00	0.00	5.94	0.20	0.00	0.00
2.88	0.08	0.00	0.00	6.00	0.21	0.00	0.00
2.94	0.09	0.00	0.00	6.06	0.21	0.00	0.00
3.00	0.09	0.00	0.00	6.12	0.21	0.00	0.00
3.06	0.09	0.00	0.00	6.18	0.21	0.00	0.00

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.22	0.00	0.00	9.36	0.46	0.05	0.05
6.30	0.22	0.00	0.00	9.42	0.46	0.06	0.05
6.36	0.22	0.00	0.00	9.48	0.47	0.06	0.05
6.42	0.23	0.00	0.00	9.54	0.48	0.06	0.05
6.48	0.23	0.00	0.00	9.60	0.49	0.06	0.05
6.54	0.23	0.00	0.00	9.66	0.49	0.07	0.05
6.60	0.24	0.00	0.00	9.72	0.50	0.07	0.06
6.66	0.24	0.00	0.00	9.78	0.51	0.07	0.06
6.72	0.24	0.00	0.00	9.84	0.52	0.08	0.06
6.78	0.25	0.00	0.00	9.90	0.52	0.08	0.06
6.84	0.25	0.00	0.01	9.96	0.53	0.08	0.06
6.90	0.25	0.00	0.01	10.02	0.54	0.09	0.07
6.96	0.26	0.00	0.01	10.08	0.55	0.09	0.07
7.02	0.26	0.00	0.01	10.14	0.56	0.10	0.07
7.08	0.26	0.00	0.01	10.20	0.57	0.10	0.07
7.14	0.27	0.00	0.01	10.26	0.58	0.11	0.08
7.20	0.27	0.00	0.01	10.32	0.59	0.11	0.08
7.26	0.27	0.01	0.01	10.38	0.60	0.11	0.08
7.32	0.28	0.01	0.01	10.44	0.61	0.12	0.09
7.38	0.28	0.01	0.01	10.50	0.62	0.12	0.09
7.44	0.29	0.01	0.01	10.56	0.63	0.13	0.10
7.50	0.29	0.01	0.01	10.62	0.64	0.14	0.10
7.56	0.29	0.01	0.01	10.68	0.65	0.14	0.10
7.62	0.30	0.01	0.01	10.74	0.66	0.15	0.11
7.68	0.30	0.01	0.01	10.80	0.67	0.15	0.11
7.74	0.31	0.01	0.01	10.86	0.68	0.16	0.11
7.80	0.31	0.01	0.01	10.92	0.70	0.17	0.12
7.86	0.31	0.01	0.01	10.98	0.71	0.17	0.12
7.92	0.32	0.01	0.02	11.04	0.72	0.18	0.13
7.98	0.32	0.01	0.02	11.10	0.73	0.19	0.13
8.04	0.33	0.02	0.02	11.16	0.75	0.20	0.14
8.10	0.33	0.02	0.02	11.22	0.76	0.21	0.16
8.16	0.34	0.02	0.02	11.28	0.78	0.22	0.17
8.22	0.34	0.02	0.02	11.34	0.80	0.23	0.18
8.28	0.35	0.02	0.02	11.40	0.82	0.24	0.19
8.34	0.35	0.02	0.02	11.46	0.84	0.25	0.21
8.40	0.36	0.02	0.02	11.52	0.86	0.26	0.22
8.46	0.36	0.02	0.02	11.58	0.88	0.28	0.25
8.52	0.37	0.02	0.03	11.64	0.92	0.31	0.34
8.58	0.37	0.03	0.03	11.70	0.97	0.34	0.45
8.64	0.38	0.03	0.03	11.76	1.02	0.37	0.57
8.70	0.38	0.03	0.03	11.82	1.09	0.42	0.70
8.76	0.39	0.03	0.03	11.88	1.16	0.47	0.83
8.82	0.40	0.03	0.03	11.94	1.26	0.55	1.00
8.88	0.40	0.04	0.03	12.00	1.42	0.68	1.49
8.94	0.41	0.04	0.03	12.06	1.59	0.82	2.27
9.00	0.42	0.04	0.04	12.12	1.69	0.90	2.24
9.06	0.42	0.04	0.04	12.18	1.76	0.96	1.60
9.12	0.43	0.04	0.04	12.24	1.83	1.01	1.22
9.18	0.44	0.05	0.04	12.30	1.88	1.06	1.03
9.24	0.44	0.05	0.04	12.36	1.93	1.10	0.88
9.30	0.45	0.05	0.04	12.42	1.97	1.13	0.74

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	1.99	1.16	0.60	15.60	2.49	1.60	0.09
12.54	2.01	1.18	0.46	15.66	2.50	1.61	0.09
12.60	2.03	1.19	0.36	15.72	2.50	1.61	0.09
12.66	2.05	1.21	0.32	15.78	2.51	1.62	0.08
12.72	2.07	1.22	0.30	15.84	2.51	1.62	0.08
12.78	2.09	1.24	0.28	15.90	2.52	1.63	0.08
12.84	2.10	1.25	0.27	15.96	2.52	1.63	0.08
12.90	2.12	1.27	0.25	16.02	2.53	1.63	0.08
12.96	2.13	1.28	0.24	16.08	2.53	1.64	0.08
13.02	2.14	1.29	0.22	16.14	2.54	1.64	0.07
13.08	2.15	1.30	0.21	16.20	2.54	1.65	0.07
13.14	2.17	1.31	0.20	16.26	2.54	1.65	0.07
13.20	2.18	1.32	0.20	16.32	2.55	1.65	0.07
13.26	2.19	1.33	0.19	16.38	2.55	1.66	0.07
13.32	2.20	1.34	0.19	16.44	2.56	1.66	0.07
13.38	2.21	1.35	0.19	16.50	2.56	1.67	0.07
13.44	2.22	1.36	0.18	16.56	2.56	1.67	0.07
13.50	2.23	1.37	0.18	16.62	2.57	1.67	0.07
13.56	2.24	1.38	0.17	16.68	2.57	1.68	0.07
13.62	2.25	1.39	0.17	16.74	2.58	1.68	0.07
13.68	2.26	1.40	0.17	16.80	2.58	1.68	0.06
13.74	2.27	1.41	0.16	16.86	2.58	1.69	0.06
13.80	2.28	1.41	0.16	16.92	2.59	1.69	0.06
13.86	2.29	1.42	0.15	16.98	2.59	1.69	0.06
13.92	2.30	1.43	0.15	17.04	2.59	1.70	0.06
13.98	2.31	1.44	0.15	17.10	2.60	1.70	0.06
14.04	2.32	1.44	0.14	17.16	2.60	1.70	0.06
14.10	2.33	1.45	0.14	17.22	2.60	1.71	0.06
14.16	2.33	1.46	0.14	17.28	2.61	1.71	0.06
14.22	2.34	1.47	0.13	17.34	2.61	1.71	0.06
14.28	2.35	1.47	0.13	17.40	2.61	1.72	0.06
14.34	2.36	1.48	0.13	17.46	2.62	1.72	0.06
14.40	2.36	1.49	0.13	17.52	2.62	1.72	0.05
14.46	2.37	1.49	0.13	17.58	2.62	1.72	0.05
14.52	2.38	1.50	0.13	17.64	2.63	1.73	0.05
14.58	2.39	1.51	0.12	17.70	2.63	1.73	0.05
14.64	2.39	1.51	0.12	17.76	2.63	1.73	0.05
14.70	2.40	1.52	0.12	17.82	2.64	1.73	0.05
14.76	2.41	1.53	0.12	17.88	2.64	1.74	0.05
14.82	2.41	1.53	0.12	17.94	2.64	1.74	0.05
14.88	2.42	1.54	0.11	18.00	2.64	1.74	0.05
14.94	2.43	1.55	0.11	18.06	2.65	1.75	0.05
15.00	2.43	1.55	0.11	18.12	2.65	1.75	0.05
15.06	2.44	1.56	0.11	18.18	2.65	1.75	0.05
15.12	2.45	1.56	0.11	18.24	2.66	1.75	0.05
15.18	2.45	1.57	0.10	18.30	2.66	1.76	0.05
15.24	2.46	1.57	0.10	18.36	2.66	1.76	0.05
15.30	2.47	1.58	0.10	18.42	2.66	1.76	0.04
15.36	2.47	1.58	0.10	18.48	2.67	1.76	0.04
15.42	2.48	1.59	0.10	18.54	2.67	1.76	0.04
15.48	2.48	1.59	0.09	18.60	2.67	1.77	0.04
15.54	2.49	1.60	0.09	18.66	2.67	1.77	0.04

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

Prepared by Tectonic Engineering

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

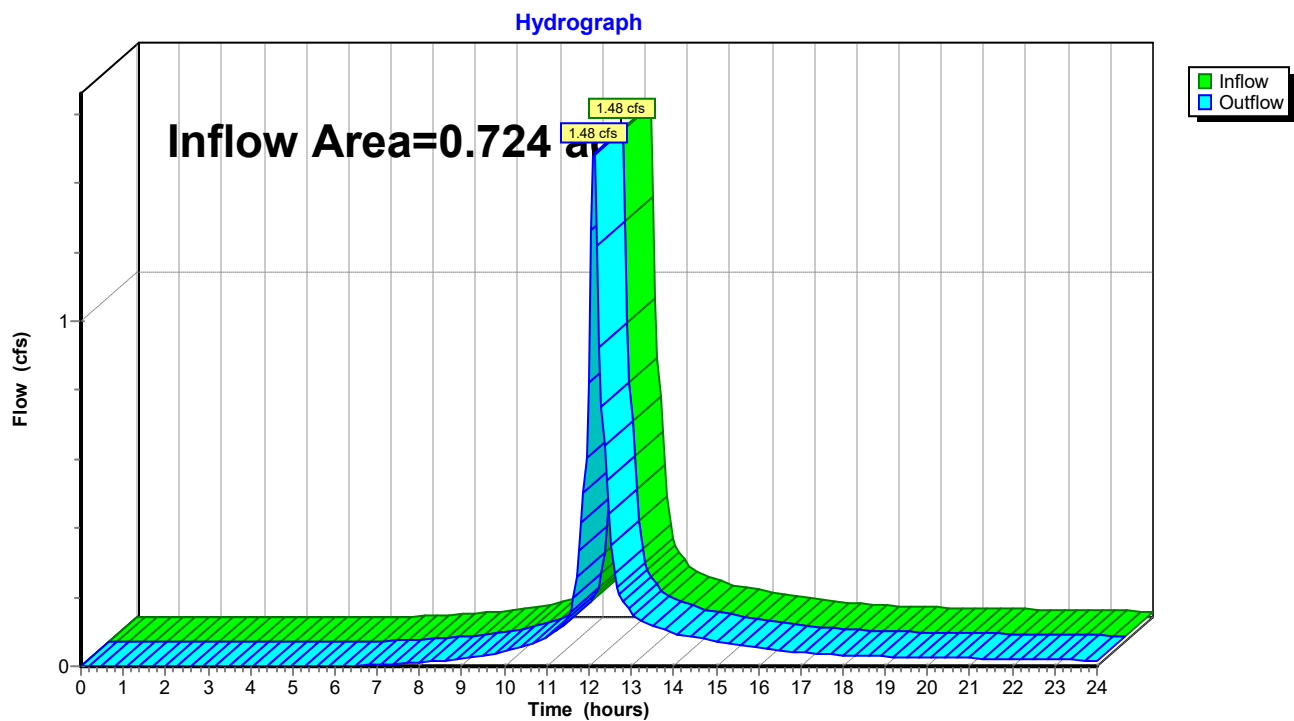
Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	2.68	1.77	0.04	21.84	2.79	1.88	0.03
18.78	2.68	1.77	0.04	21.90	2.79	1.88	0.03
18.84	2.68	1.78	0.04	21.96	2.79	1.88	0.03
18.90	2.68	1.78	0.04	22.02	2.80	1.88	0.03
18.96	2.69	1.78	0.04	22.08	2.80	1.88	0.03
19.02	2.69	1.78	0.04	22.14	2.80	1.88	0.03
19.08	2.69	1.79	0.04	22.20	2.80	1.89	0.03
19.14	2.69	1.79	0.04	22.26	2.80	1.89	0.03
19.20	2.70	1.79	0.04	22.32	2.80	1.89	0.03
19.26	2.70	1.79	0.04	22.38	2.81	1.89	0.03
19.32	2.70	1.79	0.04	22.44	2.81	1.89	0.03
19.38	2.70	1.80	0.04	22.50	2.81	1.89	0.03
19.44	2.71	1.80	0.04	22.56	2.81	1.90	0.03
19.50	2.71	1.80	0.04	22.62	2.81	1.90	0.03
19.56	2.71	1.80	0.04	22.68	2.82	1.90	0.03
19.62	2.71	1.81	0.04	22.74	2.82	1.90	0.03
19.68	2.72	1.81	0.04	22.80	2.82	1.90	0.03
19.74	2.72	1.81	0.04	22.86	2.82	1.90	0.03
19.80	2.72	1.81	0.04	22.92	2.82	1.91	0.03
19.86	2.72	1.81	0.04	22.98	2.82	1.91	0.03
19.92	2.72	1.82	0.04	23.04	2.83	1.91	0.03
19.98	2.73	1.82	0.04	23.10	2.83	1.91	0.03
20.04	2.73	1.82	0.04	23.16	2.83	1.91	0.03
20.10	2.73	1.82	0.04	23.22	2.83	1.91	0.03
20.16	2.73	1.82	0.04	23.28	2.83	1.91	0.03
20.22	2.74	1.83	0.04	23.34	2.83	1.92	0.03
20.28	2.74	1.83	0.04	23.40	2.83	1.92	0.03
20.34	2.74	1.83	0.04	23.46	2.84	1.92	0.03
20.40	2.74	1.83	0.04	23.52	2.84	1.92	0.03
20.46	2.74	1.83	0.04	23.58	2.84	1.92	0.03
20.52	2.75	1.84	0.04	23.64	2.84	1.92	0.03
20.58	2.75	1.84	0.04	23.70	2.84	1.92	0.03
20.64	2.75	1.84	0.04	23.76	2.84	1.93	0.03
20.70	2.75	1.84	0.04	23.82	2.85	1.93	0.03
20.76	2.75	1.84	0.04	23.88	2.85	1.93	0.03
20.82	2.76	1.85	0.04	23.94	2.85	1.93	0.03
20.88	2.76	1.85	0.04	24.00	2.85	1.93	0.02
20.94	2.76	1.85	0.03				
21.00	2.76	1.85	0.03				
21.06	2.76	1.85	0.03				
21.12	2.77	1.86	0.03				
21.18	2.77	1.86	0.03				
21.24	2.77	1.86	0.03				
21.30	2.77	1.86	0.03				
21.36	2.77	1.86	0.03				
21.42	2.78	1.86	0.03				
21.48	2.78	1.87	0.03				
21.54	2.78	1.87	0.03				
21.60	2.78	1.87	0.03				
21.66	2.78	1.87	0.03				
21.72	2.79	1.87	0.03				
21.78	2.79	1.87	0.03				

Summary for Reach 4R: Design Point A

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.724 ac, 72.79% Impervious, Inflow Depth > 1.93" for 1 Year event
Inflow = 1.48 cfs @ 12.12 hrs, Volume= 0.116 af
Outflow = 1.48 cfs @ 12.12 hrs, Volume= 0.116 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Reach 4R: Design Point A

Hydrograph for Reach 4R: Design Point A

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	3.12	0.00		0.00
0.06	0.00		0.00	3.18	0.00		0.00
0.12	0.00		0.00	3.24	0.00		0.00
0.18	0.00		0.00	3.30	0.00		0.00
0.24	0.00		0.00	3.36	0.00		0.00
0.30	0.00		0.00	3.42	0.00		0.00
0.36	0.00		0.00	3.48	0.00		0.00
0.42	0.00		0.00	3.54	0.00		0.00
0.48	0.00		0.00	3.60	0.00		0.00
0.54	0.00		0.00	3.66	0.00		0.00
0.60	0.00		0.00	3.72	0.00		0.00
0.66	0.00		0.00	3.78	0.00		0.00
0.72	0.00		0.00	3.84	0.00		0.00
0.78	0.00		0.00	3.90	0.00		0.00
0.84	0.00		0.00	3.96	0.00		0.00
0.90	0.00		0.00	4.02	0.00		0.00
0.96	0.00		0.00	4.08	0.00		0.00
1.02	0.00		0.00	4.14	0.00		0.00
1.08	0.00		0.00	4.20	0.00		0.00
1.14	0.00		0.00	4.26	0.00		0.00
1.20	0.00		0.00	4.32	0.00		0.00
1.26	0.00		0.00	4.38	0.00		0.00
1.32	0.00		0.00	4.44	0.00		0.00
1.38	0.00		0.00	4.50	0.00		0.00
1.44	0.00		0.00	4.56	0.00		0.00
1.50	0.00		0.00	4.62	0.00		0.00
1.56	0.00		0.00	4.68	0.00		0.00
1.62	0.00		0.00	4.74	0.00		0.00
1.68	0.00		0.00	4.80	0.00		0.00
1.74	0.00		0.00	4.86	0.00		0.00
1.80	0.00		0.00	4.92	0.00		0.00
1.86	0.00		0.00	4.98	0.00		0.00
1.92	0.00		0.00	5.04	0.00		0.00
1.98	0.00		0.00	5.10	0.00		0.00
2.04	0.00		0.00	5.16	0.00		0.00
2.10	0.00		0.00	5.22	0.00		0.00
2.16	0.00		0.00	5.28	0.00		0.00
2.22	0.00		0.00	5.34	0.00		0.00
2.28	0.00		0.00	5.40	0.00		0.00
2.34	0.00		0.00	5.46	0.00		0.00
2.40	0.00		0.00	5.52	0.00		0.00
2.46	0.00		0.00	5.58	0.00		0.00
2.52	0.00		0.00	5.64	0.00		0.00
2.58	0.00		0.00	5.70	0.00		0.00
2.64	0.00		0.00	5.76	0.00		0.00
2.70	0.00		0.00	5.82	0.00		0.00
2.76	0.00		0.00	5.88	0.00		0.00
2.82	0.00		0.00	5.94	0.00		0.00
2.88	0.00		0.00	6.00	0.00		0.00
2.94	0.00		0.00	6.06	0.00		0.00
3.00	0.00		0.00	6.12	0.00		0.00
3.06	0.00		0.00	6.18	0.00		0.00

Hydrograph for Reach 4R: Design Point A (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
6.24	0.00		0.00	9.36	0.03		0.03
6.30	0.00		0.00	9.42	0.03		0.03
6.36	0.00		0.00	9.48	0.03		0.03
6.42	0.00		0.00	9.54	0.03		0.03
6.48	0.00		0.00	9.60	0.03		0.03
6.54	0.00		0.00	9.66	0.04		0.04
6.60	0.00		0.00	9.72	0.04		0.04
6.66	0.00		0.00	9.78	0.04		0.04
6.72	0.00		0.00	9.84	0.04		0.04
6.78	0.00		0.00	9.90	0.04		0.04
6.84	0.00		0.00	9.96	0.04		0.04
6.90	0.00		0.00	10.02	0.04		0.04
6.96	0.00		0.00	10.08	0.04		0.04
7.02	0.00		0.00	10.14	0.05		0.05
7.08	0.00		0.00	10.20	0.05		0.05
7.14	0.00		0.00	10.26	0.05		0.05
7.20	0.01		0.01	10.32	0.05		0.05
7.26	0.01		0.01	10.38	0.05		0.05
7.32	0.01		0.01	10.44	0.06		0.06
7.38	0.01		0.01	10.50	0.06		0.06
7.44	0.01		0.01	10.56	0.06		0.06
7.50	0.01		0.01	10.62	0.06		0.06
7.56	0.01		0.01	10.68	0.07		0.07
7.62	0.01		0.01	10.74	0.07		0.07
7.68	0.01		0.01	10.80	0.07		0.07
7.74	0.01		0.01	10.86	0.07		0.07
7.80	0.01		0.01	10.92	0.08		0.08
7.86	0.01		0.01	10.98	0.08		0.08
7.92	0.01		0.01	11.04	0.08		0.08
7.98	0.01		0.01	11.10	0.09		0.09
8.04	0.01		0.01	11.16	0.09		0.09
8.10	0.01		0.01	11.22	0.10		0.10
8.16	0.01		0.01	11.28	0.11		0.11
8.22	0.01		0.01	11.34	0.12		0.12
8.28	0.01		0.01	11.40	0.12		0.12
8.34	0.01		0.01	11.46	0.13		0.13
8.40	0.01		0.01	11.52	0.14		0.14
8.46	0.02		0.02	11.58	0.16		0.16
8.52	0.02		0.02	11.64	0.20		0.20
8.58	0.02		0.02	11.70	0.26		0.26
8.64	0.02		0.02	11.76	0.33		0.33
8.70	0.02		0.02	11.82	0.42		0.42
8.76	0.02		0.02	11.88	0.51		0.51
8.82	0.02		0.02	11.94	0.61		0.61
8.88	0.02		0.02	12.00	0.82		0.82
8.94	0.02		0.02	12.06	1.27		1.27
9.00	0.02		0.02	12.12	1.48		1.48
9.06	0.02		0.02	12.18	1.22		1.22
9.12	0.03		0.03	12.24	0.92		0.92
9.18	0.03		0.03	12.30	0.75		0.75
9.24	0.03		0.03	12.36	0.64		0.64
9.30	0.03		0.03	12.42	0.54		0.54

Hydrograph for Reach 4R: Design Point A (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
12.48	0.44		0.44	15.60	0.06		0.06
12.54	0.35		0.35	15.66	0.06		0.06
12.60	0.27		0.27	15.72	0.06		0.06
12.66	0.23		0.23	15.78	0.06		0.06
12.72	0.21		0.21	15.84	0.06		0.06
12.78	0.19		0.19	15.90	0.05		0.05
12.84	0.18		0.18	15.96	0.05		0.05
12.90	0.17		0.17	16.02	0.05		0.05
12.96	0.16		0.16	16.08	0.05		0.05
13.02	0.15		0.15	16.14	0.05		0.05
13.08	0.14		0.14	16.20	0.05		0.05
13.14	0.14		0.14	16.26	0.05		0.05
13.20	0.13		0.13	16.32	0.05		0.05
13.26	0.13		0.13	16.38	0.05		0.05
13.32	0.13		0.13	16.44	0.05		0.05
13.38	0.12		0.12	16.50	0.05		0.05
13.44	0.12		0.12	16.56	0.05		0.05
13.50	0.12		0.12	16.62	0.04		0.04
13.56	0.12		0.12	16.68	0.04		0.04
13.62	0.11		0.11	16.74	0.04		0.04
13.68	0.11		0.11	16.80	0.04		0.04
13.74	0.11		0.11	16.86	0.04		0.04
13.80	0.11		0.11	16.92	0.04		0.04
13.86	0.10		0.10	16.98	0.04		0.04
13.92	0.10		0.10	17.04	0.04		0.04
13.98	0.10		0.10	17.10	0.04		0.04
14.04	0.10		0.10	17.16	0.04		0.04
14.10	0.09		0.09	17.22	0.04		0.04
14.16	0.09		0.09	17.28	0.04		0.04
14.22	0.09		0.09	17.34	0.04		0.04
14.28	0.09		0.09	17.40	0.04		0.04
14.34	0.09		0.09	17.46	0.04		0.04
14.40	0.09		0.09	17.52	0.04		0.04
14.46	0.08		0.08	17.58	0.04		0.04
14.52	0.08		0.08	17.64	0.04		0.04
14.58	0.08		0.08	17.70	0.03		0.03
14.64	0.08		0.08	17.76	0.03		0.03
14.70	0.08		0.08	17.82	0.03		0.03
14.76	0.08		0.08	17.88	0.03		0.03
14.82	0.08		0.08	17.94	0.03		0.03
14.88	0.08		0.08	18.00	0.03		0.03
14.94	0.07		0.07	18.06	0.03		0.03
15.00	0.07		0.07	18.12	0.03		0.03
15.06	0.07		0.07	18.18	0.03		0.03
15.12	0.07		0.07	18.24	0.03		0.03
15.18	0.07		0.07	18.30	0.03		0.03
15.24	0.07		0.07	18.36	0.03		0.03
15.30	0.07		0.07	18.42	0.03		0.03
15.36	0.07		0.07	18.48	0.03		0.03
15.42	0.06		0.06	18.54	0.03		0.03
15.48	0.06		0.06	18.60	0.03		0.03
15.54	0.06		0.06	18.66	0.03		0.03

Hydrograph for Reach 4R: Design Point A (continued)

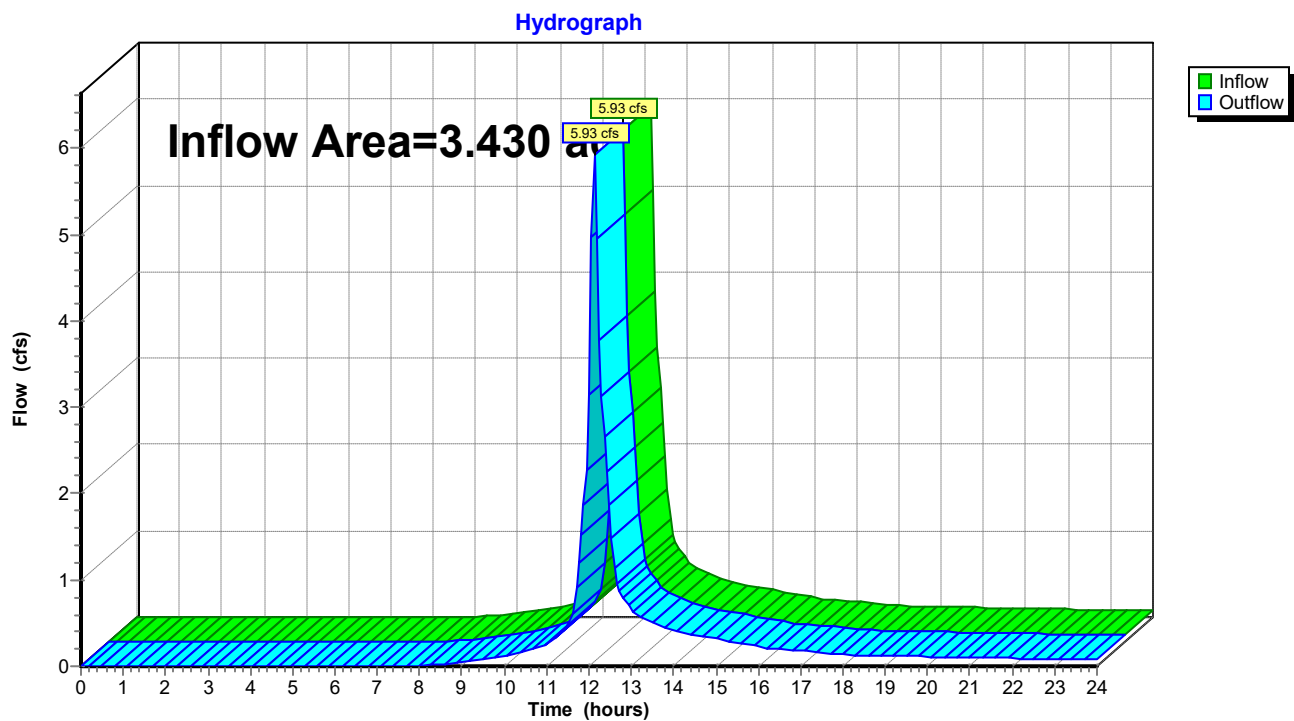
Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
18.72	0.03		0.03	21.84	0.02		0.02
18.78	0.03		0.03	21.90	0.02		0.02
18.84	0.03		0.03	21.96	0.02		0.02
18.90	0.03		0.03	22.02	0.02		0.02
18.96	0.03		0.03	22.08	0.02		0.02
19.02	0.03		0.03	22.14	0.02		0.02
19.08	0.03		0.03	22.20	0.02		0.02
19.14	0.03		0.03	22.26	0.02		0.02
19.20	0.03		0.03	22.32	0.02		0.02
19.26	0.03		0.03	22.38	0.02		0.02
19.32	0.03		0.03	22.44	0.02		0.02
19.38	0.03		0.03	22.50	0.02		0.02
19.44	0.03		0.03	22.56	0.02		0.02
19.50	0.03		0.03	22.62	0.02		0.02
19.56	0.03		0.03	22.68	0.02		0.02
19.62	0.03		0.03	22.74	0.02		0.02
19.68	0.03		0.03	22.80	0.02		0.02
19.74	0.03		0.03	22.86	0.02		0.02
19.80	0.03		0.03	22.92	0.02		0.02
19.86	0.03		0.03	22.98	0.02		0.02
19.92	0.03		0.03	23.04	0.02		0.02
19.98	0.03		0.03	23.10	0.02		0.02
20.04	0.03		0.03	23.16	0.02		0.02
20.10	0.02		0.02	23.22	0.02		0.02
20.16	0.02		0.02	23.28	0.02		0.02
20.22	0.02		0.02	23.34	0.02		0.02
20.28	0.02		0.02	23.40	0.02		0.02
20.34	0.02		0.02	23.46	0.02		0.02
20.40	0.02		0.02	23.52	0.02		0.02
20.46	0.02		0.02	23.58	0.02		0.02
20.52	0.02		0.02	23.64	0.02		0.02
20.58	0.02		0.02	23.70	0.02		0.02
20.64	0.02		0.02	23.76	0.02		0.02
20.70	0.02		0.02	23.82	0.02		0.02
20.76	0.02		0.02	23.88	0.02		0.02
20.82	0.02		0.02	23.94	0.02		0.02
20.88	0.02		0.02	24.00	0.02		0.02
20.94	0.02		0.02				
21.00	0.02		0.02				
21.06	0.02		0.02				
21.12	0.02		0.02				
21.18	0.02		0.02				
21.24	0.02		0.02				
21.30	0.02		0.02				
21.36	0.02		0.02				
21.42	0.02		0.02				
21.48	0.02		0.02				
21.54	0.02		0.02				
21.60	0.02		0.02				
21.66	0.02		0.02				
21.72	0.02		0.02				
21.78	0.02		0.02				

Summary for Reach 5R: Design Point B

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.430 ac, 56.15% Impervious, Inflow Depth > 1.61" for 1 Year event
Inflow = 5.93 cfs @ 12.12 hrs, Volume= 0.459 af
Outflow = 5.93 cfs @ 12.12 hrs, Volume= 0.459 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Reach 5R: Design Point B

Hydrograph for Reach 5R: Design Point B

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	3.12	0.00		0.00
0.06	0.00		0.00	3.18	0.00		0.00
0.12	0.00		0.00	3.24	0.00		0.00
0.18	0.00		0.00	3.30	0.00		0.00
0.24	0.00		0.00	3.36	0.00		0.00
0.30	0.00		0.00	3.42	0.00		0.00
0.36	0.00		0.00	3.48	0.00		0.00
0.42	0.00		0.00	3.54	0.00		0.00
0.48	0.00		0.00	3.60	0.00		0.00
0.54	0.00		0.00	3.66	0.00		0.00
0.60	0.00		0.00	3.72	0.00		0.00
0.66	0.00		0.00	3.78	0.00		0.00
0.72	0.00		0.00	3.84	0.00		0.00
0.78	0.00		0.00	3.90	0.00		0.00
0.84	0.00		0.00	3.96	0.00		0.00
0.90	0.00		0.00	4.02	0.00		0.00
0.96	0.00		0.00	4.08	0.00		0.00
1.02	0.00		0.00	4.14	0.00		0.00
1.08	0.00		0.00	4.20	0.00		0.00
1.14	0.00		0.00	4.26	0.00		0.00
1.20	0.00		0.00	4.32	0.00		0.00
1.26	0.00		0.00	4.38	0.00		0.00
1.32	0.00		0.00	4.44	0.00		0.00
1.38	0.00		0.00	4.50	0.00		0.00
1.44	0.00		0.00	4.56	0.00		0.00
1.50	0.00		0.00	4.62	0.00		0.00
1.56	0.00		0.00	4.68	0.00		0.00
1.62	0.00		0.00	4.74	0.00		0.00
1.68	0.00		0.00	4.80	0.00		0.00
1.74	0.00		0.00	4.86	0.00		0.00
1.80	0.00		0.00	4.92	0.00		0.00
1.86	0.00		0.00	4.98	0.00		0.00
1.92	0.00		0.00	5.04	0.00		0.00
1.98	0.00		0.00	5.10	0.00		0.00
2.04	0.00		0.00	5.16	0.00		0.00
2.10	0.00		0.00	5.22	0.00		0.00
2.16	0.00		0.00	5.28	0.00		0.00
2.22	0.00		0.00	5.34	0.00		0.00
2.28	0.00		0.00	5.40	0.00		0.00
2.34	0.00		0.00	5.46	0.00		0.00
2.40	0.00		0.00	5.52	0.00		0.00
2.46	0.00		0.00	5.58	0.00		0.00
2.52	0.00		0.00	5.64	0.00		0.00
2.58	0.00		0.00	5.70	0.00		0.00
2.64	0.00		0.00	5.76	0.00		0.00
2.70	0.00		0.00	5.82	0.00		0.00
2.76	0.00		0.00	5.88	0.00		0.00
2.82	0.00		0.00	5.94	0.00		0.00
2.88	0.00		0.00	6.00	0.00		0.00
2.94	0.00		0.00	6.06	0.00		0.00
3.00	0.00		0.00	6.12	0.00		0.00
3.06	0.00		0.00	6.18	0.00		0.00

Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
6.24	0.00		0.00	9.36	0.07		0.07
6.30	0.00		0.00	9.42	0.07		0.07
6.36	0.00		0.00	9.48	0.07		0.07
6.42	0.00		0.00	9.54	0.08		0.08
6.48	0.00		0.00	9.60	0.08		0.08
6.54	0.00		0.00	9.66	0.09		0.09
6.60	0.00		0.00	9.72	0.09		0.09
6.66	0.00		0.00	9.78	0.10		0.10
6.72	0.00		0.00	9.84	0.10		0.10
6.78	0.00		0.00	9.90	0.11		0.11
6.84	0.00		0.00	9.96	0.11		0.11
6.90	0.00		0.00	10.02	0.12		0.12
6.96	0.00		0.00	10.08	0.12		0.12
7.02	0.00		0.00	10.14	0.13		0.13
7.08	0.00		0.00	10.20	0.13		0.13
7.14	0.00		0.00	10.26	0.14		0.14
7.20	0.00		0.00	10.32	0.15		0.15
7.26	0.00		0.00	10.38	0.16		0.16
7.32	0.00		0.00	10.44	0.17		0.17
7.38	0.00		0.00	10.50	0.17		0.17
7.44	0.00		0.00	10.56	0.18		0.18
7.50	0.00		0.00	10.62	0.19		0.19
7.56	0.00		0.00	10.68	0.20		0.20
7.62	0.00		0.00	10.74	0.21		0.21
7.68	0.00		0.00	10.80	0.22		0.22
7.74	0.00		0.00	10.86	0.23		0.23
7.80	0.00		0.00	10.92	0.24		0.24
7.86	0.00		0.00	10.98	0.25		0.25
7.92	0.00		0.00	11.04	0.26		0.26
7.98	0.01		0.01	11.10	0.28		0.28
8.04	0.01		0.01	11.16	0.30		0.30
8.10	0.01		0.01	11.22	0.32		0.32
8.16	0.01		0.01	11.28	0.35		0.35
8.22	0.01		0.01	11.34	0.38		0.38
8.28	0.01		0.01	11.40	0.42		0.42
8.34	0.02		0.02	11.46	0.45		0.45
8.40	0.02		0.02	11.52	0.48		0.48
8.46	0.02		0.02	11.58	0.54		0.54
8.52	0.02		0.02	11.64	0.69		0.69
8.58	0.02		0.02	11.70	0.92		0.92
8.64	0.03		0.03	11.76	1.20		1.20
8.70	0.03		0.03	11.82	1.52		1.52
8.76	0.03		0.03	11.88	1.87		1.87
8.82	0.04		0.04	11.94	2.27		2.27
8.88	0.04		0.04	12.00	3.15		3.15
8.94	0.04		0.04	12.06	4.97		4.97
9.00	0.04		0.04	12.12	5.93		5.93
9.06	0.05		0.05	12.18	4.94		4.94
9.12	0.05		0.05	12.24	3.79		3.79
9.18	0.05		0.05	12.30	3.12		3.12
9.24	0.06		0.06	12.36	2.66		2.66
9.30	0.06		0.06	12.42	2.26		2.26

Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
12.48	1.86		1.86	15.60	0.26		0.26
12.54	1.47		1.47	15.66	0.26		0.26
12.60	1.15		1.15	15.72	0.25		0.25
12.66	0.96		0.96	15.78	0.25		0.25
12.72	0.88		0.88	15.84	0.24		0.24
12.78	0.82		0.82	15.90	0.24		0.24
12.84	0.77		0.77	15.96	0.23		0.23
12.90	0.73		0.73	16.02	0.22		0.22
12.96	0.69		0.69	16.08	0.22		0.22
13.02	0.65		0.65	16.14	0.22		0.22
13.08	0.61		0.61	16.20	0.21		0.21
13.14	0.58		0.58	16.26	0.21		0.21
13.20	0.56		0.56	16.32	0.21		0.21
13.26	0.55		0.55	16.38	0.20		0.20
13.32	0.54		0.54	16.44	0.20		0.20
13.38	0.53		0.53	16.50	0.20		0.20
13.44	0.52		0.52	16.56	0.20		0.20
13.50	0.51		0.51	16.62	0.20		0.20
13.56	0.50		0.50	16.68	0.19		0.19
13.62	0.49		0.49	16.74	0.19		0.19
13.68	0.48		0.48	16.80	0.19		0.19
13.74	0.47		0.47	16.86	0.19		0.19
13.80	0.46		0.46	16.92	0.18		0.18
13.86	0.44		0.44	16.98	0.18		0.18
13.92	0.43		0.43	17.04	0.18		0.18
13.98	0.42		0.42	17.10	0.18		0.18
14.04	0.41		0.41	17.16	0.17		0.17
14.10	0.40		0.40	17.22	0.17		0.17
14.16	0.39		0.39	17.28	0.17		0.17
14.22	0.39		0.39	17.34	0.17		0.17
14.28	0.38		0.38	17.40	0.16		0.16
14.34	0.38		0.38	17.46	0.16		0.16
14.40	0.37		0.37	17.52	0.16		0.16
14.46	0.37		0.37	17.58	0.16		0.16
14.52	0.36		0.36	17.64	0.15		0.15
14.58	0.36		0.36	17.70	0.15		0.15
14.64	0.35		0.35	17.76	0.15		0.15
14.70	0.34		0.34	17.82	0.15		0.15
14.76	0.34		0.34	17.88	0.14		0.14
14.82	0.33		0.33	17.94	0.14		0.14
14.88	0.33		0.33	18.00	0.14		0.14
14.94	0.32		0.32	18.06	0.14		0.14
15.00	0.32		0.32	18.12	0.13		0.13
15.06	0.31		0.31	18.18	0.13		0.13
15.12	0.31		0.31	18.24	0.13		0.13
15.18	0.30		0.30	18.30	0.13		0.13
15.24	0.30		0.30	18.36	0.13		0.13
15.30	0.29		0.29	18.42	0.13		0.13
15.36	0.29		0.29	18.48	0.13		0.13
15.42	0.28		0.28	18.54	0.13		0.13
15.48	0.27		0.27	18.60	0.13		0.13
15.54	0.27		0.27	18.66	0.13		0.13

Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
18.72	0.13		0.13	21.84	0.09		0.09
18.78	0.13		0.13	21.90	0.09		0.09
18.84	0.13		0.13	21.96	0.09		0.09
18.90	0.12		0.12	22.02	0.09		0.09
18.96	0.12		0.12	22.08	0.09		0.09
19.02	0.12		0.12	22.14	0.09		0.09
19.08	0.12		0.12	22.20	0.09		0.09
19.14	0.12		0.12	22.26	0.09		0.09
19.20	0.12		0.12	22.32	0.09		0.09
19.26	0.12		0.12	22.38	0.09		0.09
19.32	0.12		0.12	22.44	0.09		0.09
19.38	0.12		0.12	22.50	0.09		0.09
19.44	0.12		0.12	22.56	0.09		0.09
19.50	0.12		0.12	22.62	0.09		0.09
19.56	0.12		0.12	22.68	0.09		0.09
19.62	0.12		0.12	22.74	0.09		0.09
19.68	0.11		0.11	22.80	0.08		0.08
19.74	0.11		0.11	22.86	0.08		0.08
19.80	0.11		0.11	22.92	0.08		0.08
19.86	0.11		0.11	22.98	0.08		0.08
19.92	0.11		0.11	23.04	0.08		0.08
19.98	0.11		0.11	23.10	0.08		0.08
20.04	0.11		0.11	23.16	0.08		0.08
20.10	0.11		0.11	23.22	0.08		0.08
20.16	0.11		0.11	23.28	0.08		0.08
20.22	0.11		0.11	23.34	0.08		0.08
20.28	0.11		0.11	23.40	0.08		0.08
20.34	0.11		0.11	23.46	0.08		0.08
20.40	0.11		0.11	23.52	0.08		0.08
20.46	0.11		0.11	23.58	0.08		0.08
20.52	0.11		0.11	23.64	0.08		0.08
20.58	0.11		0.11	23.70	0.08		0.08
20.64	0.10		0.10	23.76	0.08		0.08
20.70	0.10		0.10	23.82	0.08		0.08
20.76	0.10		0.10	23.88	0.07		0.07
20.82	0.10		0.10	23.94	0.07		0.07
20.88	0.10		0.10	24.00	0.07		0.07
20.94	0.10		0.10				
21.00	0.10		0.10				
21.06	0.10		0.10				
21.12	0.10		0.10				
21.18	0.10		0.10				
21.24	0.10		0.10				
21.30	0.10		0.10				
21.36	0.10		0.10				
21.42	0.10		0.10				
21.48	0.10		0.10				
21.54	0.10		0.10				
21.60	0.10		0.10				
21.66	0.10		0.10				
21.72	0.09		0.09				
21.78	0.09		0.09				

Summary for Pond 6P: Detention

Inflow Area = 1.094 ac, 69.84% Impervious, Inflow Depth > 1.93" for 1 Year event
 Inflow = 2.36 cfs @ 12.09 hrs, Volume= 0.176 af
 Outflow = 1.40 cfs @ 12.22 hrs, Volume= 0.172 af, Atten= 41%, Lag= 7.7 min
 Primary = 1.40 cfs @ 12.22 hrs, Volume= 0.172 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
 Peak Elev= 214.16' @ 12.22 hrs Surf.Area= 1,404 sf Storage= 1,996 cf

Plug-Flow detention time= 58.6 min calculated for 0.172 af (98% of inflow)
 Center-of-Mass det. time= 46.3 min (852.7 - 806.4)

Volume	Invert	Avail.Storage	Storage Description
#1	212.66'	4,725 cf	ACF R-Tank LD 2.5 x 456 Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf 456 Chambers in 19 Rows

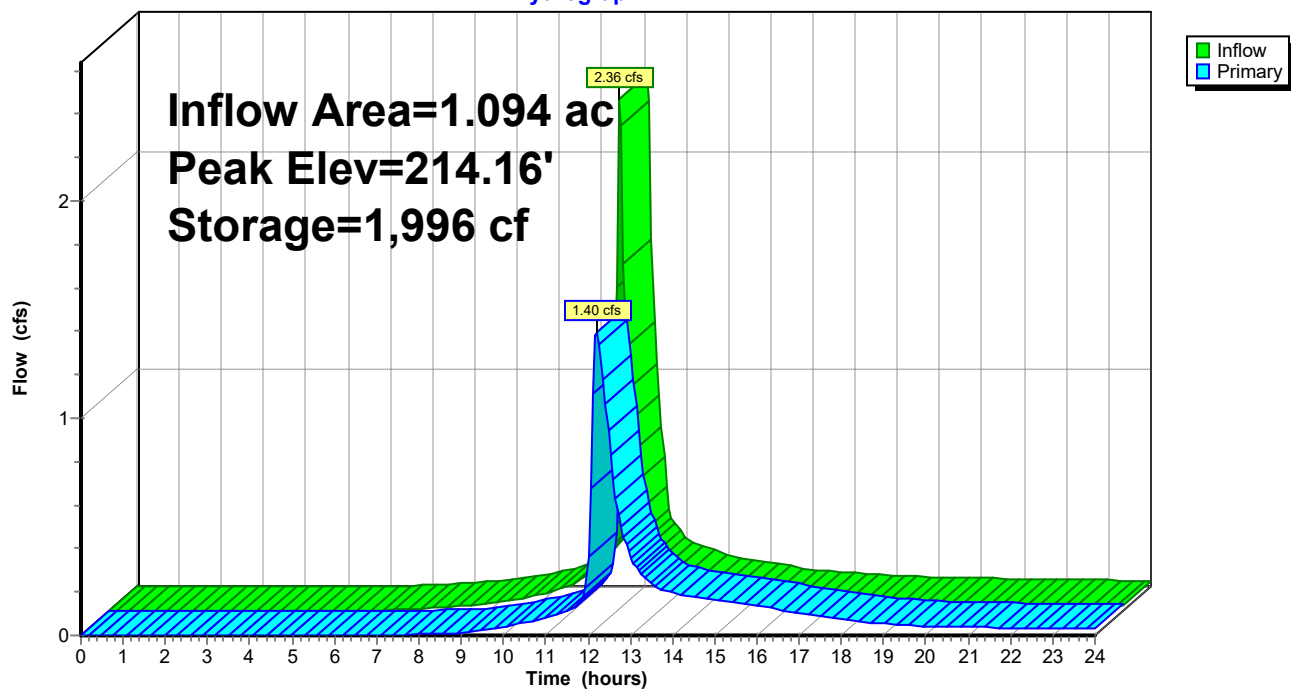
Device	Routing	Invert	Outlet Devices
#1	Primary	212.66'	3.0" Vert. Orifice/Grate C= 0.600
#2	Primary	213.38'	0.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	215.38'	1.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=1.39 cfs @ 12.22 hrs HW=214.15' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.28 cfs @ 5.63 fps)
- 2=Broad-Crested Rectangular Weir (Weir Controls 1.11 cfs @ 2.87 fps)
- 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 6P: Detention

Hydrograph



Hydrograph for Pond 6P: Detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	212.66	0.00
0.06	0.00	0	212.66	0.00
0.12	0.00	0	212.66	0.00
0.18	0.00	0	212.66	0.00
0.24	0.00	0	212.66	0.00
0.30	0.00	0	212.66	0.00
0.36	0.00	0	212.66	0.00
0.42	0.00	0	212.66	0.00
0.48	0.00	0	212.66	0.00
0.54	0.00	0	212.66	0.00
0.60	0.00	0	212.66	0.00
0.66	0.00	0	212.66	0.00
0.72	0.00	0	212.66	0.00
0.78	0.00	0	212.66	0.00
0.84	0.00	0	212.66	0.00
0.90	0.00	0	212.66	0.00
0.96	0.00	0	212.66	0.00
1.02	0.00	0	212.66	0.00
1.08	0.00	0	212.66	0.00
1.14	0.00	0	212.66	0.00
1.20	0.00	0	212.66	0.00
1.26	0.00	0	212.66	0.00
1.32	0.00	0	212.66	0.00
1.38	0.00	0	212.66	0.00
1.44	0.00	0	212.66	0.00
1.50	0.00	0	212.66	0.00
1.56	0.00	0	212.66	0.00
1.62	0.00	0	212.66	0.00
1.68	0.00	0	212.66	0.00
1.74	0.00	0	212.66	0.00
1.80	0.00	0	212.66	0.00
1.86	0.00	0	212.66	0.00
1.92	0.00	0	212.66	0.00
1.98	0.00	0	212.66	0.00
2.04	0.00	0	212.66	0.00
2.10	0.00	0	212.66	0.00
2.16	0.00	0	212.66	0.00
2.22	0.00	0	212.66	0.00
2.28	0.00	0	212.66	0.00
2.34	0.00	0	212.66	0.00
2.40	0.00	0	212.66	0.00
2.46	0.00	0	212.66	0.00
2.52	0.00	0	212.66	0.00
2.58	0.00	0	212.66	0.00
2.64	0.00	0	212.66	0.00
2.70	0.00	0	212.66	0.00
2.76	0.00	0	212.66	0.00
2.82	0.00	0	212.66	0.00
2.88	0.00	0	212.66	0.00
2.94	0.00	0	212.66	0.00
3.00	0.00	0	212.66	0.00
3.06	0.00	0	212.66	0.00

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
3.12	0.00	0	212.66	0.00
3.18	0.00	0	212.66	0.00
3.24	0.00	0	212.66	0.00
3.30	0.00	0	212.66	0.00
3.36	0.00	0	212.66	0.00
3.42	0.00	0	212.66	0.00
3.48	0.00	0	212.66	0.00
3.54	0.00	0	212.66	0.00
3.60	0.00	0	212.66	0.00
3.66	0.00	0	212.66	0.00
3.72	0.00	0	212.66	0.00
3.78	0.00	0	212.66	0.00
3.84	0.00	0	212.66	0.00
3.90	0.00	0	212.66	0.00
3.96	0.00	0	212.66	0.00
4.02	0.00	0	212.66	0.00
4.08	0.00	0	212.66	0.00
4.14	0.00	0	212.66	0.00
4.20	0.00	0	212.66	0.00
4.26	0.00	0	212.66	0.00
4.32	0.00	0	212.66	0.00
4.38	0.00	0	212.66	0.00
4.44	0.00	0	212.66	0.00
4.50	0.00	0	212.66	0.00
4.56	0.00	0	212.66	0.00
4.62	0.00	0	212.66	0.00
4.68	0.00	0	212.66	0.00
4.74	0.00	0	212.66	0.00
4.80	0.00	0	212.66	0.00
4.86	0.00	0	212.66	0.00
4.92	0.00	0	212.66	0.00
4.98	0.00	0	212.66	0.00
5.04	0.00	0	212.66	0.00
5.10	0.00	0	212.66	0.00
5.16	0.00	0	212.66	0.00
5.22	0.00	0	212.66	0.00
5.28	0.00	0	212.66	0.00
5.34	0.00	0	212.66	0.00
5.40	0.00	0	212.66	0.00
5.46	0.00	0	212.66	0.00
5.52	0.00	0	212.66	0.00
5.58	0.00	0	212.66	0.00
5.64	0.00	0	212.66	0.00
5.70	0.00	0	212.66	0.00
5.76	0.00	0	212.66	0.00
5.82	0.00	0	212.66	0.00
5.88	0.00	0	212.66	0.00
5.94	0.00	0	212.66	0.00
6.00	0.00	0	212.66	0.00
6.06	0.00	0	212.66	0.00
6.12	0.00	0	212.66	0.00
6.18	0.00	1	212.66	0.00

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
6.24	0.00	1	212.66	0.00
6.30	0.00	1	212.66	0.00
6.36	0.00	2	212.66	0.00
6.42	0.00	2	212.66	0.00
6.48	0.00	3	212.66	0.00
6.54	0.00	3	212.66	0.00
6.60	0.00	4	212.66	0.00
6.66	0.00	5	212.66	0.00
6.72	0.00	5	212.66	0.00
6.78	0.00	6	212.66	0.00
6.84	0.01	7	212.67	0.00
6.90	0.01	8	212.67	0.00
6.96	0.01	9	212.67	0.00
7.02	0.01	10	212.67	0.00
7.08	0.01	12	212.67	0.00
7.14	0.01	13	212.67	0.00
7.20	0.01	14	212.67	0.00
7.26	0.01	16	212.67	0.00
7.32	0.01	17	212.67	0.00
7.38	0.01	19	212.67	0.00
7.44	0.01	21	212.68	0.00
7.50	0.01	23	212.68	0.00
7.56	0.01	25	212.68	0.00
7.62	0.01	27	212.68	0.00
7.68	0.01	29	212.68	0.00
7.74	0.01	31	212.68	0.00
7.80	0.01	33	212.68	0.00
7.86	0.01	35	212.69	0.00
7.92	0.02	38	212.69	0.00
7.98	0.02	40	212.69	0.00
8.04	0.02	43	212.69	0.00
8.10	0.02	46	212.69	0.01
8.16	0.02	48	212.70	0.01
8.22	0.02	51	212.70	0.01
8.28	0.02	54	212.70	0.01
8.34	0.02	58	212.70	0.01
8.40	0.02	61	212.71	0.01
8.46	0.02	65	212.71	0.01
8.52	0.03	69	212.71	0.01
8.58	0.03	73	212.71	0.01
8.64	0.03	77	212.72	0.01
8.70	0.03	81	212.72	0.01
8.76	0.03	85	212.72	0.01
8.82	0.03	90	212.73	0.01
8.88	0.03	95	212.73	0.01
8.94	0.03	100	212.73	0.01
9.00	0.04	105	212.74	0.01
9.06	0.04	110	212.74	0.01
9.12	0.04	115	212.75	0.02
9.18	0.04	120	212.75	0.02
9.24	0.04	125	212.75	0.02
9.30	0.04	130	212.76	0.02

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
9.36	0.05	135	212.76	0.02
9.42	0.05	141	212.77	0.02
9.48	0.05	146	212.77	0.02
9.54	0.05	151	212.77	0.03
9.60	0.05	157	212.78	0.03
9.66	0.05	162	212.78	0.03
9.72	0.06	168	212.79	0.03
9.78	0.06	173	212.79	0.03
9.84	0.06	179	212.79	0.03
9.90	0.06	185	212.80	0.04
9.96	0.06	191	212.80	0.04
10.02	0.07	196	212.81	0.04
10.08	0.07	202	212.81	0.04
10.14	0.07	208	212.82	0.04
10.20	0.07	214	212.82	0.05
10.26	0.08	221	212.83	0.05
10.32	0.08	227	212.83	0.05
10.38	0.08	234	212.84	0.05
10.44	0.09	241	212.84	0.06
10.50	0.09	248	212.85	0.06
10.56	0.10	256	212.85	0.06
10.62	0.10	263	212.86	0.06
10.68	0.10	271	212.86	0.07
10.74	0.11	279	212.87	0.07
10.80	0.11	288	212.88	0.07
10.86	0.11	297	212.88	0.07
10.92	0.12	306	212.89	0.08
10.98	0.12	315	212.90	0.08
11.04	0.13	325	212.90	0.08
11.10	0.13	335	212.91	0.08
11.16	0.14	347	212.92	0.09
11.22	0.16	360	212.93	0.09
11.28	0.17	376	212.94	0.09
11.34	0.18	393	212.95	0.10
11.40	0.19	412	212.97	0.10
11.46	0.21	433	212.98	0.11
11.52	0.22	456	213.00	0.11
11.58	0.25	483	213.02	0.11
11.64	0.34	521	213.05	0.12
11.70	0.45	578	213.09	0.13
11.76	0.57	658	213.15	0.14
11.82	0.70	762	213.23	0.16
11.88	0.83	891	213.33	0.17
11.94	1.00	1,047	213.45	0.22
12.00	1.49	1,254	213.60	0.36
12.06	2.27	1,549	213.82	0.67
12.12	2.24	1,842	214.04	1.11
12.18	1.60	1,987	214.15	1.38
12.24	1.22	1,992	214.15	1.39
12.30	1.03	1,944	214.12	1.30
12.36	0.88	1,882	214.07	1.18
12.42	0.74	1,814	214.02	1.06

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
12.48	0.60	1,741	213.97	0.95
12.54	0.46	1,663	213.91	0.83
12.60	0.36	1,583	213.85	0.72
12.66	0.32	1,511	213.79	0.63
12.72	0.30	1,450	213.75	0.56
12.78	0.28	1,398	213.71	0.50
12.84	0.27	1,355	213.68	0.45
12.90	0.25	1,317	213.65	0.42
12.96	0.24	1,283	213.62	0.39
13.02	0.22	1,252	213.60	0.36
13.08	0.21	1,224	213.58	0.33
13.14	0.20	1,198	213.56	0.31
13.20	0.20	1,175	213.54	0.30
13.26	0.19	1,154	213.53	0.28
13.32	0.19	1,136	213.51	0.27
13.38	0.19	1,119	213.50	0.26
13.44	0.18	1,104	213.49	0.25
13.50	0.18	1,090	213.48	0.24
13.56	0.17	1,076	213.47	0.23
13.62	0.17	1,064	213.46	0.23
13.68	0.17	1,052	213.45	0.22
13.74	0.16	1,041	213.44	0.21
13.80	0.16	1,030	213.43	0.21
13.86	0.15	1,019	213.42	0.20
13.92	0.15	1,008	213.42	0.20
13.98	0.15	997	213.41	0.20
14.04	0.14	987	213.40	0.19
14.10	0.14	976	213.39	0.19
14.16	0.14	965	213.38	0.18
14.22	0.13	955	213.38	0.18
14.28	0.13	945	213.37	0.18
14.34	0.13	934	213.36	0.18
14.40	0.13	924	213.35	0.18
14.46	0.13	913	213.34	0.18
14.52	0.13	902	213.34	0.18
14.58	0.12	891	213.33	0.17
14.64	0.12	880	213.32	0.17
14.70	0.12	869	213.31	0.17
14.76	0.12	858	213.30	0.17
14.82	0.12	846	213.29	0.17
14.88	0.11	835	213.29	0.17
14.94	0.11	823	213.28	0.17
15.00	0.11	811	213.27	0.16
15.06	0.11	800	213.26	0.16
15.12	0.11	788	213.25	0.16
15.18	0.10	776	213.24	0.16
15.24	0.10	764	213.23	0.16
15.30	0.10	752	213.22	0.16
15.36	0.10	739	213.21	0.15
15.42	0.10	727	213.21	0.15
15.48	0.09	715	213.20	0.15
15.54	0.09	702	213.19	0.15

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
15.60	0.09	690	213.18	0.15
15.66	0.09	678	213.17	0.15
15.72	0.09	665	213.16	0.14
15.78	0.08	653	213.15	0.14
15.84	0.08	640	213.14	0.14
15.90	0.08	628	213.13	0.14
15.96	0.08	615	213.12	0.14
16.02	0.08	603	213.11	0.13
16.08	0.08	590	213.10	0.13
16.14	0.07	578	213.09	0.13
16.20	0.07	565	213.08	0.13
16.26	0.07	553	213.07	0.13
16.32	0.07	542	213.07	0.13
16.38	0.07	530	213.06	0.12
16.44	0.07	519	213.05	0.12
16.50	0.07	508	213.04	0.12
16.56	0.07	497	213.03	0.12
16.62	0.07	486	213.02	0.12
16.68	0.07	476	213.02	0.11
16.74	0.07	466	213.01	0.11
16.80	0.06	456	213.00	0.11
16.86	0.06	446	212.99	0.11
16.92	0.06	437	212.99	0.11
16.98	0.06	428	212.98	0.10
17.04	0.06	419	212.97	0.10
17.10	0.06	410	212.97	0.10
17.16	0.06	401	212.96	0.10
17.22	0.06	393	212.95	0.10
17.28	0.06	385	212.95	0.10
17.34	0.06	377	212.94	0.09
17.40	0.06	369	212.94	0.09
17.46	0.06	361	212.93	0.09
17.52	0.05	354	212.93	0.09
17.58	0.05	347	212.92	0.09
17.64	0.05	340	212.91	0.08
17.70	0.05	333	212.91	0.08
17.76	0.05	326	212.90	0.08
17.82	0.05	320	212.90	0.08
17.88	0.05	314	212.90	0.08
17.94	0.05	308	212.89	0.08
18.00	0.05	302	212.89	0.07
18.06	0.05	296	212.88	0.07
18.12	0.05	290	212.88	0.07
18.18	0.05	285	212.87	0.07
18.24	0.05	280	212.87	0.07
18.30	0.05	275	212.87	0.07
18.36	0.05	271	212.86	0.07
18.42	0.04	266	212.86	0.06
18.48	0.04	262	212.86	0.06
18.54	0.04	259	212.85	0.06
18.60	0.04	255	212.85	0.06
18.66	0.04	252	212.85	0.06

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
18.72	0.04	249	212.85	0.06
18.78	0.04	246	212.84	0.06
18.84	0.04	243	212.84	0.06
18.90	0.04	240	212.84	0.05
18.96	0.04	238	212.84	0.05
19.02	0.04	235	212.84	0.05
19.08	0.04	233	212.83	0.05
19.14	0.04	231	212.83	0.05
19.20	0.04	229	212.83	0.05
19.26	0.04	227	212.83	0.05
19.32	0.04	225	212.83	0.05
19.38	0.04	223	212.83	0.05
19.44	0.04	221	212.83	0.05
19.50	0.04	220	212.82	0.05
19.56	0.04	218	212.82	0.05
19.62	0.04	217	212.82	0.05
19.68	0.04	215	212.82	0.05
19.74	0.04	214	212.82	0.05
19.80	0.04	213	212.82	0.05
19.86	0.04	211	212.82	0.04
19.92	0.04	210	212.82	0.04
19.98	0.04	209	212.82	0.04
20.04	0.04	208	212.82	0.04
20.10	0.04	206	212.81	0.04
20.16	0.04	205	212.81	0.04
20.22	0.04	204	212.81	0.04
20.28	0.04	203	212.81	0.04
20.34	0.04	202	212.81	0.04
20.40	0.04	201	212.81	0.04
20.46	0.04	200	212.81	0.04
20.52	0.04	199	212.81	0.04
20.58	0.04	198	212.81	0.04
20.64	0.04	198	212.81	0.04
20.70	0.04	197	212.81	0.04
20.76	0.04	196	212.81	0.04
20.82	0.04	195	212.81	0.04
20.88	0.04	194	212.81	0.04
20.94	0.03	194	212.81	0.04
21.00	0.03	193	212.80	0.04
21.06	0.03	192	212.80	0.04
21.12	0.03	191	212.80	0.04
21.18	0.03	191	212.80	0.04
21.24	0.03	190	212.80	0.04
21.30	0.03	189	212.80	0.04
21.36	0.03	189	212.80	0.04
21.42	0.03	188	212.80	0.04
21.48	0.03	187	212.80	0.04
21.54	0.03	187	212.80	0.04
21.60	0.03	186	212.80	0.04
21.66	0.03	185	212.80	0.04
21.72	0.03	185	212.80	0.04
21.78	0.03	184	212.80	0.04

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

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Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
21.84	0.03	183	212.80	0.04
21.90	0.03	183	212.80	0.04
21.96	0.03	182	212.80	0.03
22.02	0.03	181	212.80	0.03
22.08	0.03	181	212.80	0.03
22.14	0.03	180	212.79	0.03
22.20	0.03	179	212.79	0.03
22.26	0.03	178	212.79	0.03
22.32	0.03	178	212.79	0.03
22.38	0.03	177	212.79	0.03
22.44	0.03	176	212.79	0.03
22.50	0.03	176	212.79	0.03
22.56	0.03	175	212.79	0.03
22.62	0.03	174	212.79	0.03
22.68	0.03	174	212.79	0.03
22.74	0.03	173	212.79	0.03
22.80	0.03	172	212.79	0.03
22.86	0.03	172	212.79	0.03
22.92	0.03	171	212.79	0.03
22.98	0.03	170	212.79	0.03
23.04	0.03	170	212.79	0.03
23.10	0.03	169	212.79	0.03
23.16	0.03	168	212.79	0.03
23.22	0.03	167	212.79	0.03
23.28	0.03	167	212.79	0.03
23.34	0.03	166	212.78	0.03
23.40	0.03	165	212.78	0.03
23.46	0.03	165	212.78	0.03
23.52	0.03	164	212.78	0.03
23.58	0.03	163	212.78	0.03
23.64	0.03	163	212.78	0.03
23.70	0.03	162	212.78	0.03
23.76	0.03	161	212.78	0.03
23.82	0.03	161	212.78	0.03
23.88	0.03	160	212.78	0.03
23.94	0.03	159	212.78	0.03
24.00	0.02	158	212.78	0.03

Stage-Discharge for Pond 6P: Detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
212.66	0.00	213.70	0.49	214.74	2.96	215.78	7.32
212.68	0.00	213.72	0.51	214.76	3.02	215.80	7.46
212.70	0.00	213.74	0.54	214.78	3.08	215.82	7.60
212.72	0.01	213.76	0.57	214.80	3.14	215.84	7.74
212.74	0.01	213.78	0.61	214.82	3.21	215.86	7.89
212.76	0.02	213.80	0.64	214.84	3.27	215.88	8.04
212.78	0.03	213.82	0.67	214.86	3.33	215.90	8.19
212.80	0.04	213.84	0.71	214.88	3.39	215.92	8.34
212.82	0.05	213.86	0.74	214.90	3.45	215.94	8.50
212.84	0.05	213.88	0.78	214.92	3.52	215.96	8.65
212.86	0.06	213.90	0.82	214.94	3.58	215.98	8.81
212.88	0.07	213.92	0.85	214.96	3.65	216.00	8.98
212.90	0.08	213.94	0.89	214.98	3.71	216.02	9.15
212.92	0.09	213.96	0.93	215.00	3.77	216.04	9.31
212.94	0.09	213.98	0.97	215.02	3.84	216.06	9.49
212.96	0.10	214.00	1.02	215.04	3.91	216.08	9.66
212.98	0.10	214.02	1.06	215.06	3.97	216.10	9.84
213.00	0.11	214.04	1.11	215.08	4.04	216.12	10.02
213.02	0.11	214.06	1.16	215.10	4.10	216.14	10.20
213.04	0.12	214.08	1.20	215.12	4.17	216.16	10.39
213.06	0.12	214.10	1.25	215.14	4.24	216.18	10.57
213.08	0.13	214.12	1.30	215.16	4.31	216.20	10.75
213.10	0.13	214.14	1.35	215.18	4.37		
213.12	0.14	214.16	1.41	215.20	4.44		
213.14	0.14	214.18	1.46	215.22	4.51		
213.16	0.14	214.20	1.51	215.24	4.58		
213.18	0.15	214.22	1.55	215.26	4.65		
213.20	0.15	214.24	1.60	215.28	4.72		
213.22	0.16	214.26	1.65	215.30	4.79		
213.24	0.16	214.28	1.70	215.32	4.86		
213.26	0.16	214.30	1.75	215.34	4.93		
213.28	0.17	214.32	1.80	215.36	5.00		
213.30	0.17	214.34	1.85	215.38	5.08		
213.32	0.17	214.36	1.91	215.40	5.16		
213.34	0.18	214.38	1.96	215.42	5.24		
213.36	0.18	214.40	2.01	215.44	5.33		
213.38	0.18	214.42	2.06	215.46	5.43		
213.40	0.19	214.44	2.12	215.48	5.53		
213.42	0.20	214.46	2.17	215.50	5.63		
213.44	0.21	214.48	2.22	215.52	5.73		
213.46	0.23	214.50	2.28	215.54	5.84		
213.48	0.24	214.52	2.33	215.56	5.95		
213.50	0.26	214.54	2.39	215.58	6.06		
213.52	0.28	214.56	2.44	215.60	6.18		
213.54	0.29	214.58	2.50	215.62	6.30		
213.56	0.31	214.60	2.56	215.64	6.42		
213.58	0.34	214.62	2.61	215.66	6.54		
213.60	0.36	214.64	2.67	215.68	6.66		
213.62	0.38	214.66	2.73	215.70	6.79		
213.64	0.41	214.68	2.79	215.72	6.92		
213.66	0.43	214.70	2.84	215.74	7.05		
213.68	0.46	214.72	2.90	215.76	7.18		

Stage-Area-Storage for Pond 6P: Detention

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
212.66	0	215.26	3,467
212.71	67	215.31	3,534
212.76	133	215.36	3,601
212.81	200	215.41	3,667
212.86	267	215.46	3,734
212.91	333	215.51	3,801
212.96	400	215.56	3,867
213.01	467	215.61	3,934
213.06	533	215.66	4,001
213.11	600	215.71	4,067
213.16	667	215.76	4,134
213.21	733	215.81	4,201
213.26	800	215.86	4,268
213.31	867	215.91	4,334
213.36	934	215.96	4,401
213.41	1,000	216.01	4,468
213.46	1,067	216.06	4,534
213.51	1,134	216.11	4,601
213.56	1,200	216.16	4,668
213.61	1,267		
213.66	1,334		
213.71	1,400		
213.76	1,467		
213.81	1,534		
213.86	1,600		
213.91	1,667		
213.96	1,734		
214.01	1,800		
214.06	1,867		
214.11	1,934		
214.16	2,000		
214.21	2,067		
214.26	2,134		
214.31	2,200		
214.36	2,267		
214.41	2,334		
214.46	2,400		
214.51	2,467		
214.56	2,534		
214.61	2,601		
214.66	2,667		
214.71	2,734		
214.76	2,801		
214.81	2,867		
214.86	2,934		
214.91	3,001		
214.96	3,067		
215.01	3,134		
215.06	3,201		
215.11	3,267		
215.16	3,334		
215.21	3,401		

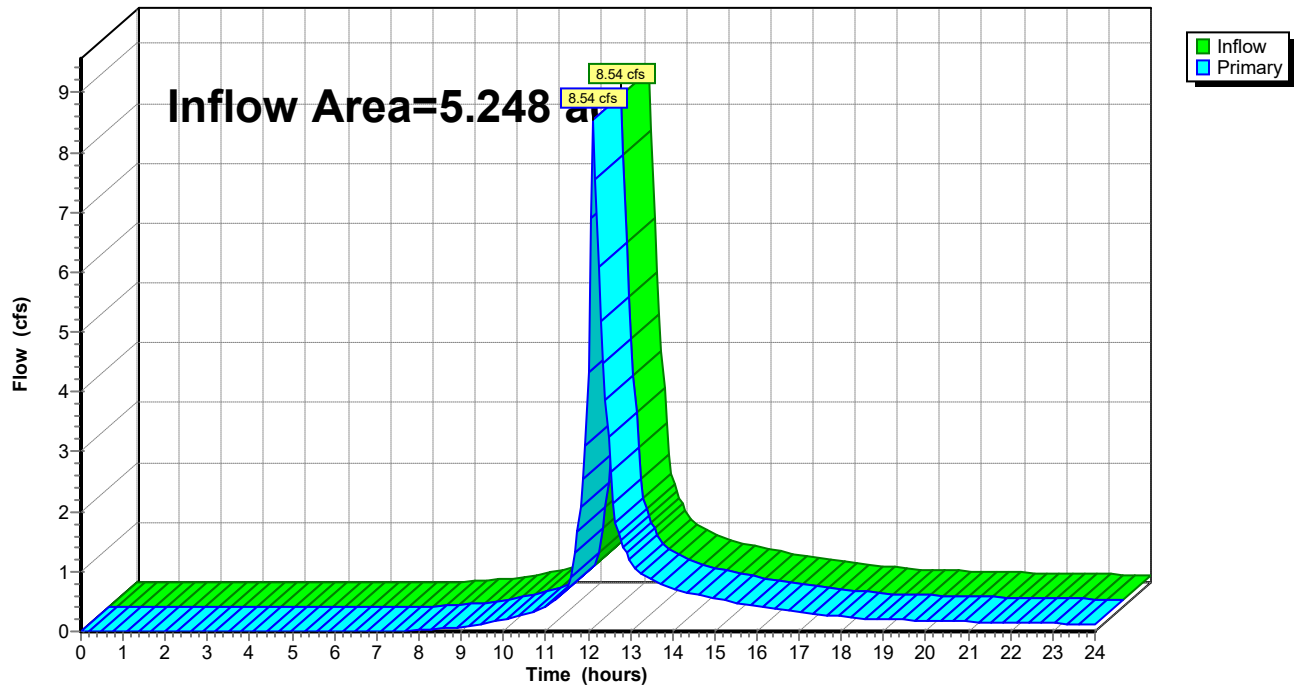
Summary for Link 10L: DP-1

Inflow Area = 5.248 ac, 61.30% Impervious, Inflow Depth > 1.71" for 1 Year event
Inflow = 8.54 cfs @ 12.13 hrs, Volume= 0.748 af
Primary = 8.54 cfs @ 12.13 hrs, Volume= 0.748 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Link 10L: DP-1

Hydrograph



Hydrograph for Link 10L: DP-1

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	3.12	0.00	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.00	0.00	0.00
0.12	0.00	0.00	0.00	3.24	0.00	0.00	0.00
0.18	0.00	0.00	0.00	3.30	0.00	0.00	0.00
0.24	0.00	0.00	0.00	3.36	0.00	0.00	0.00
0.30	0.00	0.00	0.00	3.42	0.00	0.00	0.00
0.36	0.00	0.00	0.00	3.48	0.00	0.00	0.00
0.42	0.00	0.00	0.00	3.54	0.00	0.00	0.00
0.48	0.00	0.00	0.00	3.60	0.00	0.00	0.00
0.54	0.00	0.00	0.00	3.66	0.00	0.00	0.00
0.60	0.00	0.00	0.00	3.72	0.00	0.00	0.00
0.66	0.00	0.00	0.00	3.78	0.00	0.00	0.00
0.72	0.00	0.00	0.00	3.84	0.00	0.00	0.00
0.78	0.00	0.00	0.00	3.90	0.00	0.00	0.00
0.84	0.00	0.00	0.00	3.96	0.00	0.00	0.00
0.90	0.00	0.00	0.00	4.02	0.00	0.00	0.00
0.96	0.00	0.00	0.00	4.08	0.00	0.00	0.00
1.02	0.00	0.00	0.00	4.14	0.00	0.00	0.00
1.08	0.00	0.00	0.00	4.20	0.00	0.00	0.00
1.14	0.00	0.00	0.00	4.26	0.00	0.00	0.00
1.20	0.00	0.00	0.00	4.32	0.00	0.00	0.00
1.26	0.00	0.00	0.00	4.38	0.00	0.00	0.00
1.32	0.00	0.00	0.00	4.44	0.00	0.00	0.00
1.38	0.00	0.00	0.00	4.50	0.00	0.00	0.00
1.44	0.00	0.00	0.00	4.56	0.00	0.00	0.00
1.50	0.00	0.00	0.00	4.62	0.00	0.00	0.00
1.56	0.00	0.00	0.00	4.68	0.00	0.00	0.00
1.62	0.00	0.00	0.00	4.74	0.00	0.00	0.00
1.68	0.00	0.00	0.00	4.80	0.00	0.00	0.00
1.74	0.00	0.00	0.00	4.86	0.00	0.00	0.00
1.80	0.00	0.00	0.00	4.92	0.00	0.00	0.00
1.86	0.00	0.00	0.00	4.98	0.00	0.00	0.00
1.92	0.00	0.00	0.00	5.04	0.00	0.00	0.00
1.98	0.00	0.00	0.00	5.10	0.00	0.00	0.00
2.04	0.00	0.00	0.00	5.16	0.00	0.00	0.00
2.10	0.00	0.00	0.00	5.22	0.00	0.00	0.00
2.16	0.00	0.00	0.00	5.28	0.00	0.00	0.00
2.22	0.00	0.00	0.00	5.34	0.00	0.00	0.00
2.28	0.00	0.00	0.00	5.40	0.00	0.00	0.00
2.34	0.00	0.00	0.00	5.46	0.00	0.00	0.00
2.40	0.00	0.00	0.00	5.52	0.00	0.00	0.00
2.46	0.00	0.00	0.00	5.58	0.00	0.00	0.00
2.52	0.00	0.00	0.00	5.64	0.00	0.00	0.00
2.58	0.00	0.00	0.00	5.70	0.00	0.00	0.00
2.64	0.00	0.00	0.00	5.76	0.00	0.00	0.00
2.70	0.00	0.00	0.00	5.82	0.00	0.00	0.00
2.76	0.00	0.00	0.00	5.88	0.00	0.00	0.00
2.82	0.00	0.00	0.00	5.94	0.00	0.00	0.00
2.88	0.00	0.00	0.00	6.00	0.00	0.00	0.00
2.94	0.00	0.00	0.00	6.06	0.00	0.00	0.00
3.00	0.00	0.00	0.00	6.12	0.00	0.00	0.00
3.06	0.00	0.00	0.00	6.18	0.00	0.00	0.00

Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
6.24	0.00	0.00	0.00	9.36	0.12	0.00	0.12
6.30	0.00	0.00	0.00	9.42	0.12	0.00	0.12
6.36	0.00	0.00	0.00	9.48	0.13	0.00	0.13
6.42	0.00	0.00	0.00	9.54	0.14	0.00	0.14
6.48	0.00	0.00	0.00	9.60	0.14	0.00	0.14
6.54	0.00	0.00	0.00	9.66	0.15	0.00	0.15
6.60	0.00	0.00	0.00	9.72	0.16	0.00	0.16
6.66	0.00	0.00	0.00	9.78	0.17	0.00	0.17
6.72	0.00	0.00	0.00	9.84	0.17	0.00	0.17
6.78	0.00	0.00	0.00	9.90	0.18	0.00	0.18
6.84	0.00	0.00	0.00	9.96	0.19	0.00	0.19
6.90	0.00	0.00	0.00	10.02	0.20	0.00	0.20
6.96	0.01	0.00	0.01	10.08	0.21	0.00	0.21
7.02	0.01	0.00	0.01	10.14	0.22	0.00	0.22
7.08	0.01	0.00	0.01	10.20	0.23	0.00	0.23
7.14	0.01	0.00	0.01	10.26	0.24	0.00	0.24
7.20	0.01	0.00	0.01	10.32	0.25	0.00	0.25
7.26	0.01	0.00	0.01	10.38	0.26	0.00	0.26
7.32	0.01	0.00	0.01	10.44	0.28	0.00	0.28
7.38	0.01	0.00	0.01	10.50	0.29	0.00	0.29
7.44	0.01	0.00	0.01	10.56	0.30	0.00	0.30
7.50	0.01	0.00	0.01	10.62	0.32	0.00	0.32
7.56	0.01	0.00	0.01	10.68	0.33	0.00	0.33
7.62	0.01	0.00	0.01	10.74	0.35	0.00	0.35
7.68	0.01	0.00	0.01	10.80	0.36	0.00	0.36
7.74	0.01	0.00	0.01	10.86	0.38	0.00	0.38
7.80	0.01	0.00	0.01	10.92	0.39	0.00	0.39
7.86	0.02	0.00	0.02	10.98	0.41	0.00	0.41
7.92	0.02	0.00	0.02	11.04	0.43	0.00	0.43
7.98	0.02	0.00	0.02	11.10	0.45	0.00	0.45
8.04	0.02	0.00	0.02	11.16	0.48	0.00	0.48
8.10	0.02	0.00	0.02	11.22	0.51	0.00	0.51
8.16	0.03	0.00	0.03	11.28	0.55	0.00	0.55
8.22	0.03	0.00	0.03	11.34	0.60	0.00	0.60
8.28	0.03	0.00	0.03	11.40	0.64	0.00	0.64
8.34	0.04	0.00	0.04	11.46	0.69	0.00	0.69
8.40	0.04	0.00	0.04	11.52	0.74	0.00	0.74
8.46	0.04	0.00	0.04	11.58	0.81	0.00	0.81
8.52	0.05	0.00	0.05	11.64	1.00	0.00	1.00
8.58	0.05	0.00	0.05	11.70	1.31	0.00	1.31
8.64	0.05	0.00	0.05	11.76	1.68	0.00	1.68
8.70	0.06	0.00	0.06	11.82	2.09	0.00	2.09
8.76	0.06	0.00	0.06	11.88	2.55	0.00	2.55
8.82	0.07	0.00	0.07	11.94	3.09	0.00	3.09
8.88	0.07	0.00	0.07	12.00	4.34	0.00	4.34
8.94	0.08	0.00	0.08	12.06	6.92	0.00	6.92
9.00	0.08	0.00	0.08	12.12	8.53	0.00	8.53
9.06	0.09	0.00	0.09	12.18	7.54	0.00	7.54
9.12	0.09	0.00	0.09	12.24	6.10	0.00	6.10
9.18	0.10	0.00	0.10	12.30	5.18	0.00	5.18
9.24	0.11	0.00	0.11	12.36	4.48	0.00	4.48
9.30	0.11	0.00	0.11	12.42	3.86	0.00	3.86

Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
12.48	3.25	0.00	3.25	15.60	0.47	0.00	0.47
12.54	2.65	0.00	2.65	15.66	0.46	0.00	0.46
12.60	2.14	0.00	2.14	15.72	0.45	0.00	0.45
12.66	1.82	0.00	1.82	15.78	0.45	0.00	0.45
12.72	1.64	0.00	1.64	15.84	0.44	0.00	0.44
12.78	1.51	0.00	1.51	15.90	0.43	0.00	0.43
12.84	1.41	0.00	1.41	15.96	0.42	0.00	0.42
12.90	1.32	0.00	1.32	16.02	0.41	0.00	0.41
12.96	1.24	0.00	1.24	16.08	0.40	0.00	0.40
13.02	1.16	0.00	1.16	16.14	0.40	0.00	0.40
13.08	1.08	0.00	1.08	16.20	0.39	0.00	0.39
13.14	1.03	0.00	1.03	16.26	0.38	0.00	0.38
13.20	0.99	0.00	0.99	16.32	0.38	0.00	0.38
13.26	0.96	0.00	0.96	16.38	0.37	0.00	0.37
13.32	0.94	0.00	0.94	16.44	0.37	0.00	0.37
13.38	0.91	0.00	0.91	16.50	0.36	0.00	0.36
13.44	0.89	0.00	0.89	16.56	0.36	0.00	0.36
13.50	0.87	0.00	0.87	16.62	0.36	0.00	0.36
13.56	0.85	0.00	0.85	16.68	0.35	0.00	0.35
13.62	0.83	0.00	0.83	16.74	0.35	0.00	0.35
13.68	0.81	0.00	0.81	16.80	0.34	0.00	0.34
13.74	0.79	0.00	0.79	16.86	0.34	0.00	0.34
13.80	0.77	0.00	0.77	16.92	0.33	0.00	0.33
13.86	0.75	0.00	0.75	16.98	0.33	0.00	0.33
13.92	0.73	0.00	0.73	17.04	0.32	0.00	0.32
13.98	0.72	0.00	0.72	17.10	0.32	0.00	0.32
14.04	0.70	0.00	0.70	17.16	0.31	0.00	0.31
14.10	0.68	0.00	0.68	17.22	0.31	0.00	0.31
14.16	0.67	0.00	0.67	17.28	0.30	0.00	0.30
14.22	0.66	0.00	0.66	17.34	0.30	0.00	0.30
14.28	0.65	0.00	0.65	17.40	0.29	0.00	0.29
14.34	0.64	0.00	0.64	17.46	0.29	0.00	0.29
14.40	0.64	0.00	0.64	17.52	0.28	0.00	0.28
14.46	0.63	0.00	0.63	17.58	0.28	0.00	0.28
14.52	0.62	0.00	0.62	17.64	0.27	0.00	0.27
14.58	0.61	0.00	0.61	17.70	0.27	0.00	0.27
14.64	0.60	0.00	0.60	17.76	0.26	0.00	0.26
14.70	0.60	0.00	0.60	17.82	0.26	0.00	0.26
14.76	0.59	0.00	0.59	17.88	0.25	0.00	0.25
14.82	0.58	0.00	0.58	17.94	0.25	0.00	0.25
14.88	0.57	0.00	0.57	18.00	0.25	0.00	0.25
14.94	0.56	0.00	0.56	18.06	0.24	0.00	0.24
15.00	0.56	0.00	0.56	18.12	0.24	0.00	0.24
15.06	0.55	0.00	0.55	18.18	0.23	0.00	0.23
15.12	0.54	0.00	0.54	18.24	0.23	0.00	0.23
15.18	0.53	0.00	0.53	18.30	0.23	0.00	0.23
15.24	0.52	0.00	0.52	18.36	0.23	0.00	0.23
15.30	0.51	0.00	0.51	18.42	0.22	0.00	0.22
15.36	0.51	0.00	0.51	18.48	0.22	0.00	0.22
15.42	0.50	0.00	0.50	18.54	0.22	0.00	0.22
15.48	0.49	0.00	0.49	18.60	0.22	0.00	0.22
15.54	0.48	0.00	0.48	18.66	0.22	0.00	0.22

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 1 Year Rainfall=2.85"*

Prepared by Tectonic Engineering

Printed 7/21/2021

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Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
18.72	0.21	0.00	0.21	21.84	0.15	0.00	0.15
18.78	0.21	0.00	0.21	21.90	0.15	0.00	0.15
18.84	0.21	0.00	0.21	21.96	0.15	0.00	0.15
18.90	0.21	0.00	0.21	22.02	0.15	0.00	0.15
18.96	0.21	0.00	0.21	22.08	0.15	0.00	0.15
19.02	0.20	0.00	0.20	22.14	0.15	0.00	0.15
19.08	0.20	0.00	0.20	22.20	0.14	0.00	0.14
19.14	0.20	0.00	0.20	22.26	0.14	0.00	0.14
19.20	0.20	0.00	0.20	22.32	0.14	0.00	0.14
19.26	0.20	0.00	0.20	22.38	0.14	0.00	0.14
19.32	0.20	0.00	0.20	22.44	0.14	0.00	0.14
19.38	0.19	0.00	0.19	22.50	0.14	0.00	0.14
19.44	0.19	0.00	0.19	22.56	0.14	0.00	0.14
19.50	0.19	0.00	0.19	22.62	0.14	0.00	0.14
19.56	0.19	0.00	0.19	22.68	0.14	0.00	0.14
19.62	0.19	0.00	0.19	22.74	0.14	0.00	0.14
19.68	0.19	0.00	0.19	22.80	0.14	0.00	0.14
19.74	0.19	0.00	0.19	22.86	0.14	0.00	0.14
19.80	0.18	0.00	0.18	22.92	0.13	0.00	0.13
19.86	0.18	0.00	0.18	22.98	0.13	0.00	0.13
19.92	0.18	0.00	0.18	23.04	0.13	0.00	0.13
19.98	0.18	0.00	0.18	23.10	0.13	0.00	0.13
20.04	0.18	0.00	0.18	23.16	0.13	0.00	0.13
20.10	0.18	0.00	0.18	23.22	0.13	0.00	0.13
20.16	0.18	0.00	0.18	23.28	0.13	0.00	0.13
20.22	0.18	0.00	0.18	23.34	0.13	0.00	0.13
20.28	0.17	0.00	0.17	23.40	0.13	0.00	0.13
20.34	0.17	0.00	0.17	23.46	0.13	0.00	0.13
20.40	0.17	0.00	0.17	23.52	0.13	0.00	0.13
20.46	0.17	0.00	0.17	23.58	0.12	0.00	0.12
20.52	0.17	0.00	0.17	23.64	0.12	0.00	0.12
20.58	0.17	0.00	0.17	23.70	0.12	0.00	0.12
20.64	0.17	0.00	0.17	23.76	0.12	0.00	0.12
20.70	0.17	0.00	0.17	23.82	0.12	0.00	0.12
20.76	0.17	0.00	0.17	23.88	0.12	0.00	0.12
20.82	0.17	0.00	0.17	23.94	0.12	0.00	0.12
20.88	0.16	0.00	0.16	24.00	0.12	0.00	0.12
20.94	0.16	0.00	0.16				
21.00	0.16	0.00	0.16				
21.06	0.16	0.00	0.16				
21.12	0.16	0.00	0.16				
21.18	0.16	0.00	0.16				
21.24	0.16	0.00	0.16				
21.30	0.16	0.00	0.16				
21.36	0.16	0.00	0.16				
21.42	0.16	0.00	0.16				
21.48	0.16	0.00	0.16				
21.54	0.15	0.00	0.15				
21.60	0.15	0.00	0.15				
21.66	0.15	0.00	0.15				
21.72	0.15	0.00	0.15				
21.78	0.15	0.00	0.15				

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

Prepared by Tectonic Engineering

Printed 7/21/2021

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Time span=0.00-24.00 hrs, dt=0.06 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatch A Runoff Area=0.724 ac 72.79% Impervious Runoff Depth>4.47"
Tc=8.0 min CN=91 Runoff=3.31 cfs 0.270 af

Subcatchment 2S: Subcatch B2 Runoff Area=3.430 ac 56.15% Impervious Runoff Depth>4.05"
Tc=8.0 min CN=87 Runoff=14.56 cfs 1.156 af

Subcatchment 3S: Detention Drainage Area Runoff Area=1.094 ac 69.84% Impervious Runoff Depth>4.48"
Tc=6.0 min CN=91 Runoff=5.26 cfs 0.408 af

Reach 4R: Design Point A Inflow=3.31 cfs 0.270 af
Outflow=3.31 cfs 0.270 af

Reach 5R: Design Point B Inflow=14.56 cfs 1.156 af
Outflow=14.56 cfs 1.156 af

Pond 6P: Detention Peak Elev=215.05' Storage=3,181 cf Inflow=5.26 cfs 0.408 af
Outflow=3.92 cfs 0.402 af

Link 10L: DP-1 Inflow=21.56 cfs 1.829 af
Primary=21.56 cfs 1.829 af

Total Runoff Area = 5.248 ac Runoff Volume = 1.834 af Average Runoff Depth = 4.19"
38.70% Pervious = 2.031 ac 61.30% Impervious = 3.217 ac

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Type III 24-hr 10 Year Rainfall=5.51"

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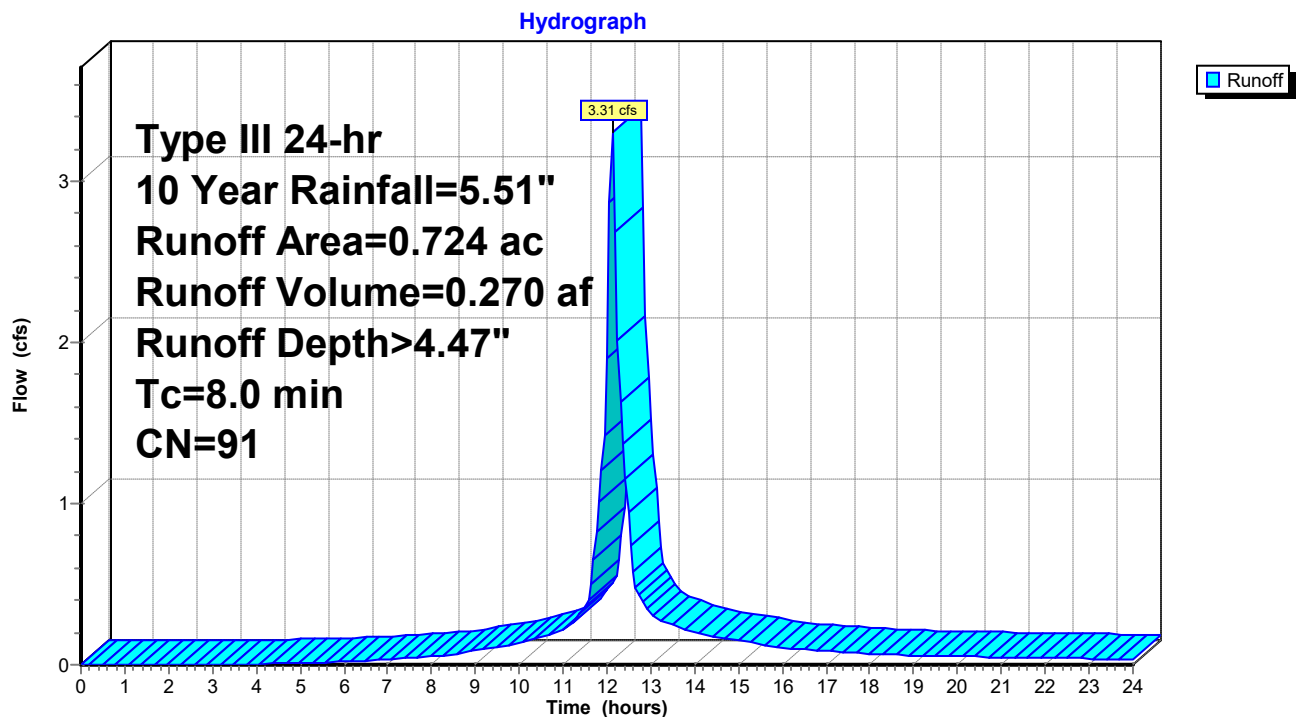
Summary for Subcatchment 1S: Subcatch A

Runoff = 3.31 cfs @ 12.11 hrs, Volume= 0.270 af, Depth> 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
Type III 24-hr 10 Year Rainfall=5.51"

Area (ac)	CN	Description
0.527	98	Paved roads w/curbs & sewers, HSG C
0.197	74	>75% Grass cover, Good, HSG C
0.724	91	Weighted Average
0.197		27.21% Pervious Area
0.527		72.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Subcatchment 1S: Subcatch A

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 1S: Subcatch A

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.18	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.18	0.00	0.00
0.12	0.01	0.00	0.00	3.24	0.18	0.00	0.00
0.18	0.01	0.00	0.00	3.30	0.19	0.00	0.00
0.24	0.01	0.00	0.00	3.36	0.19	0.00	0.00
0.30	0.02	0.00	0.00	3.42	0.20	0.00	0.00
0.36	0.02	0.00	0.00	3.48	0.20	0.00	0.00
0.42	0.02	0.00	0.00	3.54	0.20	0.00	0.00
0.48	0.03	0.00	0.00	3.60	0.21	0.00	0.00
0.54	0.03	0.00	0.00	3.66	0.21	0.00	0.00
0.60	0.03	0.00	0.00	3.72	0.22	0.00	0.00
0.66	0.04	0.00	0.00	3.78	0.22	0.00	0.00
0.72	0.04	0.00	0.00	3.84	0.23	0.00	0.00
0.78	0.04	0.00	0.00	3.90	0.23	0.00	0.00
0.84	0.05	0.00	0.00	3.96	0.23	0.00	0.00
0.90	0.05	0.00	0.00	4.02	0.24	0.00	0.00
0.96	0.05	0.00	0.00	4.08	0.24	0.00	0.00
1.02	0.06	0.00	0.00	4.14	0.25	0.00	0.00
1.08	0.06	0.00	0.00	4.20	0.25	0.00	0.00
1.14	0.06	0.00	0.00	4.26	0.26	0.00	0.00
1.20	0.07	0.00	0.00	4.32	0.26	0.00	0.01
1.26	0.07	0.00	0.00	4.38	0.26	0.00	0.01
1.32	0.07	0.00	0.00	4.44	0.27	0.00	0.01
1.38	0.08	0.00	0.00	4.50	0.27	0.01	0.01
1.44	0.08	0.00	0.00	4.56	0.28	0.01	0.01
1.50	0.08	0.00	0.00	4.62	0.28	0.01	0.01
1.56	0.09	0.00	0.00	4.68	0.29	0.01	0.01
1.62	0.09	0.00	0.00	4.74	0.29	0.01	0.01
1.68	0.09	0.00	0.00	4.80	0.30	0.01	0.01
1.74	0.10	0.00	0.00	4.86	0.30	0.01	0.01
1.80	0.10	0.00	0.00	4.92	0.31	0.01	0.01
1.86	0.10	0.00	0.00	4.98	0.31	0.01	0.01
1.92	0.11	0.00	0.00	5.04	0.32	0.01	0.01
1.98	0.11	0.00	0.00	5.10	0.32	0.01	0.01
2.04	0.11	0.00	0.00	5.16	0.33	0.01	0.01
2.10	0.12	0.00	0.00	5.22	0.33	0.02	0.01
2.16	0.12	0.00	0.00	5.28	0.34	0.02	0.01
2.22	0.12	0.00	0.00	5.34	0.34	0.02	0.01
2.28	0.13	0.00	0.00	5.40	0.35	0.02	0.01
2.34	0.13	0.00	0.00	5.46	0.35	0.02	0.01
2.40	0.13	0.00	0.00	5.52	0.36	0.02	0.01
2.46	0.14	0.00	0.00	5.58	0.36	0.02	0.02
2.52	0.14	0.00	0.00	5.64	0.37	0.02	0.02
2.58	0.14	0.00	0.00	5.70	0.37	0.03	0.02
2.64	0.15	0.00	0.00	5.76	0.38	0.03	0.02
2.70	0.15	0.00	0.00	5.82	0.38	0.03	0.02
2.76	0.15	0.00	0.00	5.88	0.39	0.03	0.02
2.82	0.16	0.00	0.00	5.94	0.39	0.03	0.02
2.88	0.16	0.00	0.00	6.00	0.40	0.03	0.02
2.94	0.17	0.00	0.00	6.06	0.40	0.03	0.02
3.00	0.17	0.00	0.00	6.12	0.41	0.04	0.02
3.06	0.17	0.00	0.00	6.18	0.41	0.04	0.02

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.42	0.04	0.02	9.36	0.88	0.28	0.10
6.30	0.42	0.04	0.02	9.42	0.90	0.29	0.11
6.36	0.43	0.04	0.02	9.48	0.91	0.30	0.11
6.42	0.44	0.05	0.02	9.54	0.92	0.31	0.11
6.48	0.44	0.05	0.02	9.60	0.94	0.32	0.11
6.54	0.45	0.05	0.03	9.66	0.95	0.33	0.12
6.60	0.45	0.05	0.03	9.72	0.97	0.34	0.12
6.66	0.46	0.06	0.03	9.78	0.98	0.35	0.12
6.72	0.47	0.06	0.03	9.84	1.00	0.36	0.13
6.78	0.47	0.06	0.03	9.90	1.01	0.37	0.13
6.84	0.48	0.06	0.03	9.96	1.03	0.38	0.13
6.90	0.49	0.07	0.03	10.02	1.05	0.39	0.13
6.96	0.49	0.07	0.03	10.08	1.06	0.40	0.14
7.02	0.50	0.07	0.03	10.14	1.08	0.42	0.14
7.08	0.51	0.07	0.03	10.20	1.10	0.43	0.15
7.14	0.52	0.08	0.04	10.26	1.12	0.44	0.15
7.20	0.52	0.08	0.04	10.32	1.13	0.46	0.16
7.26	0.53	0.08	0.04	10.38	1.15	0.47	0.16
7.32	0.54	0.09	0.04	10.44	1.17	0.48	0.17
7.38	0.54	0.09	0.04	10.50	1.19	0.50	0.17
7.44	0.55	0.09	0.04	10.56	1.21	0.51	0.18
7.50	0.56	0.10	0.04	10.62	1.23	0.53	0.18
7.56	0.57	0.10	0.04	10.68	1.26	0.55	0.19
7.62	0.58	0.10	0.04	10.74	1.28	0.56	0.20
7.68	0.58	0.11	0.04	10.80	1.30	0.58	0.20
7.74	0.59	0.11	0.05	10.86	1.32	0.60	0.21
7.80	0.60	0.12	0.05	10.92	1.35	0.62	0.21
7.86	0.61	0.12	0.05	10.98	1.37	0.64	0.22
7.92	0.62	0.12	0.05	11.04	1.39	0.65	0.22
7.98	0.63	0.13	0.05	11.10	1.42	0.68	0.23
8.04	0.63	0.13	0.05	11.16	1.45	0.70	0.25
8.10	0.64	0.14	0.05	11.22	1.48	0.72	0.26
8.16	0.65	0.14	0.06	11.28	1.51	0.75	0.28
8.22	0.66	0.15	0.06	11.34	1.54	0.78	0.30
8.28	0.67	0.15	0.06	11.40	1.58	0.80	0.32
8.34	0.68	0.16	0.06	11.46	1.62	0.84	0.34
8.40	0.69	0.16	0.06	11.52	1.66	0.87	0.36
8.46	0.70	0.17	0.07	11.58	1.71	0.91	0.40
8.52	0.71	0.18	0.07	11.64	1.78	0.97	0.50
8.58	0.72	0.18	0.07	11.70	1.87	1.05	0.65
8.64	0.73	0.19	0.07	11.76	1.98	1.14	0.83
8.70	0.74	0.19	0.08	11.82	2.10	1.25	1.01
8.76	0.76	0.20	0.08	11.88	2.24	1.38	1.21
8.82	0.77	0.21	0.08	11.94	2.43	1.55	1.43
8.88	0.78	0.21	0.08	12.00	2.75	1.84	1.90
8.94	0.79	0.22	0.08	12.06	3.08	2.15	2.87
9.00	0.80	0.23	0.09	12.12	3.27	2.32	3.31
9.06	0.82	0.24	0.09	12.18	3.41	2.46	2.68
9.12	0.83	0.25	0.09	12.24	3.53	2.57	2.01
9.18	0.84	0.25	0.10	12.30	3.64	2.67	1.63
9.24	0.85	0.26	0.10	12.36	3.73	2.76	1.37
9.30	0.87	0.27	0.10	12.42	3.80	2.83	1.15

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	3.85	2.88	0.94	15.60	4.82	3.81	0.12
12.54	3.89	2.92	0.74	15.66	4.83	3.82	0.12
12.60	3.93	2.95	0.57	15.72	4.84	3.83	0.12
12.66	3.97	2.99	0.48	15.78	4.85	3.84	0.12
12.72	4.00	3.02	0.43	15.84	4.86	3.84	0.11
12.78	4.03	3.05	0.41	15.90	4.87	3.85	0.11
12.84	4.06	3.08	0.38	15.96	4.88	3.86	0.11
12.90	4.09	3.10	0.36	16.02	4.88	3.87	0.11
12.96	4.12	3.13	0.34	16.08	4.89	3.88	0.10
13.02	4.14	3.15	0.32	16.14	4.90	3.89	0.10
13.08	4.16	3.17	0.30	16.20	4.91	3.89	0.10
13.14	4.19	3.20	0.28	16.26	4.92	3.90	0.10
13.20	4.21	3.22	0.28	16.32	4.93	3.91	0.10
13.26	4.23	3.24	0.27	16.38	4.93	3.92	0.10
13.32	4.25	3.26	0.26	16.44	4.94	3.93	0.10
13.38	4.28	3.28	0.26	16.50	4.95	3.93	0.09
13.44	4.30	3.30	0.25	16.56	4.96	3.94	0.09
13.50	4.32	3.32	0.25	16.62	4.97	3.95	0.09
13.56	4.34	3.34	0.24	16.68	4.97	3.96	0.09
13.62	4.36	3.36	0.24	16.74	4.98	3.96	0.09
13.68	4.38	3.38	0.23	16.80	4.99	3.97	0.09
13.74	4.39	3.40	0.23	16.86	4.99	3.98	0.09
13.80	4.41	3.41	0.22	16.92	5.00	3.98	0.09
13.86	4.43	3.43	0.21	16.98	5.01	3.99	0.08
13.92	4.45	3.45	0.21	17.04	5.02	4.00	0.08
13.98	4.46	3.46	0.20	17.10	5.02	4.00	0.08
14.04	4.48	3.48	0.20	17.16	5.03	4.01	0.08
14.10	4.50	3.49	0.19	17.22	5.04	4.02	0.08
14.16	4.51	3.51	0.19	17.28	5.04	4.02	0.08
14.22	4.53	3.52	0.19	17.34	5.05	4.03	0.08
14.28	4.54	3.54	0.18	17.40	5.06	4.04	0.08
14.34	4.56	3.55	0.18	17.46	5.06	4.04	0.08
14.40	4.57	3.57	0.18	17.52	5.07	4.05	0.07
14.46	4.59	3.58	0.18	17.58	5.07	4.05	0.07
14.52	4.60	3.60	0.17	17.64	5.08	4.06	0.07
14.58	4.61	3.61	0.17	17.70	5.09	4.07	0.07
14.64	4.63	3.62	0.17	17.76	5.09	4.07	0.07
14.70	4.64	3.64	0.16	17.82	5.10	4.08	0.07
14.76	4.66	3.65	0.16	17.88	5.10	4.08	0.07
14.82	4.67	3.66	0.16	17.94	5.11	4.09	0.07
14.88	4.68	3.67	0.16	18.00	5.11	4.09	0.06
14.94	4.69	3.69	0.15	18.06	5.12	4.10	0.06
15.00	4.71	3.70	0.15	18.12	5.12	4.10	0.06
15.06	4.72	3.71	0.15	18.18	5.13	4.11	0.06
15.12	4.73	3.72	0.15	18.24	5.13	4.11	0.06
15.18	4.74	3.73	0.14	18.30	5.14	4.12	0.06
15.24	4.75	3.74	0.14	18.36	5.14	4.12	0.06
15.30	4.77	3.76	0.14	18.42	5.15	4.13	0.06
15.36	4.78	3.77	0.14	18.48	5.15	4.13	0.06
15.42	4.79	3.78	0.13	18.54	5.16	4.14	0.06
15.48	4.80	3.79	0.13	18.60	5.16	4.14	0.06
15.54	4.81	3.80	0.13	18.66	5.17	4.15	0.06

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	5.17	4.15	0.06	21.84	5.39	4.37	0.04
18.78	5.18	4.16	0.06	21.90	5.40	4.37	0.04
18.84	5.18	4.16	0.06	21.96	5.40	4.37	0.04
18.90	5.19	4.17	0.06	22.02	5.41	4.38	0.04
18.96	5.19	4.17	0.06	22.08	5.41	4.38	0.04
19.02	5.20	4.18	0.06	22.14	5.41	4.38	0.04
19.08	5.20	4.18	0.06	22.20	5.42	4.39	0.04
19.14	5.21	4.18	0.06	22.26	5.42	4.39	0.04
19.20	5.21	4.19	0.06	22.32	5.42	4.39	0.04
19.26	5.22	4.19	0.06	22.38	5.43	4.40	0.04
19.32	5.22	4.20	0.06	22.44	5.43	4.40	0.04
19.38	5.23	4.20	0.06	22.50	5.43	4.40	0.04
19.44	5.23	4.21	0.05	22.56	5.44	4.41	0.04
19.50	5.24	4.21	0.05	22.62	5.44	4.41	0.04
19.56	5.24	4.22	0.05	22.68	5.44	4.41	0.04
19.62	5.25	4.22	0.05	22.74	5.45	4.42	0.04
19.68	5.25	4.22	0.05	22.80	5.45	4.42	0.04
19.74	5.25	4.23	0.05	22.86	5.45	4.42	0.04
19.80	5.26	4.23	0.05	22.92	5.46	4.43	0.04
19.86	5.26	4.24	0.05	22.98	5.46	4.43	0.04
19.92	5.27	4.24	0.05	23.04	5.46	4.43	0.04
19.98	5.27	4.25	0.05	23.10	5.47	4.43	0.04
20.04	5.28	4.25	0.05	23.16	5.47	4.44	0.04
20.10	5.28	4.25	0.05	23.22	5.47	4.44	0.04
20.16	5.28	4.26	0.05	23.28	5.47	4.44	0.04
20.22	5.29	4.26	0.05	23.34	5.48	4.45	0.04
20.28	5.29	4.27	0.05	23.40	5.48	4.45	0.04
20.34	5.30	4.27	0.05	23.46	5.48	4.45	0.04
20.40	5.30	4.27	0.05	23.52	5.49	4.46	0.04
20.46	5.31	4.28	0.05	23.58	5.49	4.46	0.04
20.52	5.31	4.28	0.05	23.64	5.49	4.46	0.04
20.58	5.31	4.29	0.05	23.70	5.50	4.46	0.04
20.64	5.32	4.29	0.05	23.76	5.50	4.47	0.03
20.70	5.32	4.29	0.05	23.82	5.50	4.47	0.03
20.76	5.33	4.30	0.05	23.88	5.50	4.47	0.03
20.82	5.33	4.30	0.05	23.94	5.51	4.48	0.03
20.88	5.33	4.31	0.05	24.00	5.51	4.48	0.03
20.94	5.34	4.31	0.05				
21.00	5.34	4.31	0.05				
21.06	5.35	4.32	0.05				
21.12	5.35	4.32	0.05				
21.18	5.35	4.33	0.05				
21.24	5.36	4.33	0.05				
21.30	5.36	4.33	0.05				
21.36	5.36	4.34	0.05				
21.42	5.37	4.34	0.05				
21.48	5.37	4.34	0.04				
21.54	5.38	4.35	0.04				
21.60	5.38	4.35	0.04				
21.66	5.38	4.36	0.04				
21.72	5.39	4.36	0.04				
21.78	5.39	4.36	0.04				

Summary for Subcatchment 2S: Subcatch B2

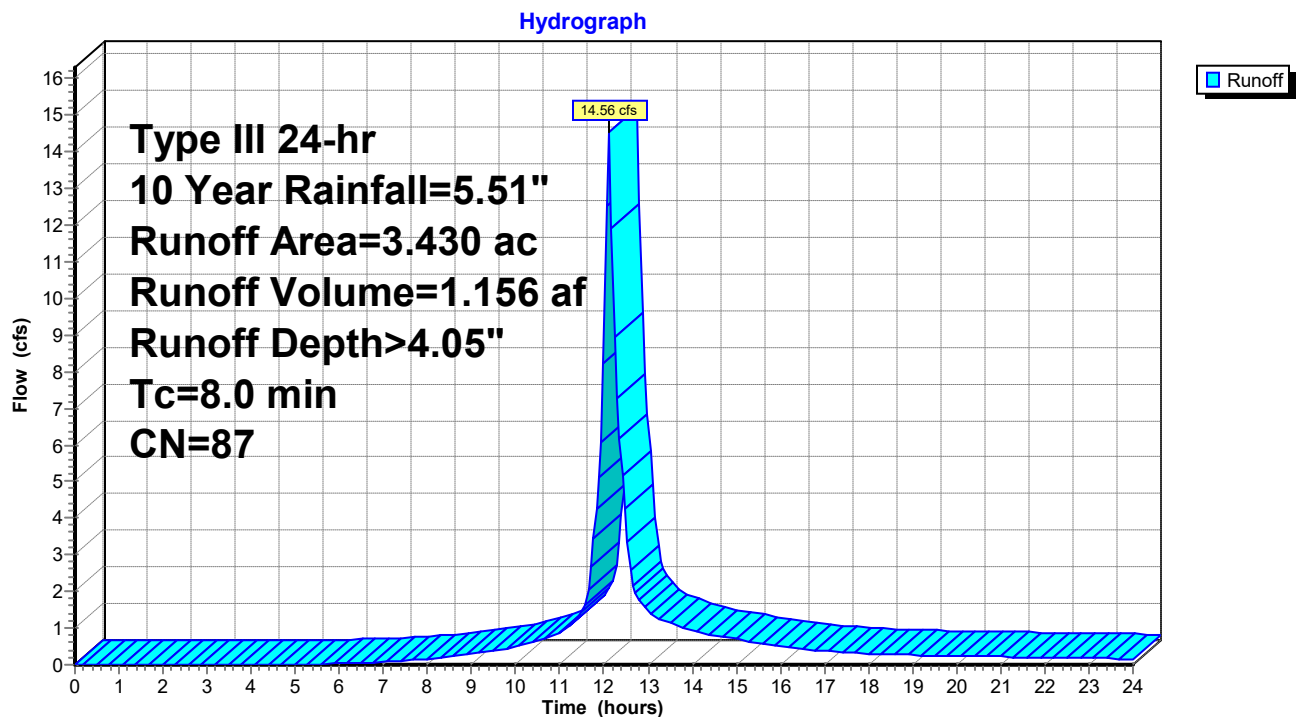
Runoff = 14.56 cfs @ 12.12 hrs, Volume= 1.156 af, Depth> 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
Type III 24-hr 10 Year Rainfall=5.51"

Area (ac)	CN	Description
1.926	98	Paved roads w/curbs & sewers, HSG C
* 1.504	74	>75% Grass cover, Good, HSG C
3.430	87	Weighted Average
1.504		43.85% Pervious Area
1.926		56.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Subcatchment 2S: Subcatch B2



2021-07-8 Post Orangetown Town Hall

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 2S: Subcatch B2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.18	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.18	0.00	0.00
0.12	0.01	0.00	0.00	3.24	0.18	0.00	0.00
0.18	0.01	0.00	0.00	3.30	0.19	0.00	0.00
0.24	0.01	0.00	0.00	3.36	0.19	0.00	0.00
0.30	0.02	0.00	0.00	3.42	0.20	0.00	0.00
0.36	0.02	0.00	0.00	3.48	0.20	0.00	0.00
0.42	0.02	0.00	0.00	3.54	0.20	0.00	0.00
0.48	0.03	0.00	0.00	3.60	0.21	0.00	0.00
0.54	0.03	0.00	0.00	3.66	0.21	0.00	0.00
0.60	0.03	0.00	0.00	3.72	0.22	0.00	0.00
0.66	0.04	0.00	0.00	3.78	0.22	0.00	0.00
0.72	0.04	0.00	0.00	3.84	0.23	0.00	0.00
0.78	0.04	0.00	0.00	3.90	0.23	0.00	0.00
0.84	0.05	0.00	0.00	3.96	0.23	0.00	0.00
0.90	0.05	0.00	0.00	4.02	0.24	0.00	0.00
0.96	0.05	0.00	0.00	4.08	0.24	0.00	0.00
1.02	0.06	0.00	0.00	4.14	0.25	0.00	0.00
1.08	0.06	0.00	0.00	4.20	0.25	0.00	0.00
1.14	0.06	0.00	0.00	4.26	0.26	0.00	0.00
1.20	0.07	0.00	0.00	4.32	0.26	0.00	0.00
1.26	0.07	0.00	0.00	4.38	0.26	0.00	0.00
1.32	0.07	0.00	0.00	4.44	0.27	0.00	0.00
1.38	0.08	0.00	0.00	4.50	0.27	0.00	0.00
1.44	0.08	0.00	0.00	4.56	0.28	0.00	0.00
1.50	0.08	0.00	0.00	4.62	0.28	0.00	0.00
1.56	0.09	0.00	0.00	4.68	0.29	0.00	0.00
1.62	0.09	0.00	0.00	4.74	0.29	0.00	0.00
1.68	0.09	0.00	0.00	4.80	0.30	0.00	0.00
1.74	0.10	0.00	0.00	4.86	0.30	0.00	0.00
1.80	0.10	0.00	0.00	4.92	0.31	0.00	0.00
1.86	0.10	0.00	0.00	4.98	0.31	0.00	0.00
1.92	0.11	0.00	0.00	5.04	0.32	0.00	0.00
1.98	0.11	0.00	0.00	5.10	0.32	0.00	0.00
2.04	0.11	0.00	0.00	5.16	0.33	0.00	0.01
2.10	0.12	0.00	0.00	5.22	0.33	0.00	0.01
2.16	0.12	0.00	0.00	5.28	0.34	0.00	0.01
2.22	0.12	0.00	0.00	5.34	0.34	0.00	0.01
2.28	0.13	0.00	0.00	5.40	0.35	0.00	0.01
2.34	0.13	0.00	0.00	5.46	0.35	0.00	0.02
2.40	0.13	0.00	0.00	5.52	0.36	0.00	0.02
2.46	0.14	0.00	0.00	5.58	0.36	0.00	0.02
2.52	0.14	0.00	0.00	5.64	0.37	0.00	0.02
2.58	0.14	0.00	0.00	5.70	0.37	0.00	0.02
2.64	0.15	0.00	0.00	5.76	0.38	0.00	0.02
2.70	0.15	0.00	0.00	5.82	0.38	0.00	0.03
2.76	0.15	0.00	0.00	5.88	0.39	0.00	0.03
2.82	0.16	0.00	0.00	5.94	0.39	0.01	0.03
2.88	0.16	0.00	0.00	6.00	0.40	0.01	0.03
2.94	0.17	0.00	0.00	6.06	0.40	0.01	0.03
3.00	0.17	0.00	0.00	6.12	0.41	0.01	0.04
3.06	0.17	0.00	0.00	6.18	0.41	0.01	0.04

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.42	0.01	0.04	9.36	0.88	0.16	0.36
6.30	0.42	0.01	0.04	9.42	0.90	0.17	0.37
6.36	0.43	0.01	0.05	9.48	0.91	0.18	0.38
6.42	0.44	0.01	0.05	9.54	0.92	0.18	0.39
6.48	0.44	0.01	0.05	9.60	0.94	0.19	0.41
6.54	0.45	0.01	0.06	9.66	0.95	0.20	0.42
6.60	0.45	0.01	0.06	9.72	0.97	0.21	0.43
6.66	0.46	0.02	0.06	9.78	0.98	0.22	0.44
6.72	0.47	0.02	0.06	9.84	1.00	0.22	0.46
6.78	0.47	0.02	0.07	9.90	1.01	0.23	0.47
6.84	0.48	0.02	0.07	9.96	1.03	0.24	0.48
6.90	0.49	0.02	0.08	10.02	1.05	0.25	0.49
6.96	0.49	0.02	0.08	10.08	1.06	0.26	0.51
7.02	0.50	0.02	0.08	10.14	1.08	0.27	0.53
7.08	0.51	0.03	0.09	10.20	1.10	0.28	0.55
7.14	0.52	0.03	0.09	10.26	1.12	0.29	0.57
7.20	0.52	0.03	0.09	10.32	1.13	0.30	0.59
7.26	0.53	0.03	0.10	10.38	1.15	0.31	0.61
7.32	0.54	0.03	0.10	10.44	1.17	0.32	0.63
7.38	0.54	0.03	0.11	10.50	1.19	0.33	0.66
7.44	0.55	0.04	0.11	10.56	1.21	0.35	0.68
7.50	0.56	0.04	0.11	10.62	1.23	0.36	0.71
7.56	0.57	0.04	0.12	10.68	1.26	0.37	0.73
7.62	0.58	0.04	0.12	10.74	1.28	0.39	0.76
7.68	0.58	0.05	0.13	10.80	1.30	0.40	0.78
7.74	0.59	0.05	0.13	10.86	1.32	0.42	0.81
7.80	0.60	0.05	0.14	10.92	1.35	0.43	0.83
7.86	0.61	0.05	0.14	10.98	1.37	0.45	0.86
7.92	0.62	0.06	0.15	11.04	1.39	0.46	0.89
7.98	0.63	0.06	0.15	11.10	1.42	0.48	0.92
8.04	0.63	0.06	0.16	11.16	1.45	0.50	0.98
8.10	0.64	0.06	0.16	11.22	1.48	0.52	1.05
8.16	0.65	0.07	0.17	11.28	1.51	0.54	1.13
8.22	0.66	0.07	0.18	11.34	1.54	0.57	1.22
8.28	0.67	0.07	0.18	11.40	1.58	0.59	1.30
8.34	0.68	0.08	0.19	11.46	1.62	0.62	1.39
8.40	0.69	0.08	0.20	11.52	1.66	0.65	1.48
8.46	0.70	0.09	0.21	11.58	1.71	0.69	1.63
8.52	0.71	0.09	0.22	11.64	1.78	0.74	2.04
8.58	0.72	0.09	0.23	11.70	1.87	0.81	2.68
8.64	0.73	0.10	0.23	11.76	1.98	0.89	3.44
8.70	0.74	0.10	0.24	11.82	2.10	0.98	4.26
8.76	0.76	0.11	0.25	11.88	2.24	1.10	5.12
8.82	0.77	0.11	0.26	11.94	2.43	1.25	6.09
8.88	0.78	0.12	0.27	12.00	2.75	1.53	8.21
8.94	0.79	0.12	0.28	12.06	3.08	1.81	12.53
9.00	0.80	0.13	0.29	12.12	3.27	1.98	14.55
9.06	0.82	0.13	0.30	12.18	3.41	2.10	11.90
9.12	0.83	0.14	0.31	12.24	3.53	2.21	8.96
9.18	0.84	0.14	0.33	12.30	3.64	2.31	7.29
9.24	0.85	0.15	0.34	12.36	3.73	2.39	6.15
9.30	0.87	0.16	0.35	12.42	3.80	2.45	5.17

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	3.85	2.50	4.25	15.60	4.82	3.40	0.57
12.54	3.89	2.54	3.35	15.66	4.83	3.41	0.56
12.60	3.93	2.57	2.59	15.72	4.84	3.42	0.55
12.66	3.97	2.61	2.18	15.78	4.85	3.43	0.54
12.72	4.00	2.64	1.97	15.84	4.86	3.43	0.52
12.78	4.03	2.67	1.84	15.90	4.87	3.44	0.51
12.84	4.06	2.69	1.74	15.96	4.88	3.45	0.50
12.90	4.09	2.72	1.64	16.02	4.88	3.46	0.49
12.96	4.12	2.74	1.54	16.08	4.89	3.47	0.48
13.02	4.14	2.77	1.45	16.14	4.90	3.47	0.47
13.08	4.16	2.79	1.36	16.20	4.91	3.48	0.46
13.14	4.19	2.81	1.30	16.26	4.92	3.49	0.45
13.20	4.21	2.83	1.26	16.32	4.93	3.50	0.45
13.26	4.23	2.85	1.23	16.38	4.93	3.51	0.44
13.32	4.25	2.87	1.20	16.44	4.94	3.51	0.44
13.38	4.28	2.89	1.18	16.50	4.95	3.52	0.43
13.44	4.30	2.91	1.15	16.56	4.96	3.53	0.43
13.50	4.32	2.93	1.13	16.62	4.97	3.53	0.42
13.56	4.34	2.95	1.10	16.68	4.97	3.54	0.42
13.62	4.36	2.97	1.08	16.74	4.98	3.55	0.41
13.68	4.38	2.98	1.05	16.80	4.99	3.56	0.41
13.74	4.39	3.00	1.03	16.86	4.99	3.56	0.40
13.80	4.41	3.02	1.00	16.92	5.00	3.57	0.40
13.86	4.43	3.03	0.98	16.98	5.01	3.58	0.39
13.92	4.45	3.05	0.95	17.04	5.02	3.58	0.38
13.98	4.46	3.06	0.93	17.10	5.02	3.59	0.38
14.04	4.48	3.08	0.90	17.16	5.03	3.60	0.37
14.10	4.50	3.09	0.88	17.22	5.04	3.60	0.37
14.16	4.51	3.11	0.86	17.28	5.04	3.61	0.36
14.22	4.53	3.12	0.85	17.34	5.05	3.61	0.36
14.28	4.54	3.14	0.84	17.40	5.06	3.62	0.35
14.34	4.56	3.15	0.83	17.46	5.06	3.63	0.35
14.40	4.57	3.17	0.81	17.52	5.07	3.63	0.34
14.46	4.59	3.18	0.80	17.58	5.07	3.64	0.34
14.52	4.60	3.19	0.79	17.64	5.08	3.64	0.33
14.58	4.61	3.21	0.78	17.70	5.09	3.65	0.33
14.64	4.63	3.22	0.77	17.76	5.09	3.65	0.32
14.70	4.64	3.23	0.75	17.82	5.10	3.66	0.31
14.76	4.66	3.24	0.74	17.88	5.10	3.66	0.31
14.82	4.67	3.26	0.73	17.94	5.11	3.67	0.30
14.88	4.68	3.27	0.72	18.00	5.11	3.67	0.30
14.94	4.69	3.28	0.71	18.06	5.12	3.68	0.29
15.00	4.71	3.29	0.69	18.12	5.12	3.68	0.29
15.06	4.72	3.30	0.68	18.18	5.13	3.69	0.29
15.12	4.73	3.31	0.67	18.24	5.13	3.69	0.28
15.18	4.74	3.33	0.66	18.30	5.14	3.70	0.28
15.24	4.75	3.34	0.65	18.36	5.14	3.70	0.28
15.30	4.77	3.35	0.63	18.42	5.15	3.71	0.28
15.36	4.78	3.36	0.62	18.48	5.15	3.71	0.28
15.42	4.79	3.37	0.61	18.54	5.16	3.72	0.28
15.48	4.80	3.38	0.60	18.60	5.16	3.72	0.28
15.54	4.81	3.39	0.58	18.66	5.17	3.73	0.27

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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	5.17	3.73	0.27	21.84	5.39	3.94	0.20
18.78	5.18	3.74	0.27	21.90	5.40	3.94	0.20
18.84	5.18	3.74	0.27	21.96	5.40	3.95	0.20
18.90	5.19	3.75	0.27	22.02	5.41	3.95	0.20
18.96	5.19	3.75	0.27	22.08	5.41	3.95	0.20
19.02	5.20	3.75	0.26	22.14	5.41	3.96	0.19
19.08	5.20	3.76	0.26	22.20	5.42	3.96	0.19
19.14	5.21	3.76	0.26	22.26	5.42	3.96	0.19
19.20	5.21	3.77	0.26	22.32	5.42	3.97	0.19
19.26	5.22	3.77	0.26	22.38	5.43	3.97	0.19
19.32	5.22	3.78	0.26	22.44	5.43	3.97	0.19
19.38	5.23	3.78	0.25	22.50	5.43	3.98	0.19
19.44	5.23	3.79	0.25	22.56	5.44	3.98	0.19
19.50	5.24	3.79	0.25	22.62	5.44	3.98	0.18
19.56	5.24	3.79	0.25	22.68	5.44	3.99	0.18
19.62	5.25	3.80	0.25	22.74	5.45	3.99	0.18
19.68	5.25	3.80	0.25	22.80	5.45	3.99	0.18
19.74	5.25	3.81	0.24	22.86	5.45	4.00	0.18
19.80	5.26	3.81	0.24	22.92	5.46	4.00	0.18
19.86	5.26	3.82	0.24	22.98	5.46	4.00	0.18
19.92	5.27	3.82	0.24	23.04	5.46	4.00	0.18
19.98	5.27	3.82	0.24	23.10	5.47	4.01	0.17
20.04	5.28	3.83	0.24	23.16	5.47	4.01	0.17
20.10	5.28	3.83	0.24	23.22	5.47	4.01	0.17
20.16	5.28	3.84	0.23	23.28	5.47	4.02	0.17
20.22	5.29	3.84	0.23	23.34	5.48	4.02	0.17
20.28	5.29	3.84	0.23	23.40	5.48	4.02	0.17
20.34	5.30	3.85	0.23	23.46	5.48	4.02	0.17
20.40	5.30	3.85	0.23	23.52	5.49	4.03	0.17
20.46	5.31	3.86	0.23	23.58	5.49	4.03	0.16
20.52	5.31	3.86	0.23	23.64	5.49	4.03	0.16
20.58	5.31	3.86	0.23	23.70	5.50	4.04	0.16
20.64	5.32	3.87	0.22	23.76	5.50	4.04	0.16
20.70	5.32	3.87	0.22	23.82	5.50	4.04	0.16
20.76	5.33	3.88	0.22	23.88	5.50	4.04	0.16
20.82	5.33	3.88	0.22	23.94	5.51	4.05	0.16
20.88	5.33	3.88	0.22	24.00	5.51	4.05	0.16
20.94	5.34	3.89	0.22				
21.00	5.34	3.89	0.22				
21.06	5.35	3.89	0.22				
21.12	5.35	3.90	0.21				
21.18	5.35	3.90	0.21				
21.24	5.36	3.90	0.21				
21.30	5.36	3.91	0.21				
21.36	5.36	3.91	0.21				
21.42	5.37	3.92	0.21				
21.48	5.37	3.92	0.21				
21.54	5.38	3.92	0.21				
21.60	5.38	3.93	0.20				
21.66	5.38	3.93	0.20				
21.72	5.39	3.93	0.20				
21.78	5.39	3.94	0.20				

Summary for Subcatchment 3S: Detention Drainage Area B1

[49] Hint: $T_c < 2dt$ may require smaller dt

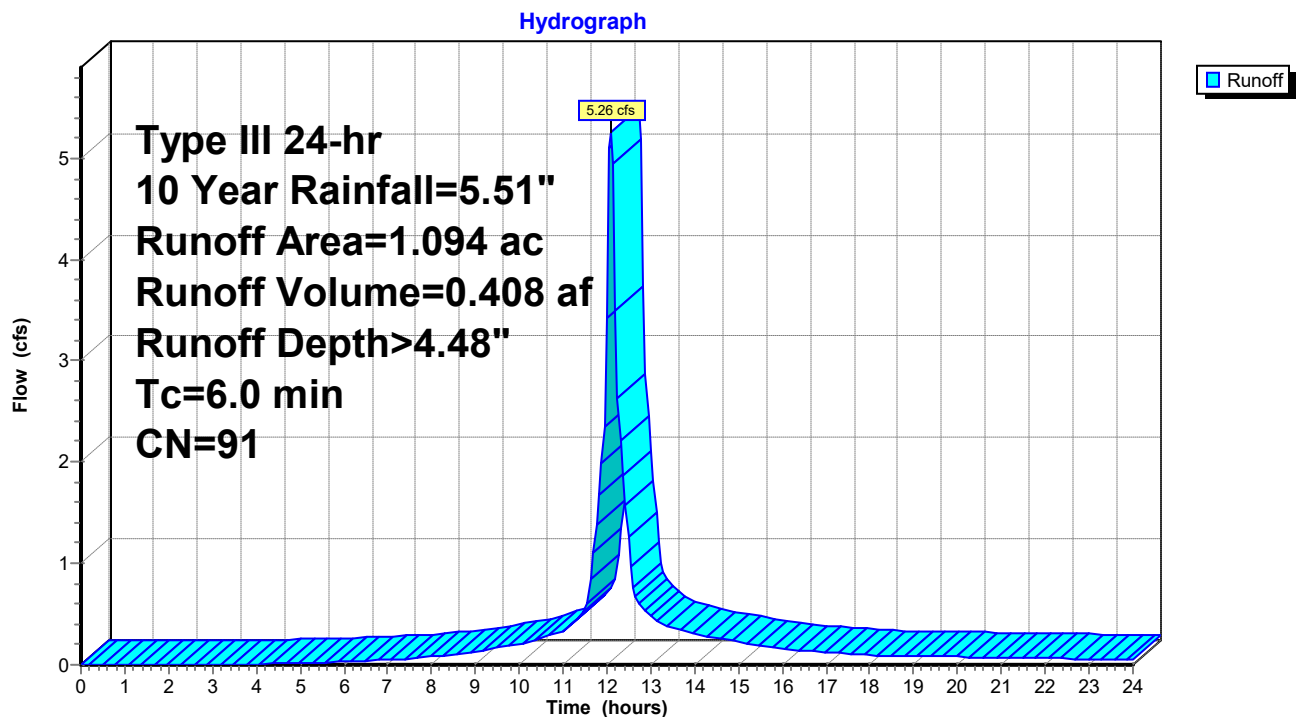
Runoff = 5.26 cfs @ 12.08 hrs, Volume= 0.408 af, Depth> 4.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, $dt=0.06$ hrs
Type III 24-hr 10 Year Rainfall=5.51"

Area (ac)	CN	Description
0.764	98	Roofs, HSG C
0.330	74	>75% Grass cover, Good, HSG C
1.094	91	Weighted Average
0.330		30.16% Pervious Area
0.764		69.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, minimum

Subcatchment 3S: Detention Drainage Area B1



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Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.18	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.18	0.00	0.00
0.12	0.01	0.00	0.00	3.24	0.18	0.00	0.00
0.18	0.01	0.00	0.00	3.30	0.19	0.00	0.00
0.24	0.01	0.00	0.00	3.36	0.19	0.00	0.00
0.30	0.02	0.00	0.00	3.42	0.20	0.00	0.00
0.36	0.02	0.00	0.00	3.48	0.20	0.00	0.00
0.42	0.02	0.00	0.00	3.54	0.20	0.00	0.00
0.48	0.03	0.00	0.00	3.60	0.21	0.00	0.00
0.54	0.03	0.00	0.00	3.66	0.21	0.00	0.00
0.60	0.03	0.00	0.00	3.72	0.22	0.00	0.00
0.66	0.04	0.00	0.00	3.78	0.22	0.00	0.00
0.72	0.04	0.00	0.00	3.84	0.23	0.00	0.00
0.78	0.04	0.00	0.00	3.90	0.23	0.00	0.00
0.84	0.05	0.00	0.00	3.96	0.23	0.00	0.00
0.90	0.05	0.00	0.00	4.02	0.24	0.00	0.01
0.96	0.05	0.00	0.00	4.08	0.24	0.00	0.01
1.02	0.06	0.00	0.00	4.14	0.25	0.00	0.01
1.08	0.06	0.00	0.00	4.20	0.25	0.00	0.01
1.14	0.06	0.00	0.00	4.26	0.26	0.00	0.01
1.20	0.07	0.00	0.00	4.32	0.26	0.00	0.01
1.26	0.07	0.00	0.00	4.38	0.26	0.00	0.01
1.32	0.07	0.00	0.00	4.44	0.27	0.00	0.01
1.38	0.08	0.00	0.00	4.50	0.27	0.01	0.01
1.44	0.08	0.00	0.00	4.56	0.28	0.01	0.01
1.50	0.08	0.00	0.00	4.62	0.28	0.01	0.01
1.56	0.09	0.00	0.00	4.68	0.29	0.01	0.01
1.62	0.09	0.00	0.00	4.74	0.29	0.01	0.01
1.68	0.09	0.00	0.00	4.80	0.30	0.01	0.01
1.74	0.10	0.00	0.00	4.86	0.30	0.01	0.01
1.80	0.10	0.00	0.00	4.92	0.31	0.01	0.02
1.86	0.10	0.00	0.00	4.98	0.31	0.01	0.02
1.92	0.11	0.00	0.00	5.04	0.32	0.01	0.02
1.98	0.11	0.00	0.00	5.10	0.32	0.01	0.02
2.04	0.11	0.00	0.00	5.16	0.33	0.01	0.02
2.10	0.12	0.00	0.00	5.22	0.33	0.02	0.02
2.16	0.12	0.00	0.00	5.28	0.34	0.02	0.02
2.22	0.12	0.00	0.00	5.34	0.34	0.02	0.02
2.28	0.13	0.00	0.00	5.40	0.35	0.02	0.02
2.34	0.13	0.00	0.00	5.46	0.35	0.02	0.02
2.40	0.13	0.00	0.00	5.52	0.36	0.02	0.02
2.46	0.14	0.00	0.00	5.58	0.36	0.02	0.02
2.52	0.14	0.00	0.00	5.64	0.37	0.02	0.02
2.58	0.14	0.00	0.00	5.70	0.37	0.03	0.02
2.64	0.15	0.00	0.00	5.76	0.38	0.03	0.03
2.70	0.15	0.00	0.00	5.82	0.38	0.03	0.03
2.76	0.15	0.00	0.00	5.88	0.39	0.03	0.03
2.82	0.16	0.00	0.00	5.94	0.39	0.03	0.03
2.88	0.16	0.00	0.00	6.00	0.40	0.03	0.03
2.94	0.17	0.00	0.00	6.06	0.40	0.03	0.03
3.00	0.17	0.00	0.00	6.12	0.41	0.04	0.03
3.06	0.17	0.00	0.00	6.18	0.41	0.04	0.03

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.42	0.04	0.03	9.36	0.88	0.28	0.16
6.30	0.42	0.04	0.03	9.42	0.90	0.29	0.16
6.36	0.43	0.04	0.04	9.48	0.91	0.30	0.17
6.42	0.44	0.05	0.04	9.54	0.92	0.31	0.17
6.48	0.44	0.05	0.04	9.60	0.94	0.32	0.18
6.54	0.45	0.05	0.04	9.66	0.95	0.33	0.18
6.60	0.45	0.05	0.04	9.72	0.97	0.34	0.18
6.66	0.46	0.06	0.04	9.78	0.98	0.35	0.19
6.72	0.47	0.06	0.04	9.84	1.00	0.36	0.19
6.78	0.47	0.06	0.04	9.90	1.01	0.37	0.20
6.84	0.48	0.06	0.05	9.96	1.03	0.38	0.20
6.90	0.49	0.07	0.05	10.02	1.05	0.39	0.21
6.96	0.49	0.07	0.05	10.08	1.06	0.40	0.21
7.02	0.50	0.07	0.05	10.14	1.08	0.42	0.22
7.08	0.51	0.07	0.05	10.20	1.10	0.43	0.23
7.14	0.52	0.08	0.05	10.26	1.12	0.44	0.23
7.20	0.52	0.08	0.06	10.32	1.13	0.46	0.24
7.26	0.53	0.08	0.06	10.38	1.15	0.47	0.25
7.32	0.54	0.09	0.06	10.44	1.17	0.48	0.26
7.38	0.54	0.09	0.06	10.50	1.19	0.50	0.27
7.44	0.55	0.09	0.06	10.56	1.21	0.51	0.27
7.50	0.56	0.10	0.06	10.62	1.23	0.53	0.28
7.56	0.57	0.10	0.07	10.68	1.26	0.55	0.29
7.62	0.58	0.10	0.07	10.74	1.28	0.56	0.30
7.68	0.58	0.11	0.07	10.80	1.30	0.58	0.31
7.74	0.59	0.11	0.07	10.86	1.32	0.60	0.32
7.80	0.60	0.12	0.07	10.92	1.35	0.62	0.33
7.86	0.61	0.12	0.07	10.98	1.37	0.64	0.33
7.92	0.62	0.12	0.08	11.04	1.39	0.65	0.34
7.98	0.63	0.13	0.08	11.10	1.42	0.68	0.36
8.04	0.63	0.13	0.08	11.16	1.45	0.70	0.38
8.10	0.64	0.14	0.08	11.22	1.48	0.72	0.41
8.16	0.65	0.14	0.08	11.28	1.51	0.75	0.44
8.22	0.66	0.15	0.09	11.34	1.54	0.78	0.47
8.28	0.67	0.15	0.09	11.40	1.58	0.80	0.50
8.34	0.68	0.16	0.09	11.46	1.62	0.84	0.53
8.40	0.69	0.16	0.10	11.52	1.66	0.87	0.57
8.46	0.70	0.17	0.10	11.58	1.71	0.91	0.64
8.52	0.71	0.18	0.10	11.64	1.78	0.97	0.84
8.58	0.72	0.18	0.11	11.70	1.87	1.05	1.11
8.64	0.73	0.19	0.11	11.76	1.98	1.14	1.39
8.70	0.74	0.19	0.12	11.82	2.10	1.25	1.68
8.76	0.76	0.20	0.12	11.88	2.24	1.38	1.98
8.82	0.77	0.21	0.12	11.94	2.43	1.55	2.35
8.88	0.78	0.21	0.13	12.00	2.75	1.84	3.42
8.94	0.79	0.22	0.13	12.06	3.08	2.15	5.11
9.00	0.80	0.23	0.13	12.12	3.27	2.32	4.94
9.06	0.82	0.24	0.14	12.18	3.41	2.46	3.48
9.12	0.83	0.25	0.14	12.24	3.53	2.57	2.63
9.18	0.84	0.25	0.15	12.30	3.64	2.67	2.20
9.24	0.85	0.26	0.15	12.36	3.73	2.76	1.87
9.30	0.87	0.27	0.15	12.42	3.80	2.83	1.57

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	3.85	2.88	1.26	15.60	4.82	3.81	0.19
12.54	3.89	2.92	0.97	15.66	4.83	3.82	0.18
12.60	3.93	2.95	0.76	15.72	4.84	3.83	0.18
12.66	3.97	2.99	0.67	15.78	4.85	3.84	0.17
12.72	4.00	3.02	0.63	15.84	4.86	3.84	0.17
12.78	4.03	3.05	0.59	15.90	4.87	3.85	0.17
12.84	4.06	3.08	0.56	15.96	4.88	3.86	0.16
12.90	4.09	3.10	0.53	16.02	4.88	3.87	0.16
12.96	4.12	3.13	0.50	16.08	4.89	3.88	0.15
13.02	4.14	3.15	0.46	16.14	4.90	3.89	0.15
13.08	4.16	3.17	0.44	16.20	4.91	3.89	0.15
13.14	4.19	3.20	0.42	16.26	4.92	3.90	0.15
13.20	4.21	3.22	0.41	16.32	4.93	3.91	0.15
13.26	4.23	3.24	0.40	16.38	4.93	3.92	0.14
13.32	4.25	3.26	0.39	16.44	4.94	3.93	0.14
13.38	4.28	3.28	0.39	16.50	4.95	3.93	0.14
13.44	4.30	3.30	0.38	16.56	4.96	3.94	0.14
13.50	4.32	3.32	0.37	16.62	4.97	3.95	0.14
13.56	4.34	3.34	0.36	16.68	4.97	3.96	0.14
13.62	4.36	3.36	0.35	16.74	4.98	3.96	0.13
13.68	4.38	3.38	0.34	16.80	4.99	3.97	0.13
13.74	4.39	3.40	0.34	16.86	4.99	3.98	0.13
13.80	4.41	3.41	0.33	16.92	5.00	3.98	0.13
13.86	4.43	3.43	0.32	16.98	5.01	3.99	0.13
13.92	4.45	3.45	0.31	17.04	5.02	4.00	0.13
13.98	4.46	3.46	0.30	17.10	5.02	4.00	0.12
14.04	4.48	3.48	0.29	17.16	5.03	4.01	0.12
14.10	4.50	3.49	0.29	17.22	5.04	4.02	0.12
14.16	4.51	3.51	0.28	17.28	5.04	4.02	0.12
14.22	4.53	3.52	0.28	17.34	5.05	4.03	0.12
14.28	4.54	3.54	0.27	17.40	5.06	4.04	0.11
14.34	4.56	3.55	0.27	17.46	5.06	4.04	0.11
14.40	4.57	3.57	0.27	17.52	5.07	4.05	0.11
14.46	4.59	3.58	0.26	17.58	5.07	4.05	0.11
14.52	4.60	3.60	0.26	17.64	5.08	4.06	0.11
14.58	4.61	3.61	0.25	17.70	5.09	4.07	0.11
14.64	4.63	3.62	0.25	17.76	5.09	4.07	0.10
14.70	4.64	3.64	0.25	17.82	5.10	4.08	0.10
14.76	4.66	3.65	0.24	17.88	5.10	4.08	0.10
14.82	4.67	3.66	0.24	17.94	5.11	4.09	0.10
14.88	4.68	3.67	0.23	18.00	5.11	4.09	0.10
14.94	4.69	3.69	0.23	18.06	5.12	4.10	0.10
15.00	4.71	3.70	0.23	18.12	5.12	4.10	0.09
15.06	4.72	3.71	0.22	18.18	5.13	4.11	0.09
15.12	4.73	3.72	0.22	18.24	5.13	4.11	0.09
15.18	4.74	3.73	0.21	18.30	5.14	4.12	0.09
15.24	4.75	3.74	0.21	18.36	5.14	4.12	0.09
15.30	4.77	3.76	0.21	18.42	5.15	4.13	0.09
15.36	4.78	3.77	0.20	18.48	5.15	4.13	0.09
15.42	4.79	3.78	0.20	18.54	5.16	4.14	0.09
15.48	4.80	3.79	0.19	18.60	5.16	4.14	0.09
15.54	4.81	3.80	0.19	18.66	5.17	4.15	0.09

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	5.17	4.15	0.09	21.84	5.39	4.37	0.07
18.78	5.18	4.16	0.09	21.90	5.40	4.37	0.06
18.84	5.18	4.16	0.09	21.96	5.40	4.37	0.06
18.90	5.19	4.17	0.09	22.02	5.41	4.38	0.06
18.96	5.19	4.17	0.09	22.08	5.41	4.38	0.06
19.02	5.20	4.18	0.09	22.14	5.41	4.38	0.06
19.08	5.20	4.18	0.09	22.20	5.42	4.39	0.06
19.14	5.21	4.18	0.09	22.26	5.42	4.39	0.06
19.20	5.21	4.19	0.08	22.32	5.42	4.39	0.06
19.26	5.22	4.19	0.08	22.38	5.43	4.40	0.06
19.32	5.22	4.20	0.08	22.44	5.43	4.40	0.06
19.38	5.23	4.20	0.08	22.50	5.43	4.40	0.06
19.44	5.23	4.21	0.08	22.56	5.44	4.41	0.06
19.50	5.24	4.21	0.08	22.62	5.44	4.41	0.06
19.56	5.24	4.22	0.08	22.68	5.44	4.41	0.06
19.62	5.25	4.22	0.08	22.74	5.45	4.42	0.06
19.68	5.25	4.22	0.08	22.80	5.45	4.42	0.06
19.74	5.25	4.23	0.08	22.86	5.45	4.42	0.06
19.80	5.26	4.23	0.08	22.92	5.46	4.43	0.06
19.86	5.26	4.24	0.08	22.98	5.46	4.43	0.06
19.92	5.27	4.24	0.08	23.04	5.46	4.43	0.06
19.98	5.27	4.25	0.08	23.10	5.47	4.43	0.06
20.04	5.28	4.25	0.08	23.16	5.47	4.44	0.06
20.10	5.28	4.25	0.08	23.22	5.47	4.44	0.06
20.16	5.28	4.26	0.08	23.28	5.47	4.44	0.06
20.22	5.29	4.26	0.08	23.34	5.48	4.45	0.06
20.28	5.29	4.27	0.08	23.40	5.48	4.45	0.05
20.34	5.30	4.27	0.08	23.46	5.48	4.45	0.05
20.40	5.30	4.27	0.07	23.52	5.49	4.46	0.05
20.46	5.31	4.28	0.07	23.58	5.49	4.46	0.05
20.52	5.31	4.28	0.07	23.64	5.49	4.46	0.05
20.58	5.31	4.29	0.07	23.70	5.50	4.46	0.05
20.64	5.32	4.29	0.07	23.76	5.50	4.47	0.05
20.70	5.32	4.29	0.07	23.82	5.50	4.47	0.05
20.76	5.33	4.30	0.07	23.88	5.50	4.47	0.05
20.82	5.33	4.30	0.07	23.94	5.51	4.48	0.05
20.88	5.33	4.31	0.07	24.00	5.51	4.48	0.05
20.94	5.34	4.31	0.07				
21.00	5.34	4.31	0.07				
21.06	5.35	4.32	0.07				
21.12	5.35	4.32	0.07				
21.18	5.35	4.33	0.07				
21.24	5.36	4.33	0.07				
21.30	5.36	4.33	0.07				
21.36	5.36	4.34	0.07				
21.42	5.37	4.34	0.07				
21.48	5.37	4.34	0.07				
21.54	5.38	4.35	0.07				
21.60	5.38	4.35	0.07				
21.66	5.38	4.36	0.07				
21.72	5.39	4.36	0.07				
21.78	5.39	4.36	0.07				

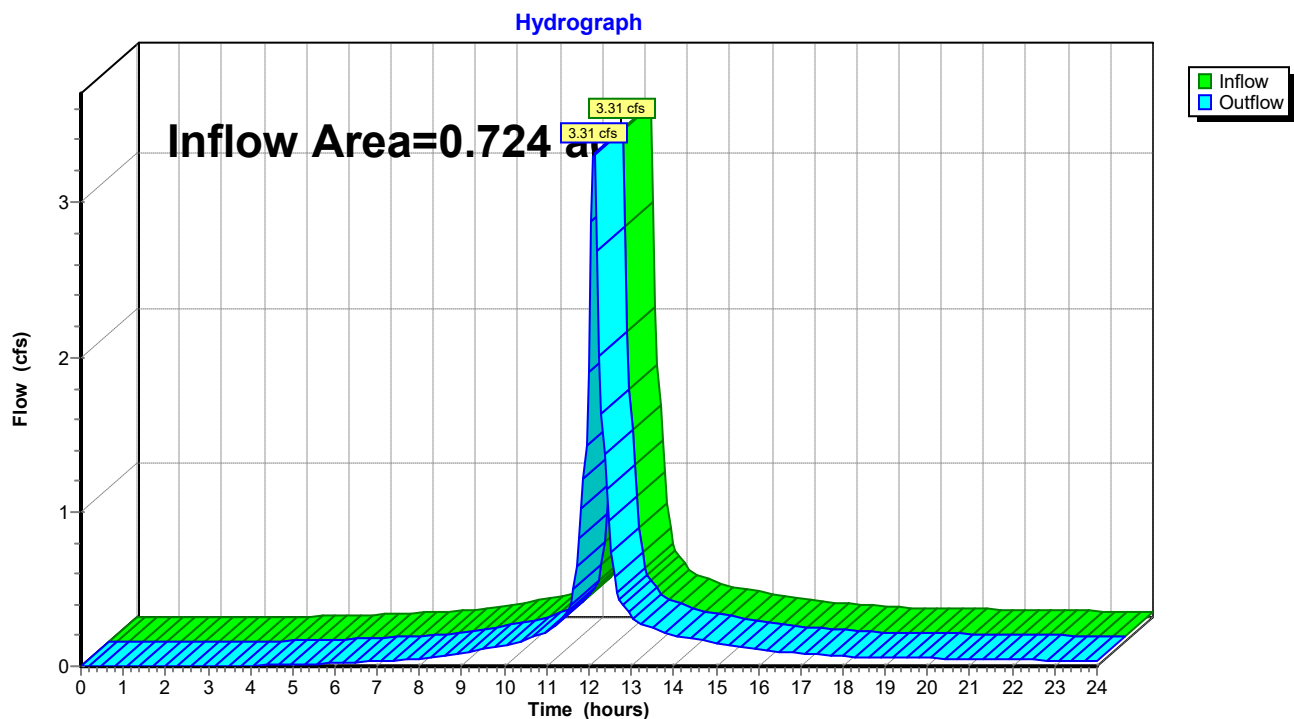
Summary for Reach 4R: Design Point A

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.724 ac, 72.79% Impervious, Inflow Depth > 4.47" for 10 Year event
 Inflow = 3.31 cfs @ 12.11 hrs, Volume= 0.270 af
 Outflow = 3.31 cfs @ 12.11 hrs, Volume= 0.270 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Reach 4R: Design Point A



Hydrograph for Reach 4R: Design Point A

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	3.12	0.00		0.00
0.06	0.00		0.00	3.18	0.00		0.00
0.12	0.00		0.00	3.24	0.00		0.00
0.18	0.00		0.00	3.30	0.00		0.00
0.24	0.00		0.00	3.36	0.00		0.00
0.30	0.00		0.00	3.42	0.00		0.00
0.36	0.00		0.00	3.48	0.00		0.00
0.42	0.00		0.00	3.54	0.00		0.00
0.48	0.00		0.00	3.60	0.00		0.00
0.54	0.00		0.00	3.66	0.00		0.00
0.60	0.00		0.00	3.72	0.00		0.00
0.66	0.00		0.00	3.78	0.00		0.00
0.72	0.00		0.00	3.84	0.00		0.00
0.78	0.00		0.00	3.90	0.00		0.00
0.84	0.00		0.00	3.96	0.00		0.00
0.90	0.00		0.00	4.02	0.00		0.00
0.96	0.00		0.00	4.08	0.00		0.00
1.02	0.00		0.00	4.14	0.00		0.00
1.08	0.00		0.00	4.20	0.00		0.00
1.14	0.00		0.00	4.26	0.00		0.00
1.20	0.00		0.00	4.32	0.01		0.01
1.26	0.00		0.00	4.38	0.01		0.01
1.32	0.00		0.00	4.44	0.01		0.01
1.38	0.00		0.00	4.50	0.01		0.01
1.44	0.00		0.00	4.56	0.01		0.01
1.50	0.00		0.00	4.62	0.01		0.01
1.56	0.00		0.00	4.68	0.01		0.01
1.62	0.00		0.00	4.74	0.01		0.01
1.68	0.00		0.00	4.80	0.01		0.01
1.74	0.00		0.00	4.86	0.01		0.01
1.80	0.00		0.00	4.92	0.01		0.01
1.86	0.00		0.00	4.98	0.01		0.01
1.92	0.00		0.00	5.04	0.01		0.01
1.98	0.00		0.00	5.10	0.01		0.01
2.04	0.00		0.00	5.16	0.01		0.01
2.10	0.00		0.00	5.22	0.01		0.01
2.16	0.00		0.00	5.28	0.01		0.01
2.22	0.00		0.00	5.34	0.01		0.01
2.28	0.00		0.00	5.40	0.01		0.01
2.34	0.00		0.00	5.46	0.01		0.01
2.40	0.00		0.00	5.52	0.01		0.01
2.46	0.00		0.00	5.58	0.02		0.02
2.52	0.00		0.00	5.64	0.02		0.02
2.58	0.00		0.00	5.70	0.02		0.02
2.64	0.00		0.00	5.76	0.02		0.02
2.70	0.00		0.00	5.82	0.02		0.02
2.76	0.00		0.00	5.88	0.02		0.02
2.82	0.00		0.00	5.94	0.02		0.02
2.88	0.00		0.00	6.00	0.02		0.02
2.94	0.00		0.00	6.06	0.02		0.02
3.00	0.00		0.00	6.12	0.02		0.02
3.06	0.00		0.00	6.18	0.02		0.02

Hydrograph for Reach 4R: Design Point A (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
6.24	0.02		0.02	9.36	0.10		0.10
6.30	0.02		0.02	9.42	0.11		0.11
6.36	0.02		0.02	9.48	0.11		0.11
6.42	0.02		0.02	9.54	0.11		0.11
6.48	0.02		0.02	9.60	0.11		0.11
6.54	0.03		0.03	9.66	0.12		0.12
6.60	0.03		0.03	9.72	0.12		0.12
6.66	0.03		0.03	9.78	0.12		0.12
6.72	0.03		0.03	9.84	0.13		0.13
6.78	0.03		0.03	9.90	0.13		0.13
6.84	0.03		0.03	9.96	0.13		0.13
6.90	0.03		0.03	10.02	0.13		0.13
6.96	0.03		0.03	10.08	0.14		0.14
7.02	0.03		0.03	10.14	0.14		0.14
7.08	0.03		0.03	10.20	0.15		0.15
7.14	0.04		0.04	10.26	0.15		0.15
7.20	0.04		0.04	10.32	0.16		0.16
7.26	0.04		0.04	10.38	0.16		0.16
7.32	0.04		0.04	10.44	0.17		0.17
7.38	0.04		0.04	10.50	0.17		0.17
7.44	0.04		0.04	10.56	0.18		0.18
7.50	0.04		0.04	10.62	0.18		0.18
7.56	0.04		0.04	10.68	0.19		0.19
7.62	0.04		0.04	10.74	0.20		0.20
7.68	0.04		0.04	10.80	0.20		0.20
7.74	0.05		0.05	10.86	0.21		0.21
7.80	0.05		0.05	10.92	0.21		0.21
7.86	0.05		0.05	10.98	0.22		0.22
7.92	0.05		0.05	11.04	0.22		0.22
7.98	0.05		0.05	11.10	0.23		0.23
8.04	0.05		0.05	11.16	0.25		0.25
8.10	0.05		0.05	11.22	0.26		0.26
8.16	0.06		0.06	11.28	0.28		0.28
8.22	0.06		0.06	11.34	0.30		0.30
8.28	0.06		0.06	11.40	0.32		0.32
8.34	0.06		0.06	11.46	0.34		0.34
8.40	0.06		0.06	11.52	0.36		0.36
8.46	0.07		0.07	11.58	0.40		0.40
8.52	0.07		0.07	11.64	0.50		0.50
8.58	0.07		0.07	11.70	0.65		0.65
8.64	0.07		0.07	11.76	0.83		0.83
8.70	0.08		0.08	11.82	1.01		1.01
8.76	0.08		0.08	11.88	1.21		1.21
8.82	0.08		0.08	11.94	1.43		1.43
8.88	0.08		0.08	12.00	1.90		1.90
8.94	0.08		0.08	12.06	2.87		2.87
9.00	0.09		0.09	12.12	3.31		3.31
9.06	0.09		0.09	12.18	2.68		2.68
9.12	0.09		0.09	12.24	2.01		2.01
9.18	0.10		0.10	12.30	1.63		1.63
9.24	0.10		0.10	12.36	1.37		1.37
9.30	0.10		0.10	12.42	1.15		1.15

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

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Hydrograph for Reach 4R: Design Point A (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
12.48	0.94		0.94	15.60	0.12		0.12
12.54	0.74		0.74	15.66	0.12		0.12
12.60	0.57		0.57	15.72	0.12		0.12
12.66	0.48		0.48	15.78	0.12		0.12
12.72	0.43		0.43	15.84	0.11		0.11
12.78	0.41		0.41	15.90	0.11		0.11
12.84	0.38		0.38	15.96	0.11		0.11
12.90	0.36		0.36	16.02	0.11		0.11
12.96	0.34		0.34	16.08	0.10		0.10
13.02	0.32		0.32	16.14	0.10		0.10
13.08	0.30		0.30	16.20	0.10		0.10
13.14	0.28		0.28	16.26	0.10		0.10
13.20	0.28		0.28	16.32	0.10		0.10
13.26	0.27		0.27	16.38	0.10		0.10
13.32	0.26		0.26	16.44	0.10		0.10
13.38	0.26		0.26	16.50	0.09		0.09
13.44	0.25		0.25	16.56	0.09		0.09
13.50	0.25		0.25	16.62	0.09		0.09
13.56	0.24		0.24	16.68	0.09		0.09
13.62	0.24		0.24	16.74	0.09		0.09
13.68	0.23		0.23	16.80	0.09		0.09
13.74	0.23		0.23	16.86	0.09		0.09
13.80	0.22		0.22	16.92	0.09		0.09
13.86	0.21		0.21	16.98	0.08		0.08
13.92	0.21		0.21	17.04	0.08		0.08
13.98	0.20		0.20	17.10	0.08		0.08
14.04	0.20		0.20	17.16	0.08		0.08
14.10	0.19		0.19	17.22	0.08		0.08
14.16	0.19		0.19	17.28	0.08		0.08
14.22	0.19		0.19	17.34	0.08		0.08
14.28	0.18		0.18	17.40	0.08		0.08
14.34	0.18		0.18	17.46	0.08		0.08
14.40	0.18		0.18	17.52	0.07		0.07
14.46	0.18		0.18	17.58	0.07		0.07
14.52	0.17		0.17	17.64	0.07		0.07
14.58	0.17		0.17	17.70	0.07		0.07
14.64	0.17		0.17	17.76	0.07		0.07
14.70	0.16		0.16	17.82	0.07		0.07
14.76	0.16		0.16	17.88	0.07		0.07
14.82	0.16		0.16	17.94	0.07		0.07
14.88	0.16		0.16	18.00	0.06		0.06
14.94	0.15		0.15	18.06	0.06		0.06
15.00	0.15		0.15	18.12	0.06		0.06
15.06	0.15		0.15	18.18	0.06		0.06
15.12	0.15		0.15	18.24	0.06		0.06
15.18	0.14		0.14	18.30	0.06		0.06
15.24	0.14		0.14	18.36	0.06		0.06
15.30	0.14		0.14	18.42	0.06		0.06
15.36	0.14		0.14	18.48	0.06		0.06
15.42	0.13		0.13	18.54	0.06		0.06
15.48	0.13		0.13	18.60	0.06		0.06
15.54	0.13		0.13	18.66	0.06		0.06

Hydrograph for Reach 4R: Design Point A (continued)

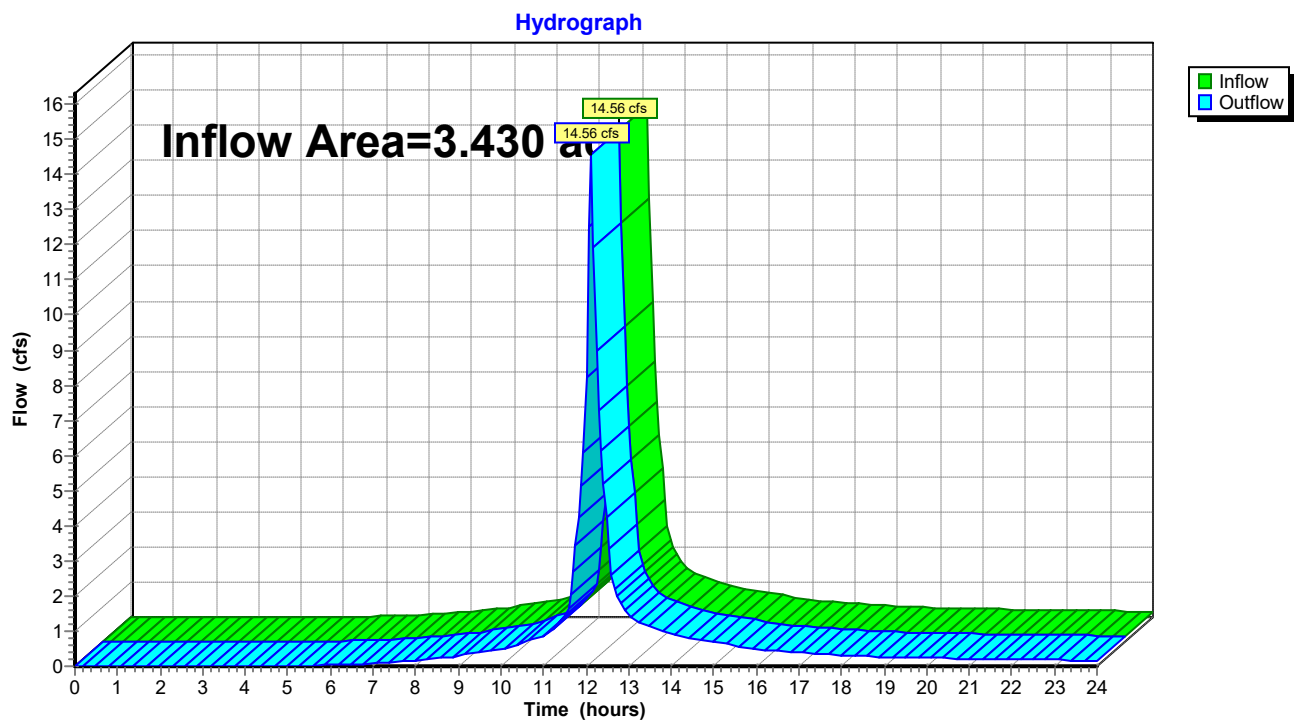
Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
18.72	0.06		0.06	21.84	0.04		0.04
18.78	0.06		0.06	21.90	0.04		0.04
18.84	0.06		0.06	21.96	0.04		0.04
18.90	0.06		0.06	22.02	0.04		0.04
18.96	0.06		0.06	22.08	0.04		0.04
19.02	0.06		0.06	22.14	0.04		0.04
19.08	0.06		0.06	22.20	0.04		0.04
19.14	0.06		0.06	22.26	0.04		0.04
19.20	0.06		0.06	22.32	0.04		0.04
19.26	0.06		0.06	22.38	0.04		0.04
19.32	0.06		0.06	22.44	0.04		0.04
19.38	0.06		0.06	22.50	0.04		0.04
19.44	0.05		0.05	22.56	0.04		0.04
19.50	0.05		0.05	22.62	0.04		0.04
19.56	0.05		0.05	22.68	0.04		0.04
19.62	0.05		0.05	22.74	0.04		0.04
19.68	0.05		0.05	22.80	0.04		0.04
19.74	0.05		0.05	22.86	0.04		0.04
19.80	0.05		0.05	22.92	0.04		0.04
19.86	0.05		0.05	22.98	0.04		0.04
19.92	0.05		0.05	23.04	0.04		0.04
19.98	0.05		0.05	23.10	0.04		0.04
20.04	0.05		0.05	23.16	0.04		0.04
20.10	0.05		0.05	23.22	0.04		0.04
20.16	0.05		0.05	23.28	0.04		0.04
20.22	0.05		0.05	23.34	0.04		0.04
20.28	0.05		0.05	23.40	0.04		0.04
20.34	0.05		0.05	23.46	0.04		0.04
20.40	0.05		0.05	23.52	0.04		0.04
20.46	0.05		0.05	23.58	0.04		0.04
20.52	0.05		0.05	23.64	0.04		0.04
20.58	0.05		0.05	23.70	0.04		0.04
20.64	0.05		0.05	23.76	0.03		0.03
20.70	0.05		0.05	23.82	0.03		0.03
20.76	0.05		0.05	23.88	0.03		0.03
20.82	0.05		0.05	23.94	0.03		0.03
20.88	0.05		0.05	24.00	0.03		0.03
20.94	0.05		0.05				
21.00	0.05		0.05				
21.06	0.05		0.05				
21.12	0.05		0.05				
21.18	0.05		0.05				
21.24	0.05		0.05				
21.30	0.05		0.05				
21.36	0.05		0.05				
21.42	0.05		0.05				
21.48	0.04		0.04				
21.54	0.04		0.04				
21.60	0.04		0.04				
21.66	0.04		0.04				
21.72	0.04		0.04				
21.78	0.04		0.04				

Summary for Reach 5R: Design Point B

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.430 ac, 56.15% Impervious, Inflow Depth > 4.05" for 10 Year event
Inflow = 14.56 cfs @ 12.12 hrs, Volume= 1.156 af
Outflow = 14.56 cfs @ 12.12 hrs, Volume= 1.156 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Reach 5R: Design Point B

Hydrograph for Reach 5R: Design Point B

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	3.12	0.00		0.00
0.06	0.00		0.00	3.18	0.00		0.00
0.12	0.00		0.00	3.24	0.00		0.00
0.18	0.00		0.00	3.30	0.00		0.00
0.24	0.00		0.00	3.36	0.00		0.00
0.30	0.00		0.00	3.42	0.00		0.00
0.36	0.00		0.00	3.48	0.00		0.00
0.42	0.00		0.00	3.54	0.00		0.00
0.48	0.00		0.00	3.60	0.00		0.00
0.54	0.00		0.00	3.66	0.00		0.00
0.60	0.00		0.00	3.72	0.00		0.00
0.66	0.00		0.00	3.78	0.00		0.00
0.72	0.00		0.00	3.84	0.00		0.00
0.78	0.00		0.00	3.90	0.00		0.00
0.84	0.00		0.00	3.96	0.00		0.00
0.90	0.00		0.00	4.02	0.00		0.00
0.96	0.00		0.00	4.08	0.00		0.00
1.02	0.00		0.00	4.14	0.00		0.00
1.08	0.00		0.00	4.20	0.00		0.00
1.14	0.00		0.00	4.26	0.00		0.00
1.20	0.00		0.00	4.32	0.00		0.00
1.26	0.00		0.00	4.38	0.00		0.00
1.32	0.00		0.00	4.44	0.00		0.00
1.38	0.00		0.00	4.50	0.00		0.00
1.44	0.00		0.00	4.56	0.00		0.00
1.50	0.00		0.00	4.62	0.00		0.00
1.56	0.00		0.00	4.68	0.00		0.00
1.62	0.00		0.00	4.74	0.00		0.00
1.68	0.00		0.00	4.80	0.00		0.00
1.74	0.00		0.00	4.86	0.00		0.00
1.80	0.00		0.00	4.92	0.00		0.00
1.86	0.00		0.00	4.98	0.00		0.00
1.92	0.00		0.00	5.04	0.00		0.00
1.98	0.00		0.00	5.10	0.00		0.00
2.04	0.00		0.00	5.16	0.01		0.01
2.10	0.00		0.00	5.22	0.01		0.01
2.16	0.00		0.00	5.28	0.01		0.01
2.22	0.00		0.00	5.34	0.01		0.01
2.28	0.00		0.00	5.40	0.01		0.01
2.34	0.00		0.00	5.46	0.02		0.02
2.40	0.00		0.00	5.52	0.02		0.02
2.46	0.00		0.00	5.58	0.02		0.02
2.52	0.00		0.00	5.64	0.02		0.02
2.58	0.00		0.00	5.70	0.02		0.02
2.64	0.00		0.00	5.76	0.02		0.02
2.70	0.00		0.00	5.82	0.03		0.03
2.76	0.00		0.00	5.88	0.03		0.03
2.82	0.00		0.00	5.94	0.03		0.03
2.88	0.00		0.00	6.00	0.03		0.03
2.94	0.00		0.00	6.06	0.03		0.03
3.00	0.00		0.00	6.12	0.04		0.04
3.06	0.00		0.00	6.18	0.04		0.04

2021-07-8 Post Orangetown Town Hall

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Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
6.24	0.04		0.04	9.36	0.36		0.36
6.30	0.04		0.04	9.42	0.37		0.37
6.36	0.05		0.05	9.48	0.38		0.38
6.42	0.05		0.05	9.54	0.39		0.39
6.48	0.05		0.05	9.60	0.41		0.41
6.54	0.06		0.06	9.66	0.42		0.42
6.60	0.06		0.06	9.72	0.43		0.43
6.66	0.06		0.06	9.78	0.44		0.44
6.72	0.06		0.06	9.84	0.46		0.46
6.78	0.07		0.07	9.90	0.47		0.47
6.84	0.07		0.07	9.96	0.48		0.48
6.90	0.08		0.08	10.02	0.49		0.49
6.96	0.08		0.08	10.08	0.51		0.51
7.02	0.08		0.08	10.14	0.53		0.53
7.08	0.09		0.09	10.20	0.55		0.55
7.14	0.09		0.09	10.26	0.57		0.57
7.20	0.09		0.09	10.32	0.59		0.59
7.26	0.10		0.10	10.38	0.61		0.61
7.32	0.10		0.10	10.44	0.63		0.63
7.38	0.11		0.11	10.50	0.66		0.66
7.44	0.11		0.11	10.56	0.68		0.68
7.50	0.11		0.11	10.62	0.71		0.71
7.56	0.12		0.12	10.68	0.73		0.73
7.62	0.12		0.12	10.74	0.76		0.76
7.68	0.13		0.13	10.80	0.78		0.78
7.74	0.13		0.13	10.86	0.81		0.81
7.80	0.14		0.14	10.92	0.83		0.83
7.86	0.14		0.14	10.98	0.86		0.86
7.92	0.15		0.15	11.04	0.89		0.89
7.98	0.15		0.15	11.10	0.92		0.92
8.04	0.16		0.16	11.16	0.98		0.98
8.10	0.16		0.16	11.22	1.05		1.05
8.16	0.17		0.17	11.28	1.13		1.13
8.22	0.18		0.18	11.34	1.22		1.22
8.28	0.18		0.18	11.40	1.30		1.30
8.34	0.19		0.19	11.46	1.39		1.39
8.40	0.20		0.20	11.52	1.48		1.48
8.46	0.21		0.21	11.58	1.63		1.63
8.52	0.22		0.22	11.64	2.04		2.04
8.58	0.23		0.23	11.70	2.68		2.68
8.64	0.23		0.23	11.76	3.44		3.44
8.70	0.24		0.24	11.82	4.26		4.26
8.76	0.25		0.25	11.88	5.12		5.12
8.82	0.26		0.26	11.94	6.09		6.09
8.88	0.27		0.27	12.00	8.21		8.21
8.94	0.28		0.28	12.06	12.53		12.53
9.00	0.29		0.29	12.12	14.55		14.55
9.06	0.30		0.30	12.18	11.90		11.90
9.12	0.31		0.31	12.24	8.96		8.96
9.18	0.33		0.33	12.30	7.29		7.29
9.24	0.34		0.34	12.36	6.15		6.15
9.30	0.35		0.35	12.42	5.17		5.17

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

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Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
12.48	4.25		4.25	15.60	0.57		0.57
12.54	3.35		3.35	15.66	0.56		0.56
12.60	2.59		2.59	15.72	0.55		0.55
12.66	2.18		2.18	15.78	0.54		0.54
12.72	1.97		1.97	15.84	0.52		0.52
12.78	1.84		1.84	15.90	0.51		0.51
12.84	1.74		1.74	15.96	0.50		0.50
12.90	1.64		1.64	16.02	0.49		0.49
12.96	1.54		1.54	16.08	0.48		0.48
13.02	1.45		1.45	16.14	0.47		0.47
13.08	1.36		1.36	16.20	0.46		0.46
13.14	1.30		1.30	16.26	0.45		0.45
13.20	1.26		1.26	16.32	0.45		0.45
13.26	1.23		1.23	16.38	0.44		0.44
13.32	1.20		1.20	16.44	0.44		0.44
13.38	1.18		1.18	16.50	0.43		0.43
13.44	1.15		1.15	16.56	0.43		0.43
13.50	1.13		1.13	16.62	0.42		0.42
13.56	1.10		1.10	16.68	0.42		0.42
13.62	1.08		1.08	16.74	0.41		0.41
13.68	1.05		1.05	16.80	0.41		0.41
13.74	1.03		1.03	16.86	0.40		0.40
13.80	1.00		1.00	16.92	0.40		0.40
13.86	0.98		0.98	16.98	0.39		0.39
13.92	0.95		0.95	17.04	0.38		0.38
13.98	0.93		0.93	17.10	0.38		0.38
14.04	0.90		0.90	17.16	0.37		0.37
14.10	0.88		0.88	17.22	0.37		0.37
14.16	0.86		0.86	17.28	0.36		0.36
14.22	0.85		0.85	17.34	0.36		0.36
14.28	0.84		0.84	17.40	0.35		0.35
14.34	0.83		0.83	17.46	0.35		0.35
14.40	0.81		0.81	17.52	0.34		0.34
14.46	0.80		0.80	17.58	0.34		0.34
14.52	0.79		0.79	17.64	0.33		0.33
14.58	0.78		0.78	17.70	0.33		0.33
14.64	0.77		0.77	17.76	0.32		0.32
14.70	0.75		0.75	17.82	0.31		0.31
14.76	0.74		0.74	17.88	0.31		0.31
14.82	0.73		0.73	17.94	0.30		0.30
14.88	0.72		0.72	18.00	0.30		0.30
14.94	0.71		0.71	18.06	0.29		0.29
15.00	0.69		0.69	18.12	0.29		0.29
15.06	0.68		0.68	18.18	0.29		0.29
15.12	0.67		0.67	18.24	0.28		0.28
15.18	0.66		0.66	18.30	0.28		0.28
15.24	0.65		0.65	18.36	0.28		0.28
15.30	0.63		0.63	18.42	0.28		0.28
15.36	0.62		0.62	18.48	0.28		0.28
15.42	0.61		0.61	18.54	0.28		0.28
15.48	0.60		0.60	18.60	0.28		0.28
15.54	0.58		0.58	18.66	0.27		0.27

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

Prepared by Tectonic Engineering

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Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
18.72	0.27		0.27	21.84	0.20		0.20
18.78	0.27		0.27	21.90	0.20		0.20
18.84	0.27		0.27	21.96	0.20		0.20
18.90	0.27		0.27	22.02	0.20		0.20
18.96	0.27		0.27	22.08	0.20		0.20
19.02	0.26		0.26	22.14	0.19		0.19
19.08	0.26		0.26	22.20	0.19		0.19
19.14	0.26		0.26	22.26	0.19		0.19
19.20	0.26		0.26	22.32	0.19		0.19
19.26	0.26		0.26	22.38	0.19		0.19
19.32	0.26		0.26	22.44	0.19		0.19
19.38	0.25		0.25	22.50	0.19		0.19
19.44	0.25		0.25	22.56	0.19		0.19
19.50	0.25		0.25	22.62	0.18		0.18
19.56	0.25		0.25	22.68	0.18		0.18
19.62	0.25		0.25	22.74	0.18		0.18
19.68	0.25		0.25	22.80	0.18		0.18
19.74	0.24		0.24	22.86	0.18		0.18
19.80	0.24		0.24	22.92	0.18		0.18
19.86	0.24		0.24	22.98	0.18		0.18
19.92	0.24		0.24	23.04	0.18		0.18
19.98	0.24		0.24	23.10	0.17		0.17
20.04	0.24		0.24	23.16	0.17		0.17
20.10	0.24		0.24	23.22	0.17		0.17
20.16	0.23		0.23	23.28	0.17		0.17
20.22	0.23		0.23	23.34	0.17		0.17
20.28	0.23		0.23	23.40	0.17		0.17
20.34	0.23		0.23	23.46	0.17		0.17
20.40	0.23		0.23	23.52	0.17		0.17
20.46	0.23		0.23	23.58	0.16		0.16
20.52	0.23		0.23	23.64	0.16		0.16
20.58	0.23		0.23	23.70	0.16		0.16
20.64	0.22		0.22	23.76	0.16		0.16
20.70	0.22		0.22	23.82	0.16		0.16
20.76	0.22		0.22	23.88	0.16		0.16
20.82	0.22		0.22	23.94	0.16		0.16
20.88	0.22		0.22	24.00	0.16		0.16
20.94	0.22		0.22				
21.00	0.22		0.22				
21.06	0.22		0.22				
21.12	0.21		0.21				
21.18	0.21		0.21				
21.24	0.21		0.21				
21.30	0.21		0.21				
21.36	0.21		0.21				
21.42	0.21		0.21				
21.48	0.21		0.21				
21.54	0.21		0.21				
21.60	0.20		0.20				
21.66	0.20		0.20				
21.72	0.20		0.20				
21.78	0.20		0.20				

Summary for Pond 6P: Detention

Inflow Area = 1.094 ac, 69.84% Impervious, Inflow Depth > 4.48" for 10 Year event
 Inflow = 5.26 cfs @ 12.08 hrs, Volume= 0.408 af
 Outflow = 3.92 cfs @ 12.17 hrs, Volume= 0.402 af, Atten= 25%, Lag= 5.3 min
 Primary = 3.92 cfs @ 12.17 hrs, Volume= 0.402 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
 Peak Elev= 215.05' @ 12.17 hrs Surf.Area= 1,404 sf Storage= 3,181 cf

Plug-Flow detention time= 44.5 min calculated for 0.401 af (98% of inflow)
 Center-of-Mass det. time= 35.9 min (819.2 - 783.3)

Volume	Invert	Avail.Storage	Storage Description
#1	212.66'	4,725 cf	ACF R-Tank LD 2.5 x 456 Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf 456 Chambers in 19 Rows

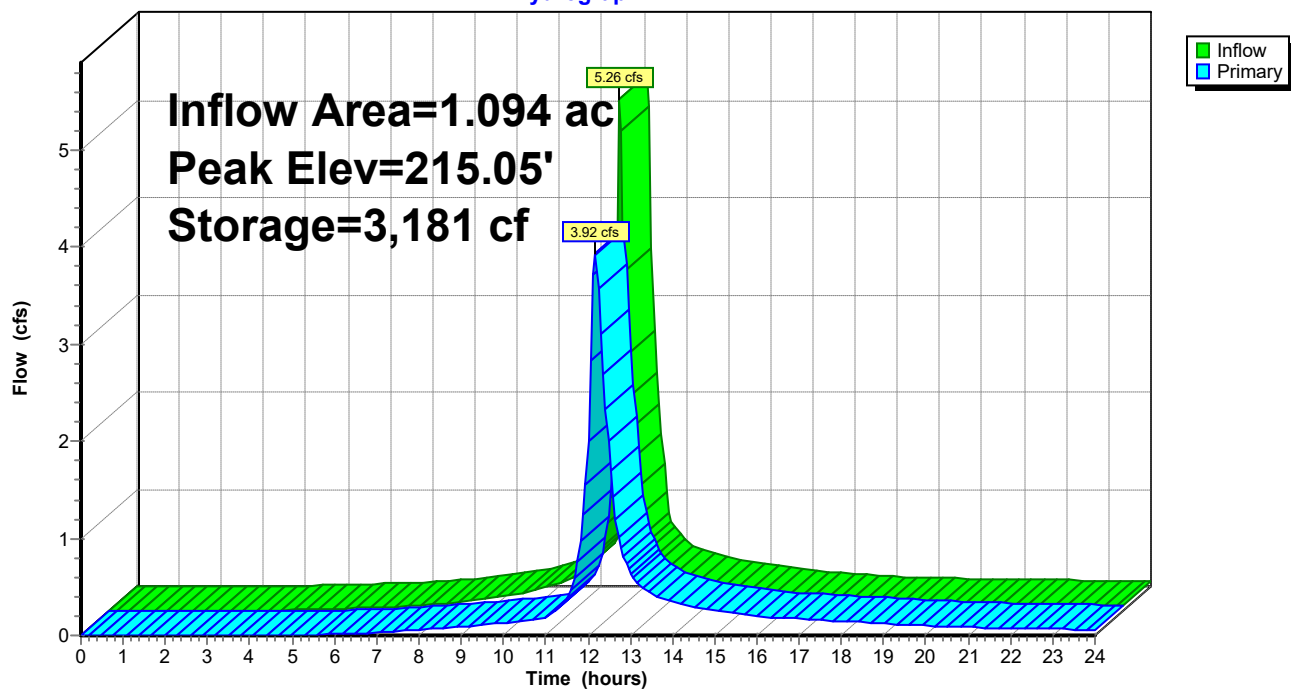
Device	Routing	Invert	Outlet Devices
#1	Primary	212.66'	3.0" Vert. Orifice/Grate C= 0.600
#2	Primary	213.38'	0.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	215.38'	1.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=3.89 cfs @ 12.17 hrs HW=215.04' (Free Discharge)

1=Orifice/Grate (Orifice Controls 0.35 cfs @ 7.22 fps)
 2=Broad-Crested Rectangular Weir (Weir Controls 3.54 cfs @ 4.27 fps)
 3=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 6P: Detention

Hydrograph



2021-07-8 Post Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

Prepared by Tectonic Engineering

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Hydrograph for Pond 6P: Detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	212.66	0.00
0.06	0.00	0	212.66	0.00
0.12	0.00	0	212.66	0.00
0.18	0.00	0	212.66	0.00
0.24	0.00	0	212.66	0.00
0.30	0.00	0	212.66	0.00
0.36	0.00	0	212.66	0.00
0.42	0.00	0	212.66	0.00
0.48	0.00	0	212.66	0.00
0.54	0.00	0	212.66	0.00
0.60	0.00	0	212.66	0.00
0.66	0.00	0	212.66	0.00
0.72	0.00	0	212.66	0.00
0.78	0.00	0	212.66	0.00
0.84	0.00	0	212.66	0.00
0.90	0.00	0	212.66	0.00
0.96	0.00	0	212.66	0.00
1.02	0.00	0	212.66	0.00
1.08	0.00	0	212.66	0.00
1.14	0.00	0	212.66	0.00
1.20	0.00	0	212.66	0.00
1.26	0.00	0	212.66	0.00
1.32	0.00	0	212.66	0.00
1.38	0.00	0	212.66	0.00
1.44	0.00	0	212.66	0.00
1.50	0.00	0	212.66	0.00
1.56	0.00	0	212.66	0.00
1.62	0.00	0	212.66	0.00
1.68	0.00	0	212.66	0.00
1.74	0.00	0	212.66	0.00
1.80	0.00	0	212.66	0.00
1.86	0.00	0	212.66	0.00
1.92	0.00	0	212.66	0.00
1.98	0.00	0	212.66	0.00
2.04	0.00	0	212.66	0.00
2.10	0.00	0	212.66	0.00
2.16	0.00	0	212.66	0.00
2.22	0.00	0	212.66	0.00
2.28	0.00	0	212.66	0.00
2.34	0.00	0	212.66	0.00
2.40	0.00	0	212.66	0.00
2.46	0.00	0	212.66	0.00
2.52	0.00	0	212.66	0.00
2.58	0.00	0	212.66	0.00
2.64	0.00	0	212.66	0.00
2.70	0.00	0	212.66	0.00
2.76	0.00	0	212.66	0.00
2.82	0.00	0	212.66	0.00
2.88	0.00	0	212.66	0.00
2.94	0.00	0	212.66	0.00
3.00	0.00	0	212.66	0.00
3.06	0.00	0	212.66	0.00

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
3.12	0.00	0	212.66	0.00
3.18	0.00	0	212.66	0.00
3.24	0.00	0	212.66	0.00
3.30	0.00	0	212.66	0.00
3.36	0.00	0	212.66	0.00
3.42	0.00	0	212.66	0.00
3.48	0.00	0	212.66	0.00
3.54	0.00	0	212.66	0.00
3.60	0.00	0	212.66	0.00
3.66	0.00	0	212.66	0.00
3.72	0.00	1	212.66	0.00
3.78	0.00	1	212.66	0.00
3.84	0.00	2	212.66	0.00
3.90	0.00	2	212.66	0.00
3.96	0.00	3	212.66	0.00
4.02	0.01	4	212.66	0.00
4.08	0.01	5	212.66	0.00
4.14	0.01	6	212.66	0.00
4.20	0.01	8	212.67	0.00
4.26	0.01	9	212.67	0.00
4.32	0.01	11	212.67	0.00
4.38	0.01	12	212.67	0.00
4.44	0.01	14	212.67	0.00
4.50	0.01	16	212.67	0.00
4.56	0.01	18	212.67	0.00
4.62	0.01	20	212.67	0.00
4.68	0.01	22	212.68	0.00
4.74	0.01	24	212.68	0.00
4.80	0.01	26	212.68	0.00
4.86	0.01	29	212.68	0.00
4.92	0.02	31	212.68	0.00
4.98	0.02	34	212.69	0.00
5.04	0.02	37	212.69	0.00
5.10	0.02	40	212.69	0.00
5.16	0.02	42	212.69	0.00
5.22	0.02	45	212.69	0.00
5.28	0.02	48	212.70	0.01
5.34	0.02	52	212.70	0.01
5.40	0.02	55	212.70	0.01
5.46	0.02	58	212.70	0.01
5.52	0.02	62	212.71	0.01
5.58	0.02	65	212.71	0.01
5.64	0.02	69	212.71	0.01
5.70	0.02	72	212.71	0.01
5.76	0.03	76	212.72	0.01
5.82	0.03	80	212.72	0.01
5.88	0.03	83	212.72	0.01
5.94	0.03	87	212.73	0.01
6.00	0.03	91	212.73	0.01
6.06	0.03	95	212.73	0.01
6.12	0.03	99	212.73	0.01
6.18	0.03	103	212.74	0.01

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
6.24	0.03	108	212.74	0.01
6.30	0.03	112	212.74	0.02
6.36	0.04	116	212.75	0.02
6.42	0.04	120	212.75	0.02
6.48	0.04	124	212.75	0.02
6.54	0.04	128	212.76	0.02
6.60	0.04	132	212.76	0.02
6.66	0.04	137	212.76	0.02
6.72	0.04	141	212.77	0.02
6.78	0.04	145	212.77	0.02
6.84	0.05	150	212.77	0.03
6.90	0.05	154	212.78	0.03
6.96	0.05	159	212.78	0.03
7.02	0.05	163	212.78	0.03
7.08	0.05	168	212.79	0.03
7.14	0.05	172	212.79	0.03
7.20	0.06	177	212.79	0.03
7.26	0.06	182	212.80	0.03
7.32	0.06	187	212.80	0.04
7.38	0.06	192	212.80	0.04
7.44	0.06	196	212.81	0.04
7.50	0.06	201	212.81	0.04
7.56	0.07	206	212.81	0.04
7.62	0.07	211	212.82	0.04
7.68	0.07	216	212.82	0.05
7.74	0.07	221	212.83	0.05
7.80	0.07	226	212.83	0.05
7.86	0.07	231	212.83	0.05
7.92	0.08	236	212.84	0.05
7.98	0.08	241	212.84	0.05
8.04	0.08	246	212.84	0.06
8.10	0.08	251	212.85	0.06
8.16	0.08	256	212.85	0.06
8.22	0.09	261	212.86	0.06
8.28	0.09	267	212.86	0.06
8.34	0.09	273	212.86	0.07
8.40	0.10	279	212.87	0.07
8.46	0.10	286	212.87	0.07
8.52	0.10	293	212.88	0.07
8.58	0.11	300	212.88	0.07
8.64	0.11	307	212.89	0.08
8.70	0.12	315	212.90	0.08
8.76	0.12	324	212.90	0.08
8.82	0.12	332	212.91	0.08
8.88	0.13	341	212.92	0.08
8.94	0.13	350	212.92	0.09
9.00	0.13	360	212.93	0.09
9.06	0.14	370	212.94	0.09
9.12	0.14	380	212.94	0.09
9.18	0.15	390	212.95	0.10
9.24	0.15	401	212.96	0.10
9.30	0.15	412	212.97	0.10

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
9.36	0.16	424	212.98	0.10
9.42	0.16	436	212.99	0.11
9.48	0.17	448	213.00	0.11
9.54	0.17	461	213.01	0.11
9.60	0.18	474	213.02	0.11
9.66	0.18	488	213.03	0.12
9.72	0.18	502	213.04	0.12
9.78	0.19	516	213.05	0.12
9.84	0.19	531	213.06	0.12
9.90	0.20	546	213.07	0.13
9.96	0.20	561	213.08	0.13
10.02	0.21	577	213.09	0.13
10.08	0.21	594	213.11	0.13
10.14	0.22	611	213.12	0.14
10.20	0.23	629	213.13	0.14
10.26	0.23	648	213.15	0.14
10.32	0.24	668	213.16	0.14
10.38	0.25	690	213.18	0.15
10.44	0.26	712	213.19	0.15
10.50	0.27	736	213.21	0.15
10.56	0.27	760	213.23	0.16
10.62	0.28	786	213.25	0.16
10.68	0.29	813	213.27	0.16
10.74	0.30	841	213.29	0.17
10.80	0.31	870	213.31	0.17
10.86	0.32	900	213.33	0.18
10.92	0.33	931	213.36	0.18
10.98	0.33	963	213.38	0.18
11.04	0.34	995	213.41	0.20
11.10	0.36	1,028	213.43	0.21
11.16	0.38	1,062	213.46	0.22
11.22	0.41	1,097	213.48	0.25
11.28	0.44	1,134	213.51	0.27
11.34	0.47	1,172	213.54	0.30
11.40	0.50	1,211	213.57	0.32
11.46	0.53	1,250	213.60	0.36
11.52	0.57	1,288	213.63	0.39
11.58	0.64	1,330	213.66	0.43
11.64	0.84	1,391	213.70	0.49
11.70	1.11	1,484	213.77	0.60
11.76	1.39	1,608	213.87	0.75
11.82	1.68	1,754	213.98	0.97
11.88	1.98	1,912	214.09	1.24
11.94	2.35	2,079	214.22	1.55
12.00	3.42	2,317	214.40	2.00
12.06	5.11	2,715	214.70	2.83
12.12	4.94	3,093	214.98	3.71
12.18	3.48	3,179	215.04	3.92
12.24	2.63	3,032	214.93	3.56
12.30	2.20	2,835	214.79	3.10
12.36	1.87	2,650	214.65	2.69
12.42	1.57	2,479	214.52	2.33

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
12.48	1.26	2,317	214.40	2.00
12.54	0.97	2,158	214.28	1.70
12.60	0.76	2,007	214.17	1.42
12.66	0.67	1,881	214.07	1.18
12.72	0.63	1,784	214.00	1.01
12.78	0.59	1,709	213.94	0.90
12.84	0.56	1,649	213.90	0.81
12.90	0.53	1,599	213.86	0.74
12.96	0.50	1,556	213.83	0.68
13.02	0.46	1,518	213.80	0.63
13.08	0.44	1,482	213.77	0.59
13.14	0.42	1,451	213.75	0.56
13.20	0.41	1,424	213.73	0.53
13.26	0.40	1,401	213.71	0.50
13.32	0.39	1,381	213.70	0.48
13.38	0.39	1,363	213.68	0.46
13.44	0.38	1,347	213.67	0.45
13.50	0.37	1,333	213.66	0.43
13.56	0.36	1,320	213.65	0.42
13.62	0.35	1,308	213.64	0.41
13.68	0.34	1,296	213.63	0.40
13.74	0.34	1,285	213.62	0.39
13.80	0.33	1,274	213.62	0.38
13.86	0.32	1,263	213.61	0.37
13.92	0.31	1,253	213.60	0.36
13.98	0.30	1,243	213.59	0.35
14.04	0.29	1,233	213.58	0.34
14.10	0.29	1,223	213.58	0.33
14.16	0.28	1,213	213.57	0.33
14.22	0.28	1,204	213.56	0.32
14.28	0.27	1,196	213.56	0.31
14.34	0.27	1,188	213.55	0.31
14.40	0.27	1,180	213.54	0.30
14.46	0.26	1,173	213.54	0.30
14.52	0.26	1,166	213.53	0.29
14.58	0.25	1,159	213.53	0.29
14.64	0.25	1,152	213.52	0.28
14.70	0.25	1,146	213.52	0.28
14.76	0.24	1,140	213.51	0.27
14.82	0.24	1,134	213.51	0.27
14.88	0.23	1,128	213.51	0.26
14.94	0.23	1,121	213.50	0.26
15.00	0.23	1,115	213.50	0.26
15.06	0.22	1,109	213.49	0.25
15.12	0.22	1,102	213.49	0.25
15.18	0.21	1,096	213.48	0.24
15.24	0.21	1,089	213.48	0.24
15.30	0.21	1,083	213.47	0.24
15.36	0.20	1,076	213.47	0.23
15.42	0.20	1,070	213.46	0.23
15.48	0.19	1,063	213.46	0.23
15.54	0.19	1,056	213.45	0.22

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
15.60	0.19	1,050	213.45	0.22
15.66	0.18	1,043	213.44	0.21
15.72	0.18	1,036	213.44	0.21
15.78	0.17	1,029	213.43	0.21
15.84	0.17	1,022	213.43	0.20
15.90	0.17	1,014	213.42	0.20
15.96	0.16	1,006	213.41	0.20
16.02	0.16	998	213.41	0.20
16.08	0.15	990	213.40	0.19
16.14	0.15	982	213.40	0.19
16.20	0.15	973	213.39	0.19
16.26	0.15	966	213.38	0.18
16.32	0.15	958	213.38	0.18
16.38	0.14	950	213.37	0.18
16.44	0.14	942	213.37	0.18
16.50	0.14	934	213.36	0.18
16.56	0.14	926	213.35	0.18
16.62	0.14	917	213.35	0.18
16.68	0.14	909	213.34	0.18
16.74	0.13	900	213.33	0.18
16.80	0.13	891	213.33	0.17
16.86	0.13	882	213.32	0.17
16.92	0.13	873	213.31	0.17
16.98	0.13	863	213.31	0.17
17.04	0.13	854	213.30	0.17
17.10	0.12	844	213.29	0.17
17.16	0.12	835	213.29	0.17
17.22	0.12	825	213.28	0.17
17.28	0.12	815	213.27	0.16
17.34	0.12	805	213.26	0.16
17.40	0.11	795	213.26	0.16
17.46	0.11	784	213.25	0.16
17.52	0.11	774	213.24	0.16
17.58	0.11	764	213.23	0.16
17.64	0.11	753	213.22	0.16
17.70	0.11	743	213.22	0.16
17.76	0.10	732	213.21	0.15
17.82	0.10	721	213.20	0.15
17.88	0.10	710	213.19	0.15
17.94	0.10	700	213.18	0.15
18.00	0.10	689	213.18	0.15
18.06	0.10	678	213.17	0.15
18.12	0.09	667	213.16	0.14
18.18	0.09	656	213.15	0.14
18.24	0.09	646	213.14	0.14
18.30	0.09	635	213.14	0.14
18.36	0.09	625	213.13	0.14
18.42	0.09	615	213.12	0.14
18.48	0.09	606	213.11	0.14
18.54	0.09	596	213.11	0.13
18.60	0.09	587	213.10	0.13
18.66	0.09	578	213.09	0.13

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
18.72	0.09	569	213.09	0.13
18.78	0.09	560	213.08	0.13
18.84	0.09	552	213.07	0.13
18.90	0.09	543	213.07	0.13
18.96	0.09	535	213.06	0.12
19.02	0.09	527	213.06	0.12
19.08	0.09	520	213.05	0.12
19.14	0.09	512	213.04	0.12
19.20	0.08	505	213.04	0.12
19.26	0.08	497	213.03	0.12
19.32	0.08	490	213.03	0.12
19.38	0.08	483	213.02	0.12
19.44	0.08	477	213.02	0.11
19.50	0.08	470	213.01	0.11
19.56	0.08	463	213.01	0.11
19.62	0.08	457	213.00	0.11
19.68	0.08	451	213.00	0.11
19.74	0.08	445	212.99	0.11
19.80	0.08	439	212.99	0.11
19.86	0.08	433	212.98	0.11
19.92	0.08	428	212.98	0.10
19.98	0.08	422	212.98	0.10
20.04	0.08	417	212.97	0.10
20.10	0.08	412	212.97	0.10
20.16	0.08	406	212.96	0.10
20.22	0.08	401	212.96	0.10
20.28	0.08	397	212.96	0.10
20.34	0.08	392	212.95	0.10
20.40	0.07	387	212.95	0.10
20.46	0.07	383	212.95	0.10
20.52	0.07	378	212.94	0.09
20.58	0.07	374	212.94	0.09
20.64	0.07	370	212.94	0.09
20.70	0.07	366	212.93	0.09
20.76	0.07	362	212.93	0.09
20.82	0.07	358	212.93	0.09
20.88	0.07	355	212.93	0.09
20.94	0.07	351	212.92	0.09
21.00	0.07	348	212.92	0.09
21.06	0.07	345	212.92	0.09
21.12	0.07	341	212.92	0.08
21.18	0.07	338	212.91	0.08
21.24	0.07	335	212.91	0.08
21.30	0.07	332	212.91	0.08
21.36	0.07	330	212.91	0.08
21.42	0.07	327	212.90	0.08
21.48	0.07	324	212.90	0.08
21.54	0.07	321	212.90	0.08
21.60	0.07	319	212.90	0.08
21.66	0.07	316	212.90	0.08
21.72	0.07	314	212.90	0.08
21.78	0.07	311	212.89	0.08

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 10 Year Rainfall=5.51"*

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Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
21.84	0.07	309	212.89	0.08
21.90	0.06	306	212.89	0.08
21.96	0.06	304	212.89	0.08
22.02	0.06	302	212.89	0.07
22.08	0.06	300	212.88	0.07
22.14	0.06	297	212.88	0.07
22.20	0.06	295	212.88	0.07
22.26	0.06	293	212.88	0.07
22.32	0.06	291	212.88	0.07
22.38	0.06	289	212.88	0.07
22.44	0.06	287	212.88	0.07
22.50	0.06	285	212.87	0.07
22.56	0.06	283	212.87	0.07
22.62	0.06	281	212.87	0.07
22.68	0.06	279	212.87	0.07
22.74	0.06	277	212.87	0.07
22.80	0.06	276	212.87	0.07
22.86	0.06	274	212.87	0.07
22.92	0.06	272	212.86	0.07
22.98	0.06	271	212.86	0.07
23.04	0.06	269	212.86	0.06
23.10	0.06	267	212.86	0.06
23.16	0.06	266	212.86	0.06
23.22	0.06	264	212.86	0.06
23.28	0.06	263	212.86	0.06
23.34	0.06	261	212.86	0.06
23.40	0.05	260	212.85	0.06
23.46	0.05	259	212.85	0.06
23.52	0.05	257	212.85	0.06
23.58	0.05	256	212.85	0.06
23.64	0.05	254	212.85	0.06
23.70	0.05	253	212.85	0.06
23.76	0.05	252	212.85	0.06
23.82	0.05	250	212.85	0.06
23.88	0.05	249	212.85	0.06
23.94	0.05	248	212.85	0.06
24.00	0.05	247	212.84	0.06

Stage-Discharge for Pond 6P: Detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
212.66	0.00	213.70	0.49	214.74	2.96	215.78	7.32
212.68	0.00	213.72	0.51	214.76	3.02	215.80	7.46
212.70	0.00	213.74	0.54	214.78	3.08	215.82	7.60
212.72	0.01	213.76	0.57	214.80	3.14	215.84	7.74
212.74	0.01	213.78	0.61	214.82	3.21	215.86	7.89
212.76	0.02	213.80	0.64	214.84	3.27	215.88	8.04
212.78	0.03	213.82	0.67	214.86	3.33	215.90	8.19
212.80	0.04	213.84	0.71	214.88	3.39	215.92	8.34
212.82	0.05	213.86	0.74	214.90	3.45	215.94	8.50
212.84	0.05	213.88	0.78	214.92	3.52	215.96	8.65
212.86	0.06	213.90	0.82	214.94	3.58	215.98	8.81
212.88	0.07	213.92	0.85	214.96	3.65	216.00	8.98
212.90	0.08	213.94	0.89	214.98	3.71	216.02	9.15
212.92	0.09	213.96	0.93	215.00	3.77	216.04	9.31
212.94	0.09	213.98	0.97	215.02	3.84	216.06	9.49
212.96	0.10	214.00	1.02	215.04	3.91	216.08	9.66
212.98	0.10	214.02	1.06	215.06	3.97	216.10	9.84
213.00	0.11	214.04	1.11	215.08	4.04	216.12	10.02
213.02	0.11	214.06	1.16	215.10	4.10	216.14	10.20
213.04	0.12	214.08	1.20	215.12	4.17	216.16	10.39
213.06	0.12	214.10	1.25	215.14	4.24	216.18	10.57
213.08	0.13	214.12	1.30	215.16	4.31	216.20	10.75
213.10	0.13	214.14	1.35	215.18	4.37		
213.12	0.14	214.16	1.41	215.20	4.44		
213.14	0.14	214.18	1.46	215.22	4.51		
213.16	0.14	214.20	1.51	215.24	4.58		
213.18	0.15	214.22	1.55	215.26	4.65		
213.20	0.15	214.24	1.60	215.28	4.72		
213.22	0.16	214.26	1.65	215.30	4.79		
213.24	0.16	214.28	1.70	215.32	4.86		
213.26	0.16	214.30	1.75	215.34	4.93		
213.28	0.17	214.32	1.80	215.36	5.00		
213.30	0.17	214.34	1.85	215.38	5.08		
213.32	0.17	214.36	1.91	215.40	5.16		
213.34	0.18	214.38	1.96	215.42	5.24		
213.36	0.18	214.40	2.01	215.44	5.33		
213.38	0.18	214.42	2.06	215.46	5.43		
213.40	0.19	214.44	2.12	215.48	5.53		
213.42	0.20	214.46	2.17	215.50	5.63		
213.44	0.21	214.48	2.22	215.52	5.73		
213.46	0.23	214.50	2.28	215.54	5.84		
213.48	0.24	214.52	2.33	215.56	5.95		
213.50	0.26	214.54	2.39	215.58	6.06		
213.52	0.28	214.56	2.44	215.60	6.18		
213.54	0.29	214.58	2.50	215.62	6.30		
213.56	0.31	214.60	2.56	215.64	6.42		
213.58	0.34	214.62	2.61	215.66	6.54		
213.60	0.36	214.64	2.67	215.68	6.66		
213.62	0.38	214.66	2.73	215.70	6.79		
213.64	0.41	214.68	2.79	215.72	6.92		
213.66	0.43	214.70	2.84	215.74	7.05		
213.68	0.46	214.72	2.90	215.76	7.18		

Stage-Area-Storage for Pond 6P: Detention

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
212.66	0	215.26	3,467
212.71	67	215.31	3,534
212.76	133	215.36	3,601
212.81	200	215.41	3,667
212.86	267	215.46	3,734
212.91	333	215.51	3,801
212.96	400	215.56	3,867
213.01	467	215.61	3,934
213.06	533	215.66	4,001
213.11	600	215.71	4,067
213.16	667	215.76	4,134
213.21	733	215.81	4,201
213.26	800	215.86	4,268
213.31	867	215.91	4,334
213.36	934	215.96	4,401
213.41	1,000	216.01	4,468
213.46	1,067	216.06	4,534
213.51	1,134	216.11	4,601
213.56	1,200	216.16	4,668
213.61	1,267		
213.66	1,334		
213.71	1,400		
213.76	1,467		
213.81	1,534		
213.86	1,600		
213.91	1,667		
213.96	1,734		
214.01	1,800		
214.06	1,867		
214.11	1,934		
214.16	2,000		
214.21	2,067		
214.26	2,134		
214.31	2,200		
214.36	2,267		
214.41	2,334		
214.46	2,400		
214.51	2,467		
214.56	2,534		
214.61	2,601		
214.66	2,667		
214.71	2,734		
214.76	2,801		
214.81	2,867		
214.86	2,934		
214.91	3,001		
214.96	3,067		
215.01	3,134		
215.06	3,201		
215.11	3,267		
215.16	3,334		
215.21	3,401		

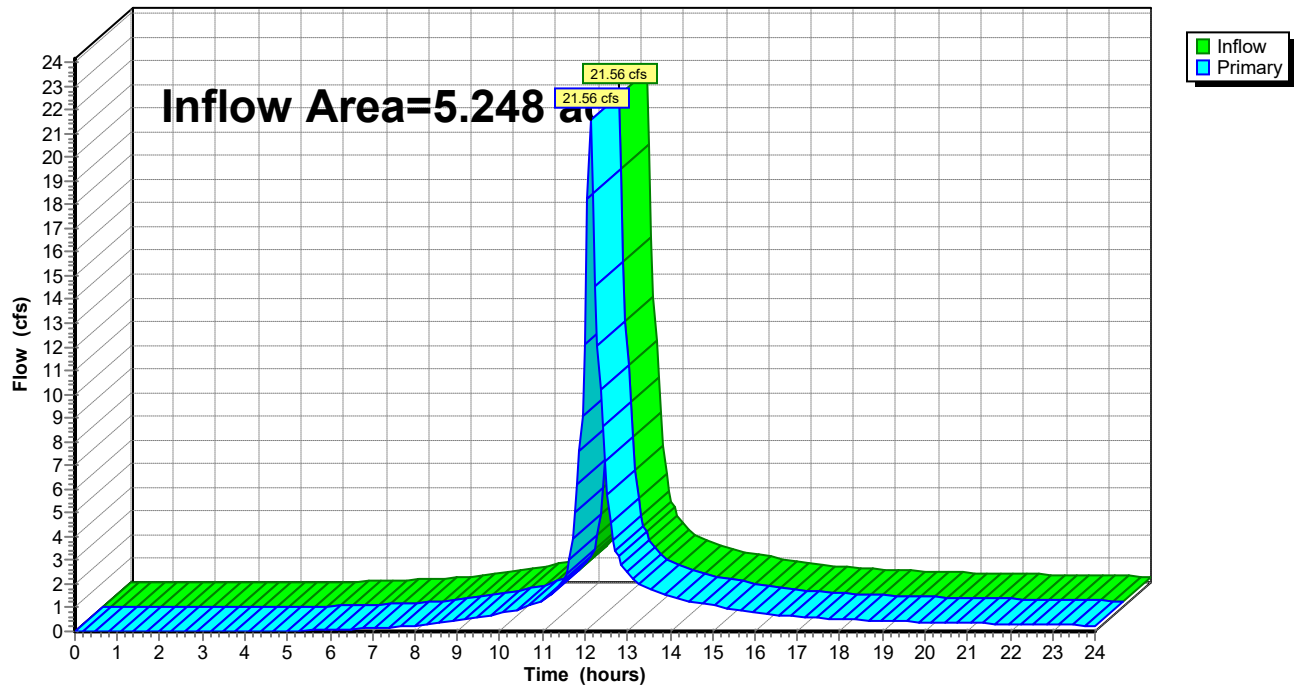
Summary for Link 10L: DP-1

Inflow Area = 5.248 ac, 61.30% Impervious, Inflow Depth > 4.18" for 10 Year event
 Inflow = 21.56 cfs @ 12.12 hrs, Volume= 1.829 af
 Primary = 21.56 cfs @ 12.12 hrs, Volume= 1.829 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Link 10L: DP-1

Hydrograph



Hydrograph for Link 10L: DP-1

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	3.12	0.00	0.00	0.00
0.06	0.00	0.00	0.00	3.18	0.00	0.00	0.00
0.12	0.00	0.00	0.00	3.24	0.00	0.00	0.00
0.18	0.00	0.00	0.00	3.30	0.00	0.00	0.00
0.24	0.00	0.00	0.00	3.36	0.00	0.00	0.00
0.30	0.00	0.00	0.00	3.42	0.00	0.00	0.00
0.36	0.00	0.00	0.00	3.48	0.00	0.00	0.00
0.42	0.00	0.00	0.00	3.54	0.00	0.00	0.00
0.48	0.00	0.00	0.00	3.60	0.00	0.00	0.00
0.54	0.00	0.00	0.00	3.66	0.00	0.00	0.00
0.60	0.00	0.00	0.00	3.72	0.00	0.00	0.00
0.66	0.00	0.00	0.00	3.78	0.00	0.00	0.00
0.72	0.00	0.00	0.00	3.84	0.00	0.00	0.00
0.78	0.00	0.00	0.00	3.90	0.00	0.00	0.00
0.84	0.00	0.00	0.00	3.96	0.00	0.00	0.00
0.90	0.00	0.00	0.00	4.02	0.00	0.00	0.00
0.96	0.00	0.00	0.00	4.08	0.00	0.00	0.00
1.02	0.00	0.00	0.00	4.14	0.00	0.00	0.00
1.08	0.00	0.00	0.00	4.20	0.01	0.00	0.01
1.14	0.00	0.00	0.00	4.26	0.01	0.00	0.01
1.20	0.00	0.00	0.00	4.32	0.01	0.00	0.01
1.26	0.00	0.00	0.00	4.38	0.01	0.00	0.01
1.32	0.00	0.00	0.00	4.44	0.01	0.00	0.01
1.38	0.00	0.00	0.00	4.50	0.01	0.00	0.01
1.44	0.00	0.00	0.00	4.56	0.01	0.00	0.01
1.50	0.00	0.00	0.00	4.62	0.01	0.00	0.01
1.56	0.00	0.00	0.00	4.68	0.01	0.00	0.01
1.62	0.00	0.00	0.00	4.74	0.01	0.00	0.01
1.68	0.00	0.00	0.00	4.80	0.01	0.00	0.01
1.74	0.00	0.00	0.00	4.86	0.01	0.00	0.01
1.80	0.00	0.00	0.00	4.92	0.01	0.00	0.01
1.86	0.00	0.00	0.00	4.98	0.02	0.00	0.02
1.92	0.00	0.00	0.00	5.04	0.02	0.00	0.02
1.98	0.00	0.00	0.00	5.10	0.02	0.00	0.02
2.04	0.00	0.00	0.00	5.16	0.02	0.00	0.02
2.10	0.00	0.00	0.00	5.22	0.03	0.00	0.03
2.16	0.00	0.00	0.00	5.28	0.03	0.00	0.03
2.22	0.00	0.00	0.00	5.34	0.03	0.00	0.03
2.28	0.00	0.00	0.00	5.40	0.03	0.00	0.03
2.34	0.00	0.00	0.00	5.46	0.04	0.00	0.04
2.40	0.00	0.00	0.00	5.52	0.04	0.00	0.04
2.46	0.00	0.00	0.00	5.58	0.04	0.00	0.04
2.52	0.00	0.00	0.00	5.64	0.04	0.00	0.04
2.58	0.00	0.00	0.00	5.70	0.05	0.00	0.05
2.64	0.00	0.00	0.00	5.76	0.05	0.00	0.05
2.70	0.00	0.00	0.00	5.82	0.05	0.00	0.05
2.76	0.00	0.00	0.00	5.88	0.06	0.00	0.06
2.82	0.00	0.00	0.00	5.94	0.06	0.00	0.06
2.88	0.00	0.00	0.00	6.00	0.06	0.00	0.06
2.94	0.00	0.00	0.00	6.06	0.06	0.00	0.06
3.00	0.00	0.00	0.00	6.12	0.07	0.00	0.07
3.06	0.00	0.00	0.00	6.18	0.07	0.00	0.07

2021-07-8 Post Orangetown Town Hall

Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
6.24	0.08	0.00	0.08	9.36	0.57	0.00	0.57
6.30	0.08	0.00	0.08	9.42	0.58	0.00	0.58
6.36	0.09	0.00	0.09	9.48	0.60	0.00	0.60
6.42	0.09	0.00	0.09	9.54	0.62	0.00	0.62
6.48	0.10	0.00	0.10	9.60	0.63	0.00	0.63
6.54	0.10	0.00	0.10	9.66	0.65	0.00	0.65
6.60	0.11	0.00	0.11	9.72	0.67	0.00	0.67
6.66	0.11	0.00	0.11	9.78	0.69	0.00	0.69
6.72	0.12	0.00	0.12	9.84	0.70	0.00	0.70
6.78	0.12	0.00	0.12	9.90	0.72	0.00	0.72
6.84	0.13	0.00	0.13	9.96	0.74	0.00	0.74
6.90	0.13	0.00	0.13	10.02	0.76	0.00	0.76
6.96	0.14	0.00	0.14	10.08	0.78	0.00	0.78
7.02	0.15	0.00	0.15	10.14	0.80	0.00	0.80
7.08	0.15	0.00	0.15	10.20	0.83	0.00	0.83
7.14	0.16	0.00	0.16	10.26	0.86	0.00	0.86
7.20	0.16	0.00	0.16	10.32	0.89	0.00	0.89
7.26	0.17	0.00	0.17	10.38	0.92	0.00	0.92
7.32	0.18	0.00	0.18	10.44	0.95	0.00	0.95
7.38	0.18	0.00	0.18	10.50	0.99	0.00	0.99
7.44	0.19	0.00	0.19	10.56	1.02	0.00	1.02
7.50	0.20	0.00	0.20	10.62	1.05	0.00	1.05
7.56	0.20	0.00	0.20	10.68	1.08	0.00	1.08
7.62	0.21	0.00	0.21	10.74	1.12	0.00	1.12
7.68	0.22	0.00	0.22	10.80	1.15	0.00	1.15
7.74	0.23	0.00	0.23	10.86	1.19	0.00	1.19
7.80	0.23	0.00	0.23	10.92	1.22	0.00	1.22
7.86	0.24	0.00	0.24	10.98	1.26	0.00	1.26
7.92	0.25	0.00	0.25	11.04	1.31	0.00	1.31
7.98	0.26	0.00	0.26	11.10	1.36	0.00	1.36
8.04	0.26	0.00	0.26	11.16	1.45	0.00	1.45
8.10	0.27	0.00	0.27	11.22	1.56	0.00	1.56
8.16	0.28	0.00	0.28	11.28	1.69	0.00	1.69
8.22	0.29	0.00	0.29	11.34	1.82	0.00	1.82
8.28	0.31	0.00	0.31	11.40	1.95	0.00	1.95
8.34	0.32	0.00	0.32	11.46	2.09	0.00	2.09
8.40	0.33	0.00	0.33	11.52	2.24	0.00	2.24
8.46	0.34	0.00	0.34	11.58	2.46	0.00	2.46
8.52	0.36	0.00	0.36	11.64	3.03	0.00	3.03
8.58	0.37	0.00	0.37	11.70	3.93	0.00	3.93
8.64	0.38	0.00	0.38	11.76	5.02	0.00	5.02
8.70	0.40	0.00	0.40	11.82	6.24	0.00	6.24
8.76	0.41	0.00	0.41	11.88	7.57	0.00	7.57
8.82	0.43	0.00	0.43	11.94	9.07	0.00	9.07
8.88	0.44	0.00	0.44	12.00	12.12	0.00	12.12
8.94	0.46	0.00	0.46	12.06	18.24	0.00	18.24
9.00	0.47	0.00	0.47	12.12	21.56	0.00	21.56
9.06	0.49	0.00	0.49	12.18	18.50	0.00	18.50
9.12	0.50	0.00	0.50	12.24	14.53	0.00	14.53
9.18	0.52	0.00	0.52	12.30	12.02	0.00	12.02
9.24	0.53	0.00	0.53	12.36	10.21	0.00	10.21
9.30	0.55	0.00	0.55	12.42	8.65	0.00	8.65

2021-07-8 Post Orangetown Town Hall

Type III 24-hr 10 Year Rainfall=5.51"

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Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
12.48	7.19	0.00	7.19	15.60	0.91	0.00	0.91
12.54	5.78	0.00	5.78	15.66	0.90	0.00	0.90
12.60	4.58	0.00	4.58	15.72	0.88	0.00	0.88
12.66	3.84	0.00	3.84	15.78	0.86	0.00	0.86
12.72	3.42	0.00	3.42	15.84	0.84	0.00	0.84
12.78	3.14	0.00	3.14	15.90	0.82	0.00	0.82
12.84	2.93	0.00	2.93	15.96	0.81	0.00	0.81
12.90	2.74	0.00	2.74	16.02	0.79	0.00	0.79
12.96	2.57	0.00	2.57	16.08	0.77	0.00	0.77
13.02	2.40	0.00	2.40	16.14	0.76	0.00	0.76
13.08	2.25	0.00	2.25	16.20	0.75	0.00	0.75
13.14	2.14	0.00	2.14	16.26	0.74	0.00	0.74
13.20	2.06	0.00	2.06	16.32	0.73	0.00	0.73
13.26	2.00	0.00	2.00	16.38	0.72	0.00	0.72
13.32	1.95	0.00	1.95	16.44	0.71	0.00	0.71
13.38	1.90	0.00	1.90	16.50	0.71	0.00	0.71
13.44	1.85	0.00	1.85	16.56	0.70	0.00	0.70
13.50	1.81	0.00	1.81	16.62	0.69	0.00	0.69
13.56	1.76	0.00	1.76	16.68	0.68	0.00	0.68
13.62	1.72	0.00	1.72	16.74	0.68	0.00	0.68
13.68	1.68	0.00	1.68	16.80	0.67	0.00	0.67
13.74	1.64	0.00	1.64	16.86	0.66	0.00	0.66
13.80	1.60	0.00	1.60	16.92	0.65	0.00	0.65
13.86	1.56	0.00	1.56	16.98	0.65	0.00	0.65
13.92	1.52	0.00	1.52	17.04	0.64	0.00	0.64
13.98	1.48	0.00	1.48	17.10	0.63	0.00	0.63
14.04	1.44	0.00	1.44	17.16	0.62	0.00	0.62
14.10	1.41	0.00	1.41	17.22	0.61	0.00	0.61
14.16	1.38	0.00	1.38	17.28	0.61	0.00	0.61
14.22	1.36	0.00	1.36	17.34	0.60	0.00	0.60
14.28	1.33	0.00	1.33	17.40	0.59	0.00	0.59
14.34	1.31	0.00	1.31	17.46	0.58	0.00	0.58
14.40	1.29	0.00	1.29	17.52	0.58	0.00	0.58
14.46	1.27	0.00	1.27	17.58	0.57	0.00	0.57
14.52	1.25	0.00	1.25	17.64	0.56	0.00	0.56
14.58	1.23	0.00	1.23	17.70	0.55	0.00	0.55
14.64	1.21	0.00	1.21	17.76	0.54	0.00	0.54
14.70	1.19	0.00	1.19	17.82	0.54	0.00	0.54
14.76	1.18	0.00	1.18	17.88	0.53	0.00	0.53
14.82	1.16	0.00	1.16	17.94	0.52	0.00	0.52
14.88	1.14	0.00	1.14	18.00	0.51	0.00	0.51
14.94	1.12	0.00	1.12	18.06	0.50	0.00	0.50
15.00	1.10	0.00	1.10	18.12	0.50	0.00	0.50
15.06	1.08	0.00	1.08	18.18	0.49	0.00	0.49
15.12	1.06	0.00	1.06	18.24	0.49	0.00	0.49
15.18	1.05	0.00	1.05	18.30	0.48	0.00	0.48
15.24	1.03	0.00	1.03	18.36	0.48	0.00	0.48
15.30	1.01	0.00	1.01	18.42	0.48	0.00	0.48
15.36	0.99	0.00	0.99	18.48	0.47	0.00	0.47
15.42	0.97	0.00	0.97	18.54	0.47	0.00	0.47
15.48	0.95	0.00	0.95	18.60	0.47	0.00	0.47
15.54	0.93	0.00	0.93	18.66	0.46	0.00	0.46

Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
18.72	0.46	0.00	0.46	21.84	0.32	0.00	0.32
18.78	0.46	0.00	0.46	21.90	0.32	0.00	0.32
18.84	0.45	0.00	0.45	21.96	0.32	0.00	0.32
18.90	0.45	0.00	0.45	22.02	0.31	0.00	0.31
18.96	0.45	0.00	0.45	22.08	0.31	0.00	0.31
19.02	0.44	0.00	0.44	22.14	0.31	0.00	0.31
19.08	0.44	0.00	0.44	22.20	0.31	0.00	0.31
19.14	0.44	0.00	0.44	22.26	0.31	0.00	0.31
19.20	0.43	0.00	0.43	22.32	0.30	0.00	0.30
19.26	0.43	0.00	0.43	22.38	0.30	0.00	0.30
19.32	0.43	0.00	0.43	22.44	0.30	0.00	0.30
19.38	0.42	0.00	0.42	22.50	0.30	0.00	0.30
19.44	0.42	0.00	0.42	22.56	0.30	0.00	0.30
19.50	0.42	0.00	0.42	22.62	0.29	0.00	0.29
19.56	0.42	0.00	0.42	22.68	0.29	0.00	0.29
19.62	0.41	0.00	0.41	22.74	0.29	0.00	0.29
19.68	0.41	0.00	0.41	22.80	0.29	0.00	0.29
19.74	0.41	0.00	0.41	22.86	0.28	0.00	0.28
19.80	0.40	0.00	0.40	22.92	0.28	0.00	0.28
19.86	0.40	0.00	0.40	22.98	0.28	0.00	0.28
19.92	0.40	0.00	0.40	23.04	0.28	0.00	0.28
19.98	0.39	0.00	0.39	23.10	0.28	0.00	0.28
20.04	0.39	0.00	0.39	23.16	0.27	0.00	0.27
20.10	0.39	0.00	0.39	23.22	0.27	0.00	0.27
20.16	0.38	0.00	0.38	23.28	0.27	0.00	0.27
20.22	0.38	0.00	0.38	23.34	0.27	0.00	0.27
20.28	0.38	0.00	0.38	23.40	0.27	0.00	0.27
20.34	0.38	0.00	0.38	23.46	0.26	0.00	0.26
20.40	0.37	0.00	0.37	23.52	0.26	0.00	0.26
20.46	0.37	0.00	0.37	23.58	0.26	0.00	0.26
20.52	0.37	0.00	0.37	23.64	0.26	0.00	0.26
20.58	0.37	0.00	0.37	23.70	0.26	0.00	0.26
20.64	0.36	0.00	0.36	23.76	0.25	0.00	0.25
20.70	0.36	0.00	0.36	23.82	0.25	0.00	0.25
20.76	0.36	0.00	0.36	23.88	0.25	0.00	0.25
20.82	0.36	0.00	0.36	23.94	0.25	0.00	0.25
20.88	0.36	0.00	0.36	24.00	0.25	0.00	0.25
20.94	0.35	0.00	0.35				
21.00	0.35	0.00	0.35				
21.06	0.35	0.00	0.35				
21.12	0.35	0.00	0.35				
21.18	0.34	0.00	0.34				
21.24	0.34	0.00	0.34				
21.30	0.34	0.00	0.34				
21.36	0.34	0.00	0.34				
21.42	0.33	0.00	0.33				
21.48	0.33	0.00	0.33				
21.54	0.33	0.00	0.33				
21.60	0.33	0.00	0.33				
21.66	0.33	0.00	0.33				
21.72	0.32	0.00	0.32				
21.78	0.32	0.00	0.32				

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

Prepared by Tectonic Engineering

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Time span=0.00-24.00 hrs, dt=0.06 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Subcatch A Runoff Area=0.724 ac 72.79% Impervious Runoff Depth>7.98"
Tc=8.0 min CN=91 Runoff=5.71 cfs 0.481 af

Subcatchment 2S: Subcatch B2 Runoff Area=3.430 ac 56.15% Impervious Runoff Depth>7.49"
Tc=8.0 min CN=87 Runoff=26.09 cfs 2.140 af

Subcatchment 3S: Detention Drainage Area Runoff Area=1.094 ac 69.84% Impervious Runoff Depth>7.98"
Tc=6.0 min CN=91 Runoff=9.08 cfs 0.727 af

Reach 4R: Design Point A Inflow=5.71 cfs 0.481 af
Outflow=5.71 cfs 0.481 af

Reach 5R: Design Point B Inflow=26.09 cfs 2.140 af
Outflow=26.09 cfs 2.140 af

Pond 6P: Detention Peak Elev=215.84' Storage=4,247 cf Inflow=9.08 cfs 0.727 af
Outflow=7.73 cfs 0.718 af

Link 10L: DP-1 Inflow=39.29 cfs 3.339 af
Primary=39.29 cfs 3.339 af

Total Runoff Area = 5.248 ac Runoff Volume = 3.349 af Average Runoff Depth = 7.66"
38.70% Pervious = 2.031 ac 61.30% Impervious = 3.217 ac

Summary for Subcatchment 1S: Subcatch A

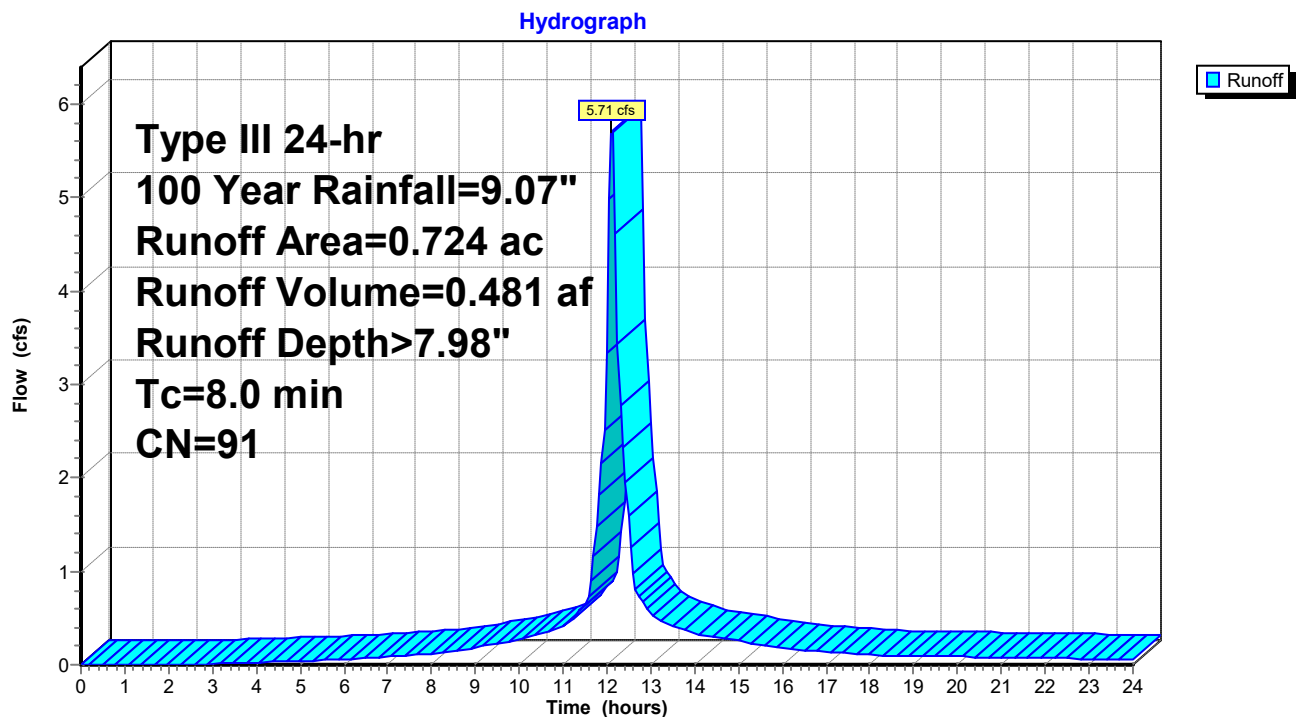
Runoff = 5.71 cfs @ 12.11 hrs, Volume= 0.481 af, Depth> 7.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
Type III 24-hr 100 Year Rainfall=9.07"

Area (ac)	CN	Description
0.527	98	Paved roads w/curbs & sewers, HSG C
0.197	74	>75% Grass cover, Good, HSG C
0.724	91	Weighted Average
0.197		27.21% Pervious Area
0.527		72.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Subcatchment 1S: Subcatch A



Hydrograph for Subcatchment 1S: Subcatch A

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.29	0.01	0.01
0.06	0.01	0.00	0.00	3.18	0.30	0.01	0.01
0.12	0.01	0.00	0.00	3.24	0.30	0.01	0.01
0.18	0.02	0.00	0.00	3.30	0.31	0.01	0.01
0.24	0.02	0.00	0.00	3.36	0.32	0.01	0.01
0.30	0.03	0.00	0.00	3.42	0.32	0.01	0.02
0.36	0.03	0.00	0.00	3.48	0.33	0.02	0.02
0.42	0.04	0.00	0.00	3.54	0.34	0.02	0.02
0.48	0.04	0.00	0.00	3.60	0.34	0.02	0.02
0.54	0.05	0.00	0.00	3.66	0.35	0.02	0.02
0.60	0.05	0.00	0.00	3.72	0.36	0.02	0.02
0.66	0.06	0.00	0.00	3.78	0.36	0.02	0.02
0.72	0.07	0.00	0.00	3.84	0.37	0.03	0.02
0.78	0.07	0.00	0.00	3.90	0.38	0.03	0.02
0.84	0.08	0.00	0.00	3.96	0.39	0.03	0.02
0.90	0.08	0.00	0.00	4.02	0.39	0.03	0.02
0.96	0.09	0.00	0.00	4.08	0.40	0.03	0.03
1.02	0.09	0.00	0.00	4.14	0.41	0.04	0.03
1.08	0.10	0.00	0.00	4.20	0.41	0.04	0.03
1.14	0.10	0.00	0.00	4.26	0.42	0.04	0.03
1.20	0.11	0.00	0.00	4.32	0.43	0.04	0.03
1.26	0.11	0.00	0.00	4.38	0.44	0.05	0.03
1.32	0.12	0.00	0.00	4.44	0.44	0.05	0.03
1.38	0.13	0.00	0.00	4.50	0.45	0.05	0.03
1.44	0.13	0.00	0.00	4.56	0.46	0.05	0.03
1.50	0.14	0.00	0.00	4.62	0.47	0.06	0.03
1.56	0.14	0.00	0.00	4.68	0.47	0.06	0.03
1.62	0.15	0.00	0.00	4.74	0.48	0.06	0.04
1.68	0.15	0.00	0.00	4.80	0.49	0.07	0.04
1.74	0.16	0.00	0.00	4.86	0.50	0.07	0.04
1.80	0.16	0.00	0.00	4.92	0.50	0.07	0.04
1.86	0.17	0.00	0.00	4.98	0.51	0.08	0.04
1.92	0.17	0.00	0.00	5.04	0.52	0.08	0.04
1.98	0.18	0.00	0.00	5.10	0.53	0.08	0.04
2.04	0.19	0.00	0.00	5.16	0.54	0.09	0.04
2.10	0.19	0.00	0.00	5.22	0.54	0.09	0.04
2.16	0.20	0.00	0.00	5.28	0.55	0.09	0.04
2.22	0.20	0.00	0.00	5.34	0.56	0.10	0.04
2.28	0.21	0.00	0.00	5.40	0.57	0.10	0.05
2.34	0.21	0.00	0.00	5.46	0.58	0.10	0.05
2.40	0.22	0.00	0.00	5.52	0.58	0.11	0.05
2.46	0.22	0.00	0.00	5.58	0.59	0.11	0.05
2.52	0.23	0.00	0.00	5.64	0.60	0.12	0.05
2.58	0.24	0.00	0.00	5.70	0.61	0.12	0.05
2.64	0.24	0.00	0.00	5.76	0.62	0.13	0.05
2.70	0.25	0.00	0.01	5.82	0.63	0.13	0.05
2.76	0.25	0.00	0.01	5.88	0.64	0.13	0.05
2.82	0.26	0.00	0.01	5.94	0.64	0.14	0.05
2.88	0.27	0.00	0.01	6.00	0.65	0.14	0.05
2.94	0.27	0.01	0.01	6.06	0.66	0.15	0.06
3.00	0.28	0.01	0.01	6.12	0.67	0.15	0.06
3.06	0.29	0.01	0.01	6.18	0.68	0.16	0.06

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

Prepared by Tectonic Engineering

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.69	0.16	0.06	9.36	1.45	0.70	0.21
6.30	0.70	0.17	0.06	9.42	1.47	0.72	0.22
6.36	0.71	0.17	0.06	9.48	1.50	0.74	0.22
6.42	0.72	0.18	0.06	9.54	1.52	0.76	0.23
6.48	0.73	0.18	0.07	9.60	1.54	0.78	0.23
6.54	0.74	0.19	0.07	9.66	1.57	0.80	0.24
6.60	0.75	0.20	0.07	9.72	1.59	0.82	0.24
6.66	0.76	0.20	0.07	9.78	1.62	0.84	0.25
6.72	0.77	0.21	0.07	9.84	1.64	0.86	0.25
6.78	0.78	0.22	0.08	9.90	1.67	0.88	0.26
6.84	0.79	0.22	0.08	9.96	1.70	0.90	0.26
6.90	0.80	0.23	0.08	10.02	1.72	0.93	0.27
6.96	0.81	0.24	0.08	10.08	1.75	0.95	0.27
7.02	0.82	0.24	0.08	10.14	1.78	0.97	0.28
7.08	0.84	0.25	0.09	10.20	1.81	1.00	0.29
7.14	0.85	0.26	0.09	10.26	1.84	1.02	0.29
7.20	0.86	0.27	0.09	10.32	1.87	1.05	0.30
7.26	0.87	0.27	0.09	10.38	1.90	1.08	0.31
7.32	0.88	0.28	0.09	10.44	1.93	1.10	0.32
7.38	0.90	0.29	0.10	10.50	1.96	1.13	0.33
7.44	0.91	0.30	0.10	10.56	2.00	1.16	0.34
7.50	0.92	0.31	0.10	10.62	2.03	1.19	0.35
7.56	0.93	0.31	0.10	10.68	2.07	1.22	0.36
7.62	0.95	0.32	0.10	10.74	2.10	1.25	0.37
7.68	0.96	0.33	0.11	10.80	2.14	1.29	0.38
7.74	0.97	0.34	0.11	10.86	2.18	1.32	0.39
7.80	0.99	0.35	0.11	10.92	2.22	1.35	0.40
7.86	1.00	0.36	0.11	10.98	2.25	1.39	0.41
7.92	1.02	0.37	0.11	11.04	2.29	1.42	0.42
7.98	1.03	0.38	0.12	11.10	2.34	1.46	0.43
8.04	1.04	0.39	0.12	11.16	2.38	1.51	0.46
8.10	1.06	0.40	0.12	11.22	2.43	1.55	0.49
8.16	1.07	0.41	0.12	11.28	2.49	1.60	0.52
8.22	1.09	0.42	0.13	11.34	2.54	1.65	0.56
8.28	1.10	0.43	0.13	11.40	2.60	1.70	0.59
8.34	1.12	0.45	0.14	11.46	2.66	1.76	0.63
8.40	1.14	0.46	0.14	11.52	2.73	1.82	0.66
8.46	1.15	0.47	0.14	11.58	2.81	1.90	0.73
8.52	1.17	0.48	0.15	11.64	2.93	2.01	0.90
8.58	1.19	0.50	0.15	11.70	3.08	2.14	1.17
8.64	1.21	0.51	0.16	11.76	3.25	2.31	1.48
8.70	1.22	0.52	0.16	11.82	3.46	2.50	1.81
8.76	1.24	0.54	0.17	11.88	3.69	2.72	2.15
8.82	1.26	0.55	0.17	11.94	4.00	3.01	2.51
8.88	1.28	0.57	0.18	12.00	4.53	3.53	3.33
8.94	1.30	0.58	0.18	12.06	5.07	4.05	4.99
9.00	1.32	0.60	0.18	12.12	5.38	4.35	5.70
9.06	1.34	0.61	0.19	12.18	5.61	4.58	4.60
9.12	1.36	0.63	0.19	12.24	5.82	4.78	3.44
9.18	1.38	0.65	0.20	12.30	5.99	4.95	2.77
9.24	1.41	0.66	0.20	12.36	6.14	5.09	2.33
9.30	1.43	0.68	0.21	12.42	6.26	5.21	1.95

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	6.34	5.29	1.59	15.60	7.93	6.86	0.21
12.54	6.41	5.36	1.25	15.66	7.95	6.87	0.20
12.60	6.47	5.42	0.97	15.72	7.97	6.89	0.20
12.66	6.53	5.48	0.81	15.78	7.98	6.91	0.20
12.72	6.58	5.53	0.73	15.84	8.00	6.92	0.19
12.78	6.64	5.58	0.69	15.90	8.01	6.94	0.19
12.84	6.69	5.63	0.65	15.96	8.03	6.95	0.18
12.90	6.73	5.68	0.61	16.02	8.04	6.96	0.18
12.96	6.78	5.72	0.57	16.08	8.05	6.98	0.17
13.02	6.82	5.76	0.54	16.14	8.07	6.99	0.17
13.08	6.85	5.80	0.50	16.20	8.08	7.01	0.17
13.14	6.89	5.83	0.48	16.26	8.10	7.02	0.17
13.20	6.93	5.87	0.47	16.32	8.11	7.03	0.16
13.26	6.97	5.91	0.45	16.38	8.12	7.05	0.16
13.32	7.00	5.94	0.44	16.44	8.14	7.06	0.16
13.38	7.04	5.98	0.44	16.50	8.15	7.07	0.16
13.44	7.07	6.01	0.43	16.56	8.16	7.08	0.16
13.50	7.11	6.04	0.42	16.62	8.17	7.10	0.15
13.56	7.14	6.08	0.41	16.68	8.19	7.11	0.15
13.62	7.17	6.11	0.40	16.74	8.20	7.12	0.15
13.68	7.20	6.14	0.39	16.80	8.21	7.13	0.15
13.74	7.23	6.17	0.38	16.86	8.22	7.14	0.15
13.80	7.26	6.20	0.37	16.92	8.23	7.16	0.14
13.86	7.29	6.23	0.36	16.98	8.25	7.17	0.14
13.92	7.32	6.25	0.35	17.04	8.26	7.18	0.14
13.98	7.35	6.28	0.34	17.10	8.27	7.19	0.14
14.04	7.37	6.31	0.33	17.16	8.28	7.20	0.14
14.10	7.40	6.33	0.32	17.22	8.29	7.21	0.13
14.16	7.43	6.36	0.32	17.28	8.30	7.22	0.13
14.22	7.45	6.38	0.31	17.34	8.31	7.23	0.13
14.28	7.48	6.41	0.31	17.40	8.32	7.24	0.13
14.34	7.50	6.43	0.30	17.46	8.33	7.25	0.13
14.40	7.53	6.46	0.30	17.52	8.34	7.26	0.12
14.46	7.55	6.48	0.29	17.58	8.35	7.27	0.12
14.52	7.57	6.50	0.29	17.64	8.36	7.28	0.12
14.58	7.60	6.53	0.29	17.70	8.37	7.29	0.12
14.64	7.62	6.55	0.28	17.76	8.38	7.30	0.12
14.70	7.64	6.57	0.28	17.82	8.39	7.31	0.11
14.76	7.66	6.59	0.27	17.88	8.40	7.32	0.11
14.82	7.69	6.61	0.27	17.94	8.41	7.33	0.11
14.88	7.71	6.63	0.26	18.00	8.42	7.34	0.11
14.94	7.73	6.66	0.26	18.06	8.43	7.34	0.11
15.00	7.75	6.68	0.25	18.12	8.43	7.35	0.11
15.06	7.77	6.70	0.25	18.18	8.44	7.36	0.10
15.12	7.79	6.72	0.25	18.24	8.45	7.37	0.10
15.18	7.81	6.73	0.24	18.30	8.46	7.38	0.10
15.24	7.83	6.75	0.24	18.36	8.47	7.39	0.10
15.30	7.85	6.77	0.23	18.42	8.48	7.40	0.10
15.36	7.86	6.79	0.23	18.48	8.49	7.40	0.10
15.42	7.88	6.81	0.22	18.54	8.49	7.41	0.10
15.48	7.90	6.83	0.22	18.60	8.50	7.42	0.10
15.54	7.92	6.84	0.21	18.66	8.51	7.43	0.10

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Hydrograph for Subcatchment 1S: Subcatch A (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	8.52	7.44	0.10	21.84	8.88	7.79	0.07
18.78	8.53	7.44	0.10	21.90	8.89	7.80	0.07
18.84	8.53	7.45	0.10	21.96	8.89	7.81	0.07
18.90	8.54	7.46	0.10	22.02	8.90	7.81	0.07
18.96	8.55	7.47	0.10	22.08	8.90	7.82	0.07
19.02	8.56	7.48	0.10	22.14	8.91	7.82	0.07
19.08	8.57	7.48	0.10	22.20	8.91	7.83	0.07
19.14	8.57	7.49	0.09	22.26	8.92	7.83	0.07
19.20	8.58	7.50	0.09	22.32	8.93	7.84	0.07
19.26	8.59	7.51	0.09	22.38	8.93	7.85	0.07
19.32	8.60	7.51	0.09	22.44	8.94	7.85	0.07
19.38	8.60	7.52	0.09	22.50	8.94	7.86	0.07
19.44	8.61	7.53	0.09	22.56	8.95	7.86	0.07
19.50	8.62	7.54	0.09	22.62	8.95	7.87	0.07
19.56	8.63	7.54	0.09	22.68	8.96	7.87	0.07
19.62	8.63	7.55	0.09	22.74	8.96	7.88	0.07
19.68	8.64	7.56	0.09	22.80	8.97	7.88	0.07
19.74	8.65	7.57	0.09	22.86	8.98	7.89	0.07
19.80	8.66	7.57	0.09	22.92	8.98	7.89	0.06
19.86	8.66	7.58	0.09	22.98	8.99	7.90	0.06
19.92	8.67	7.59	0.09	23.04	8.99	7.90	0.06
19.98	8.68	7.59	0.09	23.10	9.00	7.91	0.06
20.04	8.68	7.60	0.09	23.16	9.00	7.91	0.06
20.10	8.69	7.61	0.09	23.22	9.01	7.92	0.06
20.16	8.70	7.61	0.08	23.28	9.01	7.92	0.06
20.22	8.71	7.62	0.08	23.34	9.02	7.93	0.06
20.28	8.71	7.63	0.08	23.40	9.02	7.93	0.06
20.34	8.72	7.64	0.08	23.46	9.03	7.94	0.06
20.40	8.73	7.64	0.08	23.52	9.03	7.94	0.06
20.46	8.73	7.65	0.08	23.58	9.04	7.95	0.06
20.52	8.74	7.66	0.08	23.64	9.04	7.95	0.06
20.58	8.75	7.66	0.08	23.70	9.05	7.96	0.06
20.64	8.75	7.67	0.08	23.76	9.05	7.96	0.06
20.70	8.76	7.68	0.08	23.82	9.06	7.97	0.06
20.76	8.77	7.68	0.08	23.88	9.06	7.97	0.06
20.82	8.77	7.69	0.08	23.94	9.07	7.98	0.06
20.88	8.78	7.70	0.08	24.00	9.07	7.98	0.06
20.94	8.79	7.70	0.08				
21.00	8.79	7.71	0.08				
21.06	8.80	7.71	0.08				
21.12	8.81	7.72	0.08				
21.18	8.81	7.73	0.08				
21.24	8.82	7.73	0.08				
21.30	8.82	7.74	0.08				
21.36	8.83	7.75	0.08				
21.42	8.84	7.75	0.08				
21.48	8.84	7.76	0.08				
21.54	8.85	7.76	0.07				
21.60	8.86	7.77	0.07				
21.66	8.86	7.78	0.07				
21.72	8.87	7.78	0.07				
21.78	8.87	7.79	0.07				

Summary for Subcatchment 2S: Subcatch B2

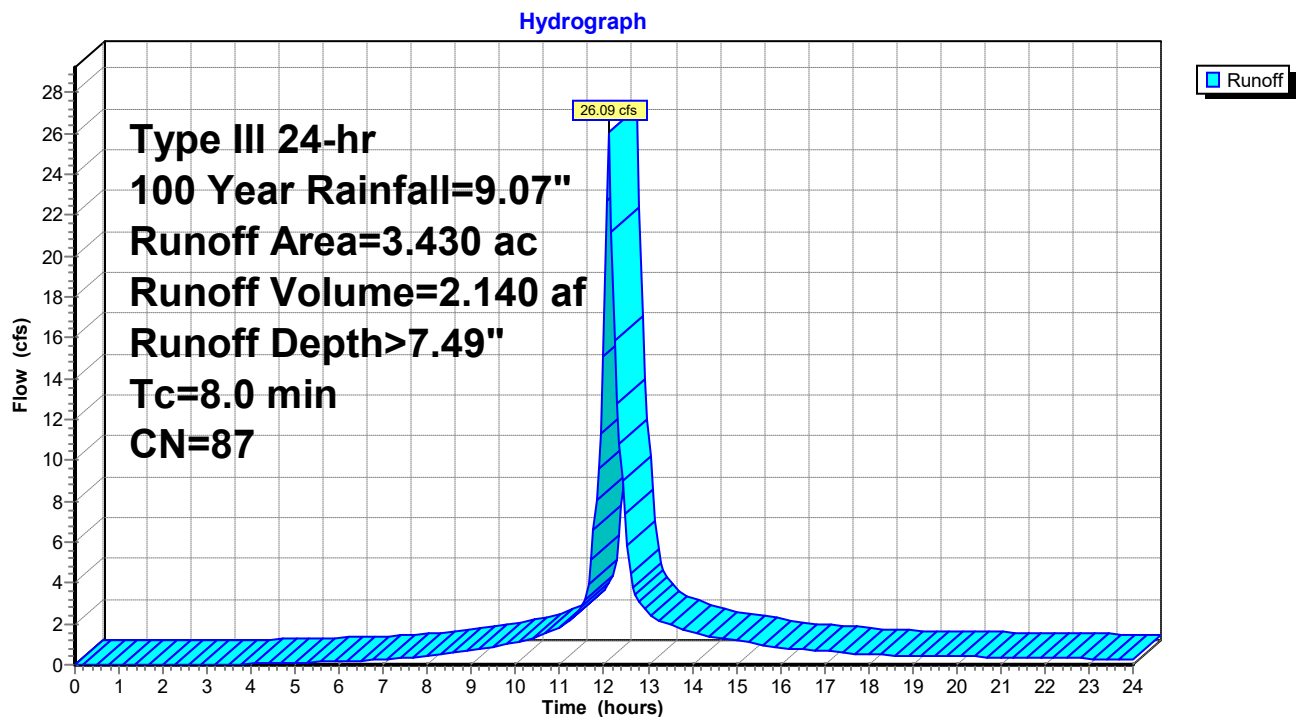
Runoff = 26.09 cfs @ 12.11 hrs, Volume= 2.140 af, Depth> 7.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
Type III 24-hr 100 Year Rainfall=9.07"

Area (ac)	CN	Description
1.926	98	Paved roads w/curbs & sewers, HSG C
* 1.504	74	>75% Grass cover, Good, HSG C
3.430	87	Weighted Average
1.504		43.85% Pervious Area
1.926		56.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0					Direct Entry,

Subcatchment 2S: Subcatch B2



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Hydrograph for Subcatchment 2S: Subcatch B2

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.29	0.00	0.00
0.06	0.01	0.00	0.00	3.18	0.30	0.00	0.00
0.12	0.01	0.00	0.00	3.24	0.30	0.00	0.00
0.18	0.02	0.00	0.00	3.30	0.31	0.00	0.00
0.24	0.02	0.00	0.00	3.36	0.32	0.00	0.00
0.30	0.03	0.00	0.00	3.42	0.32	0.00	0.01
0.36	0.03	0.00	0.00	3.48	0.33	0.00	0.01
0.42	0.04	0.00	0.00	3.54	0.34	0.00	0.01
0.48	0.04	0.00	0.00	3.60	0.34	0.00	0.02
0.54	0.05	0.00	0.00	3.66	0.35	0.00	0.02
0.60	0.05	0.00	0.00	3.72	0.36	0.00	0.02
0.66	0.06	0.00	0.00	3.78	0.36	0.00	0.03
0.72	0.07	0.00	0.00	3.84	0.37	0.00	0.03
0.78	0.07	0.00	0.00	3.90	0.38	0.00	0.03
0.84	0.08	0.00	0.00	3.96	0.39	0.00	0.04
0.90	0.08	0.00	0.00	4.02	0.39	0.01	0.04
0.96	0.09	0.00	0.00	4.08	0.40	0.01	0.04
1.02	0.09	0.00	0.00	4.14	0.41	0.01	0.05
1.08	0.10	0.00	0.00	4.20	0.41	0.01	0.05
1.14	0.10	0.00	0.00	4.26	0.42	0.01	0.05
1.20	0.11	0.00	0.00	4.32	0.43	0.01	0.06
1.26	0.11	0.00	0.00	4.38	0.44	0.01	0.06
1.32	0.12	0.00	0.00	4.44	0.44	0.01	0.06
1.38	0.13	0.00	0.00	4.50	0.45	0.01	0.07
1.44	0.13	0.00	0.00	4.56	0.46	0.02	0.07
1.50	0.14	0.00	0.00	4.62	0.47	0.02	0.08
1.56	0.14	0.00	0.00	4.68	0.47	0.02	0.08
1.62	0.15	0.00	0.00	4.74	0.48	0.02	0.08
1.68	0.15	0.00	0.00	4.80	0.49	0.02	0.09
1.74	0.16	0.00	0.00	4.86	0.50	0.02	0.09
1.80	0.16	0.00	0.00	4.92	0.50	0.02	0.09
1.86	0.17	0.00	0.00	4.98	0.51	0.03	0.10
1.92	0.17	0.00	0.00	5.04	0.52	0.03	0.10
1.98	0.18	0.00	0.00	5.10	0.53	0.03	0.11
2.04	0.19	0.00	0.00	5.16	0.54	0.03	0.11
2.10	0.19	0.00	0.00	5.22	0.54	0.03	0.11
2.16	0.20	0.00	0.00	5.28	0.55	0.04	0.12
2.22	0.20	0.00	0.00	5.34	0.56	0.04	0.12
2.28	0.21	0.00	0.00	5.40	0.57	0.04	0.13
2.34	0.21	0.00	0.00	5.46	0.58	0.04	0.13
2.40	0.22	0.00	0.00	5.52	0.58	0.05	0.13
2.46	0.22	0.00	0.00	5.58	0.59	0.05	0.14
2.52	0.23	0.00	0.00	5.64	0.60	0.05	0.14
2.58	0.24	0.00	0.00	5.70	0.61	0.05	0.15
2.64	0.24	0.00	0.00	5.76	0.62	0.06	0.15
2.70	0.25	0.00	0.00	5.82	0.63	0.06	0.15
2.76	0.25	0.00	0.00	5.88	0.64	0.06	0.16
2.82	0.26	0.00	0.00	5.94	0.64	0.06	0.16
2.88	0.27	0.00	0.00	6.00	0.65	0.07	0.17
2.94	0.27	0.00	0.00	6.06	0.66	0.07	0.17
3.00	0.28	0.00	0.00	6.12	0.67	0.07	0.17
3.06	0.29	0.00	0.00	6.18	0.68	0.08	0.18

Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.69	0.08	0.19	9.36	1.45	0.50	0.85
6.30	0.70	0.08	0.19	9.42	1.47	0.52	0.87
6.36	0.71	0.09	0.20	9.48	1.50	0.53	0.89
6.42	0.72	0.09	0.21	9.54	1.52	0.55	0.91
6.48	0.73	0.10	0.21	9.60	1.54	0.57	0.93
6.54	0.74	0.10	0.22	9.66	1.57	0.58	0.95
6.60	0.75	0.10	0.23	9.72	1.59	0.60	0.98
6.66	0.76	0.11	0.24	9.78	1.62	0.62	1.00
6.72	0.77	0.11	0.24	9.84	1.64	0.64	1.02
6.78	0.78	0.12	0.25	9.90	1.67	0.66	1.05
6.84	0.79	0.12	0.26	9.96	1.70	0.68	1.07
6.90	0.80	0.13	0.27	10.02	1.72	0.70	1.09
6.96	0.81	0.13	0.27	10.08	1.75	0.72	1.12
7.02	0.82	0.14	0.28	10.14	1.78	0.74	1.15
7.08	0.84	0.14	0.29	10.20	1.81	0.76	1.19
7.14	0.85	0.15	0.30	10.26	1.84	0.78	1.23
7.20	0.86	0.15	0.31	10.32	1.87	0.80	1.27
7.26	0.87	0.16	0.32	10.38	1.90	0.83	1.31
7.32	0.88	0.16	0.32	10.44	1.93	0.85	1.35
7.38	0.90	0.17	0.33	10.50	1.96	0.88	1.40
7.44	0.91	0.18	0.34	10.56	2.00	0.90	1.44
7.50	0.92	0.18	0.35	10.62	2.03	0.93	1.48
7.56	0.93	0.19	0.36	10.68	2.07	0.96	1.53
7.62	0.95	0.20	0.37	10.74	2.10	0.99	1.57
7.68	0.96	0.20	0.38	10.80	2.14	1.02	1.62
7.74	0.97	0.21	0.39	10.86	2.18	1.05	1.66
7.80	0.99	0.22	0.40	10.92	2.22	1.08	1.71
7.86	1.00	0.22	0.41	10.98	2.25	1.11	1.75
7.92	1.02	0.23	0.42	11.04	2.29	1.14	1.80
7.98	1.03	0.24	0.43	11.10	2.34	1.18	1.87
8.04	1.04	0.25	0.44	11.16	2.38	1.21	1.98
8.10	1.06	0.26	0.45	11.22	2.43	1.26	2.12
8.16	1.07	0.26	0.46	11.28	2.49	1.30	2.27
8.22	1.09	0.27	0.48	11.34	2.54	1.35	2.42
8.28	1.10	0.28	0.49	11.40	2.60	1.39	2.58
8.34	1.12	0.29	0.51	11.46	2.66	1.45	2.74
8.40	1.14	0.30	0.53	11.52	2.73	1.50	2.90
8.46	1.15	0.31	0.55	11.58	2.81	1.58	3.19
8.52	1.17	0.32	0.56	11.64	2.93	1.68	3.95
8.58	1.19	0.33	0.58	11.70	3.08	1.81	5.16
8.64	1.21	0.34	0.60	11.76	3.25	1.96	6.56
8.70	1.22	0.35	0.62	11.82	3.46	2.14	8.06
8.76	1.24	0.37	0.64	11.88	3.69	2.35	9.60
8.82	1.26	0.38	0.66	11.94	4.00	2.63	11.30
8.88	1.28	0.39	0.68	12.00	4.53	3.13	15.06
8.94	1.30	0.40	0.70	12.06	5.07	3.64	22.68
9.00	1.32	0.42	0.72	12.12	5.38	3.93	26.05
9.06	1.34	0.43	0.74	12.18	5.61	4.15	21.13
9.12	1.36	0.44	0.76	12.24	5.82	4.34	15.81
9.18	1.38	0.46	0.78	12.30	5.99	4.51	12.80
9.24	1.41	0.47	0.80	12.36	6.14	4.65	10.76
9.30	1.43	0.49	0.82	12.42	6.26	4.76	9.02

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	6.34	4.85	7.39	15.60	7.93	6.38	0.98
12.54	6.41	4.91	5.81	15.66	7.95	6.40	0.96
12.60	6.47	4.97	4.50	15.72	7.97	6.42	0.94
12.66	6.53	5.03	3.77	15.78	7.98	6.43	0.91
12.72	6.58	5.08	3.41	15.84	8.00	6.45	0.89
12.78	6.64	5.13	3.18	15.90	8.01	6.46	0.87
12.84	6.69	5.18	3.00	15.96	8.03	6.48	0.85
12.90	6.73	5.22	2.83	16.02	8.04	6.49	0.83
12.96	6.78	5.26	2.66	16.08	8.05	6.50	0.81
13.02	6.82	5.30	2.50	16.14	8.07	6.52	0.80
13.08	6.85	5.34	2.34	16.20	8.08	6.53	0.78
13.14	6.89	5.38	2.23	16.26	8.10	6.54	0.77
13.20	6.93	5.41	2.17	16.32	8.11	6.56	0.76
13.26	6.97	5.45	2.12	16.38	8.12	6.57	0.76
13.32	7.00	5.48	2.07	16.44	8.14	6.58	0.75
13.38	7.04	5.52	2.03	16.50	8.15	6.59	0.74
13.44	7.07	5.55	1.98	16.56	8.16	6.61	0.73
13.50	7.11	5.58	1.94	16.62	8.17	6.62	0.72
13.56	7.14	5.61	1.90	16.68	8.19	6.63	0.71
13.62	7.17	5.64	1.85	16.74	8.20	6.64	0.70
13.68	7.20	5.68	1.81	16.80	8.21	6.65	0.69
13.74	7.23	5.70	1.77	16.86	8.22	6.67	0.68
13.80	7.26	5.73	1.72	16.92	8.23	6.68	0.67
13.86	7.29	5.76	1.68	16.98	8.25	6.69	0.66
13.92	7.32	5.79	1.64	17.04	8.26	6.70	0.65
13.98	7.35	5.82	1.59	17.10	8.27	6.71	0.65
14.04	7.37	5.84	1.55	17.16	8.28	6.72	0.64
14.10	7.40	5.87	1.51	17.22	8.29	6.73	0.63
14.16	7.43	5.89	1.48	17.28	8.30	6.74	0.62
14.22	7.45	5.92	1.46	17.34	8.31	6.75	0.61
14.28	7.48	5.94	1.44	17.40	8.32	6.76	0.60
14.34	7.50	5.96	1.42	17.46	8.33	6.77	0.59
14.40	7.53	5.99	1.39	17.52	8.34	6.78	0.58
14.46	7.55	6.01	1.37	17.58	8.35	6.79	0.57
14.52	7.57	6.03	1.35	17.64	8.36	6.80	0.56
14.58	7.60	6.06	1.33	17.70	8.37	6.81	0.55
14.64	7.62	6.08	1.31	17.76	8.38	6.82	0.55
14.70	7.64	6.10	1.29	17.82	8.39	6.83	0.54
14.76	7.66	6.12	1.27	17.88	8.40	6.84	0.53
14.82	7.69	6.14	1.25	17.94	8.41	6.85	0.52
14.88	7.71	6.16	1.23	18.00	8.42	6.86	0.51
14.94	7.73	6.18	1.21	18.06	8.43	6.86	0.50
15.00	7.75	6.20	1.19	18.12	8.43	6.87	0.49
15.06	7.77	6.22	1.17	18.18	8.44	6.88	0.49
15.12	7.79	6.24	1.14	18.24	8.45	6.89	0.48
15.18	7.81	6.26	1.12	18.30	8.46	6.90	0.48
15.24	7.83	6.28	1.10	18.36	8.47	6.91	0.48
15.30	7.85	6.30	1.08	18.42	8.48	6.91	0.48
15.36	7.86	6.32	1.06	18.48	8.49	6.92	0.47
15.42	7.88	6.33	1.04	18.54	8.49	6.93	0.47
15.48	7.90	6.35	1.02	18.60	8.50	6.94	0.47
15.54	7.92	6.37	1.00	18.66	8.51	6.95	0.47

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Hydrograph for Subcatchment 2S: Subcatch B2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	8.52	6.95	0.46	21.84	8.88	7.31	0.34
18.78	8.53	6.96	0.46	21.90	8.89	7.31	0.34
18.84	8.53	6.97	0.46	21.96	8.89	7.32	0.34
18.90	8.54	6.98	0.45	22.02	8.90	7.33	0.33
18.96	8.55	6.99	0.45	22.08	8.90	7.33	0.33
19.02	8.56	6.99	0.45	22.14	8.91	7.34	0.33
19.08	8.57	7.00	0.45	22.20	8.91	7.34	0.33
19.14	8.57	7.01	0.44	22.26	8.92	7.35	0.33
19.20	8.58	7.02	0.44	22.32	8.93	7.35	0.32
19.26	8.59	7.02	0.44	22.38	8.93	7.36	0.32
19.32	8.60	7.03	0.44	22.44	8.94	7.36	0.32
19.38	8.60	7.04	0.43	22.50	8.94	7.37	0.32
19.44	8.61	7.05	0.43	22.56	8.95	7.38	0.31
19.50	8.62	7.05	0.43	22.62	8.95	7.38	0.31
19.56	8.63	7.06	0.42	22.68	8.96	7.39	0.31
19.62	8.63	7.07	0.42	22.74	8.96	7.39	0.31
19.68	8.64	7.08	0.42	22.80	8.97	7.40	0.31
19.74	8.65	7.08	0.42	22.86	8.98	7.40	0.30
19.80	8.66	7.09	0.41	22.92	8.98	7.41	0.30
19.86	8.66	7.10	0.41	22.98	8.99	7.41	0.30
19.92	8.67	7.10	0.41	23.04	8.99	7.42	0.30
19.98	8.68	7.11	0.41	23.10	9.00	7.42	0.30
20.04	8.68	7.12	0.40	23.16	9.00	7.43	0.29
20.10	8.69	7.12	0.40	23.22	9.01	7.43	0.29
20.16	8.70	7.13	0.40	23.28	9.01	7.44	0.29
20.22	8.71	7.14	0.40	23.34	9.02	7.44	0.29
20.28	8.71	7.14	0.39	23.40	9.02	7.45	0.29
20.34	8.72	7.15	0.39	23.46	9.03	7.45	0.28
20.40	8.73	7.16	0.39	23.52	9.03	7.46	0.28
20.46	8.73	7.16	0.39	23.58	9.04	7.46	0.28
20.52	8.74	7.17	0.38	23.64	9.04	7.47	0.28
20.58	8.75	7.18	0.38	23.70	9.05	7.47	0.28
20.64	8.75	7.18	0.38	23.76	9.05	7.48	0.27
20.70	8.76	7.19	0.38	23.82	9.06	7.48	0.27
20.76	8.77	7.20	0.38	23.88	9.06	7.49	0.27
20.82	8.77	7.20	0.37	23.94	9.07	7.49	0.27
20.88	8.78	7.21	0.37	24.00	9.07	7.49	0.27
20.94	8.79	7.22	0.37				
21.00	8.79	7.22	0.37				
21.06	8.80	7.23	0.37				
21.12	8.81	7.24	0.36				
21.18	8.81	7.24	0.36				
21.24	8.82	7.25	0.36				
21.30	8.82	7.25	0.36				
21.36	8.83	7.26	0.36				
21.42	8.84	7.27	0.35				
21.48	8.84	7.27	0.35				
21.54	8.85	7.28	0.35				
21.60	8.86	7.28	0.35				
21.66	8.86	7.29	0.35				
21.72	8.87	7.30	0.34				
21.78	8.87	7.30	0.34				

Summary for Subcatchment 3S: Detention Drainage Area B1

[49] Hint: $T_c < 2dt$ may require smaller dt

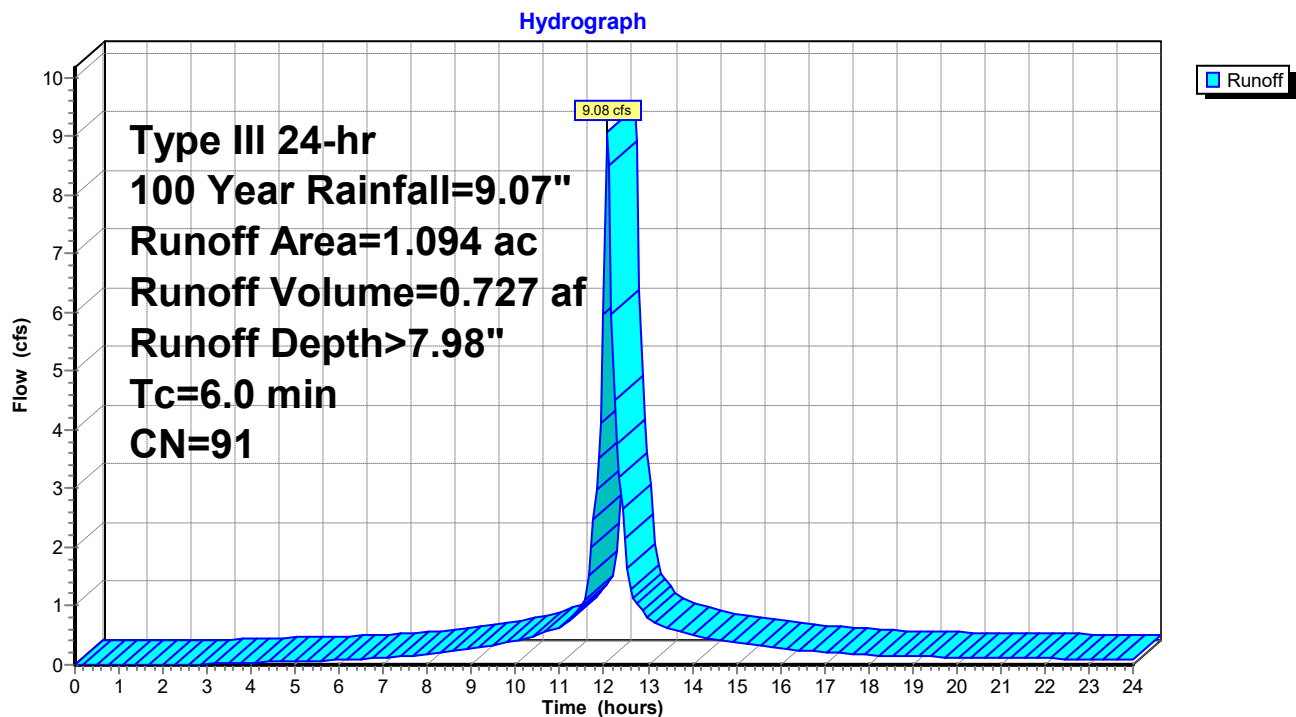
Runoff = 9.08 cfs @ 12.08 hrs, Volume= 0.727 af, Depth> 7.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, $dt=0.06$ hrs
Type III 24-hr 100 Year Rainfall=9.07"

Area (ac)	CN	Description
0.764	98	Roofs, HSG C
0.330	74	>75% Grass cover, Good, HSG C
1.094	91	Weighted Average
0.330		30.16% Pervious Area
0.764		69.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, minimum

Subcatchment 3S: Detention Drainage Area B1



Hydrograph for Subcatchment 3S: Detention Drainage Area B1

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	3.12	0.29	0.01	0.02
0.06	0.01	0.00	0.00	3.18	0.30	0.01	0.02
0.12	0.01	0.00	0.00	3.24	0.30	0.01	0.02
0.18	0.02	0.00	0.00	3.30	0.31	0.01	0.02
0.24	0.02	0.00	0.00	3.36	0.32	0.01	0.02
0.30	0.03	0.00	0.00	3.42	0.32	0.01	0.02
0.36	0.03	0.00	0.00	3.48	0.33	0.02	0.03
0.42	0.04	0.00	0.00	3.54	0.34	0.02	0.03
0.48	0.04	0.00	0.00	3.60	0.34	0.02	0.03
0.54	0.05	0.00	0.00	3.66	0.35	0.02	0.03
0.60	0.05	0.00	0.00	3.72	0.36	0.02	0.03
0.66	0.06	0.00	0.00	3.78	0.36	0.02	0.03
0.72	0.07	0.00	0.00	3.84	0.37	0.03	0.03
0.78	0.07	0.00	0.00	3.90	0.38	0.03	0.03
0.84	0.08	0.00	0.00	3.96	0.39	0.03	0.04
0.90	0.08	0.00	0.00	4.02	0.39	0.03	0.04
0.96	0.09	0.00	0.00	4.08	0.40	0.03	0.04
1.02	0.09	0.00	0.00	4.14	0.41	0.04	0.04
1.08	0.10	0.00	0.00	4.20	0.41	0.04	0.04
1.14	0.10	0.00	0.00	4.26	0.42	0.04	0.04
1.20	0.11	0.00	0.00	4.32	0.43	0.04	0.04
1.26	0.11	0.00	0.00	4.38	0.44	0.05	0.05
1.32	0.12	0.00	0.00	4.44	0.44	0.05	0.05
1.38	0.13	0.00	0.00	4.50	0.45	0.05	0.05
1.44	0.13	0.00	0.00	4.56	0.46	0.05	0.05
1.50	0.14	0.00	0.00	4.62	0.47	0.06	0.05
1.56	0.14	0.00	0.00	4.68	0.47	0.06	0.05
1.62	0.15	0.00	0.00	4.74	0.48	0.06	0.05
1.68	0.15	0.00	0.00	4.80	0.49	0.07	0.06
1.74	0.16	0.00	0.00	4.86	0.50	0.07	0.06
1.80	0.16	0.00	0.00	4.92	0.50	0.07	0.06
1.86	0.17	0.00	0.00	4.98	0.51	0.08	0.06
1.92	0.17	0.00	0.00	5.04	0.52	0.08	0.06
1.98	0.18	0.00	0.00	5.10	0.53	0.08	0.06
2.04	0.19	0.00	0.00	5.16	0.54	0.09	0.06
2.10	0.19	0.00	0.00	5.22	0.54	0.09	0.06
2.16	0.20	0.00	0.00	5.28	0.55	0.09	0.07
2.22	0.20	0.00	0.00	5.34	0.56	0.10	0.07
2.28	0.21	0.00	0.00	5.40	0.57	0.10	0.07
2.34	0.21	0.00	0.00	5.46	0.58	0.10	0.07
2.40	0.22	0.00	0.00	5.52	0.58	0.11	0.07
2.46	0.22	0.00	0.00	5.58	0.59	0.11	0.07
2.52	0.23	0.00	0.00	5.64	0.60	0.12	0.07
2.58	0.24	0.00	0.01	5.70	0.61	0.12	0.08
2.64	0.24	0.00	0.01	5.76	0.62	0.13	0.08
2.70	0.25	0.00	0.01	5.82	0.63	0.13	0.08
2.76	0.25	0.00	0.01	5.88	0.64	0.13	0.08
2.82	0.26	0.00	0.01	5.94	0.64	0.14	0.08
2.88	0.27	0.00	0.01	6.00	0.65	0.14	0.08
2.94	0.27	0.01	0.01	6.06	0.66	0.15	0.08
3.00	0.28	0.01	0.01	6.12	0.67	0.15	0.09
3.06	0.29	0.01	0.02	6.18	0.68	0.16	0.09

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
6.24	0.69	0.16	0.09	9.36	1.45	0.70	0.32
6.30	0.70	0.17	0.09	9.42	1.47	0.72	0.33
6.36	0.71	0.17	0.10	9.48	1.50	0.74	0.34
6.42	0.72	0.18	0.10	9.54	1.52	0.76	0.35
6.48	0.73	0.18	0.10	9.60	1.54	0.78	0.35
6.54	0.74	0.19	0.10	9.66	1.57	0.80	0.36
6.60	0.75	0.20	0.11	9.72	1.59	0.82	0.37
6.66	0.76	0.20	0.11	9.78	1.62	0.84	0.38
6.72	0.77	0.21	0.11	9.84	1.64	0.86	0.38
6.78	0.78	0.22	0.12	9.90	1.67	0.88	0.39
6.84	0.79	0.22	0.12	9.96	1.70	0.90	0.40
6.90	0.80	0.23	0.12	10.02	1.72	0.93	0.40
6.96	0.81	0.24	0.12	10.08	1.75	0.95	0.41
7.02	0.82	0.24	0.13	10.14	1.78	0.97	0.43
7.08	0.84	0.25	0.13	10.20	1.81	1.00	0.44
7.14	0.85	0.26	0.13	10.26	1.84	1.02	0.45
7.20	0.86	0.27	0.14	10.32	1.87	1.05	0.47
7.26	0.87	0.27	0.14	10.38	1.90	1.08	0.48
7.32	0.88	0.28	0.14	10.44	1.93	1.10	0.50
7.38	0.90	0.29	0.15	10.50	1.96	1.13	0.51
7.44	0.91	0.30	0.15	10.56	2.00	1.16	0.52
7.50	0.92	0.31	0.15	10.62	2.03	1.19	0.54
7.56	0.93	0.31	0.16	10.68	2.07	1.22	0.55
7.62	0.95	0.32	0.16	10.74	2.10	1.25	0.57
7.68	0.96	0.33	0.16	10.80	2.14	1.29	0.58
7.74	0.97	0.34	0.16	10.86	2.18	1.32	0.60
7.80	0.99	0.35	0.17	10.92	2.22	1.35	0.61
7.86	1.00	0.36	0.17	10.98	2.25	1.39	0.63
7.92	1.02	0.37	0.17	11.04	2.29	1.42	0.64
7.98	1.03	0.38	0.18	11.10	2.34	1.46	0.67
8.04	1.04	0.39	0.18	11.16	2.38	1.51	0.71
8.10	1.06	0.40	0.19	11.22	2.43	1.55	0.76
8.16	1.07	0.41	0.19	11.28	2.49	1.60	0.82
8.22	1.09	0.42	0.20	11.34	2.54	1.65	0.87
8.28	1.10	0.43	0.20	11.40	2.60	1.70	0.92
8.34	1.12	0.45	0.21	11.46	2.66	1.76	0.98
8.40	1.14	0.46	0.22	11.52	2.73	1.82	1.03
8.46	1.15	0.47	0.22	11.58	2.81	1.90	1.17
8.52	1.17	0.48	0.23	11.64	2.93	2.01	1.52
8.58	1.19	0.50	0.24	11.70	3.08	2.14	1.99
8.64	1.21	0.51	0.24	11.76	3.25	2.31	2.48
8.70	1.22	0.52	0.25	11.82	3.46	2.50	2.99
8.76	1.24	0.54	0.26	11.88	3.69	2.72	3.51
8.82	1.26	0.55	0.26	11.94	4.00	3.01	4.12
8.88	1.28	0.57	0.27	12.00	4.53	3.53	5.96
8.94	1.30	0.58	0.28	12.06	5.07	4.05	8.83
9.00	1.32	0.60	0.28	12.12	5.38	4.35	8.49
9.06	1.34	0.61	0.29	12.18	5.61	4.58	5.96
9.12	1.36	0.63	0.30	12.24	5.82	4.78	4.49
9.18	1.38	0.65	0.30	12.30	5.99	4.95	3.75
9.24	1.41	0.66	0.31	12.36	6.14	5.09	3.18
9.30	1.43	0.68	0.32	12.42	6.26	5.21	2.66

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
12.48	6.34	5.29	2.14	15.60	7.93	6.86	0.31
12.54	6.41	5.36	1.63	15.66	7.95	6.87	0.31
12.60	6.47	5.42	1.28	15.72	7.97	6.89	0.30
12.66	6.53	5.48	1.13	15.78	7.98	6.91	0.29
12.72	6.58	5.53	1.06	15.84	8.00	6.92	0.29
12.78	6.64	5.58	1.00	15.90	8.01	6.94	0.28
12.84	6.69	5.63	0.95	15.96	8.03	6.95	0.27
12.90	6.73	5.68	0.89	16.02	8.04	6.96	0.27
12.96	6.78	5.72	0.84	16.08	8.05	6.98	0.26
13.02	6.82	5.76	0.78	16.14	8.07	6.99	0.25
13.08	6.85	5.80	0.74	16.20	8.08	7.01	0.25
13.14	6.89	5.83	0.71	16.26	8.10	7.02	0.25
13.20	6.93	5.87	0.69	16.32	8.11	7.03	0.25
13.26	6.97	5.91	0.68	16.38	8.12	7.05	0.24
13.32	7.00	5.94	0.66	16.44	8.14	7.06	0.24
13.38	7.04	5.98	0.65	16.50	8.15	7.07	0.24
13.44	7.07	6.01	0.64	16.56	8.16	7.08	0.23
13.50	7.11	6.04	0.62	16.62	8.17	7.10	0.23
13.56	7.14	6.08	0.61	16.68	8.19	7.11	0.23
13.62	7.17	6.11	0.59	16.74	8.20	7.12	0.22
13.68	7.20	6.14	0.58	16.80	8.21	7.13	0.22
13.74	7.23	6.17	0.57	16.86	8.22	7.14	0.22
13.80	7.26	6.20	0.55	16.92	8.23	7.16	0.22
13.86	7.29	6.23	0.54	16.98	8.25	7.17	0.21
13.92	7.32	6.25	0.52	17.04	8.26	7.18	0.21
13.98	7.35	6.28	0.51	17.10	8.27	7.19	0.21
14.04	7.37	6.31	0.50	17.16	8.28	7.20	0.20
14.10	7.40	6.33	0.48	17.22	8.29	7.21	0.20
14.16	7.43	6.36	0.48	17.28	8.30	7.22	0.20
14.22	7.45	6.38	0.47	17.34	8.31	7.23	0.20
14.28	7.48	6.41	0.46	17.40	8.32	7.24	0.19
14.34	7.50	6.43	0.46	17.46	8.33	7.25	0.19
14.40	7.53	6.46	0.45	17.52	8.34	7.26	0.19
14.46	7.55	6.48	0.44	17.58	8.35	7.27	0.18
14.52	7.57	6.50	0.43	17.64	8.36	7.28	0.18
14.58	7.60	6.53	0.43	17.70	8.37	7.29	0.18
14.64	7.62	6.55	0.42	17.76	8.38	7.30	0.17
14.70	7.64	6.57	0.41	17.82	8.39	7.31	0.17
14.76	7.66	6.59	0.41	17.88	8.40	7.32	0.17
14.82	7.69	6.61	0.40	17.94	8.41	7.33	0.17
14.88	7.71	6.63	0.39	18.00	8.42	7.34	0.16
14.94	7.73	6.66	0.39	18.06	8.43	7.34	0.16
15.00	7.75	6.68	0.38	18.12	8.43	7.35	0.16
15.06	7.77	6.70	0.37	18.18	8.44	7.36	0.16
15.12	7.79	6.72	0.37	18.24	8.45	7.37	0.16
15.18	7.81	6.73	0.36	18.30	8.46	7.38	0.16
15.24	7.83	6.75	0.35	18.36	8.47	7.39	0.15
15.30	7.85	6.77	0.35	18.42	8.48	7.40	0.15
15.36	7.86	6.79	0.34	18.48	8.49	7.40	0.15
15.42	7.88	6.81	0.33	18.54	8.49	7.41	0.15
15.48	7.90	6.83	0.33	18.60	8.50	7.42	0.15
15.54	7.92	6.84	0.32	18.66	8.51	7.43	0.15

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

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Hydrograph for Subcatchment 3S: Detention Drainage Area B1 (continued)

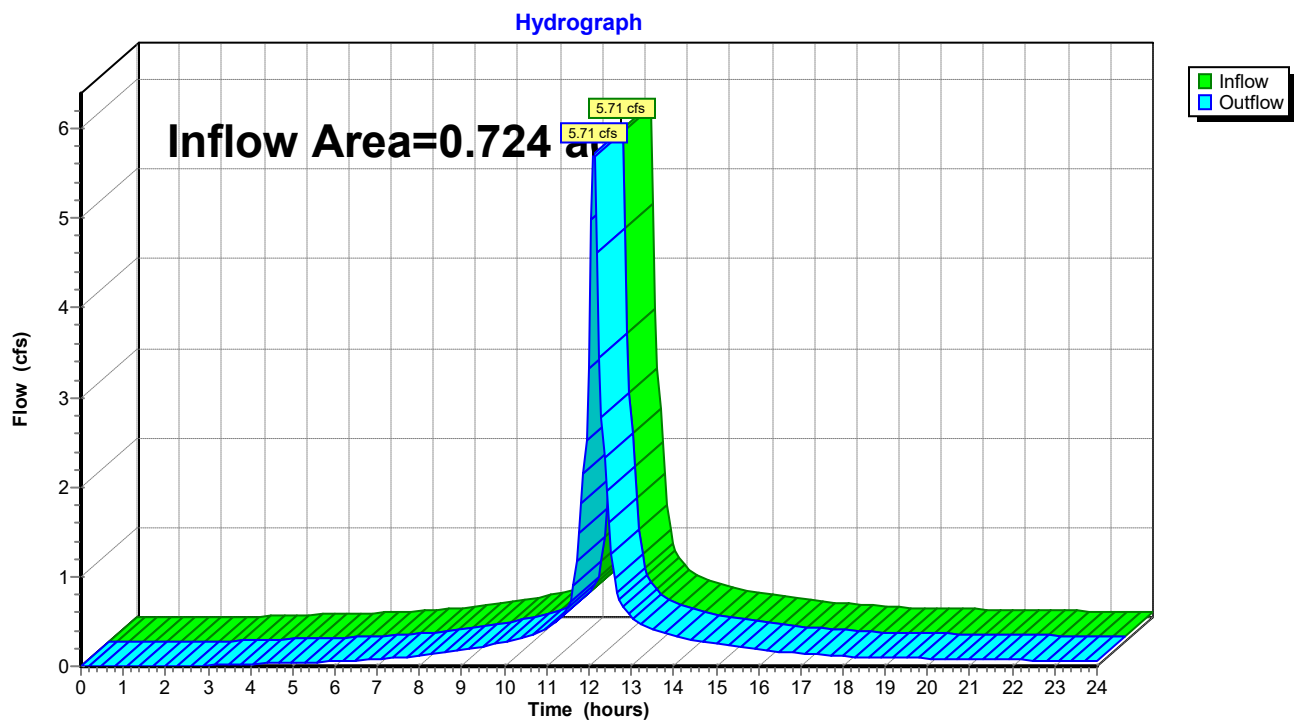
Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
18.72	8.52	7.44	0.15	21.84	8.88	7.79	0.11
18.78	8.53	7.44	0.15	21.90	8.89	7.80	0.11
18.84	8.53	7.45	0.15	21.96	8.89	7.81	0.11
18.90	8.54	7.46	0.15	22.02	8.90	7.81	0.11
18.96	8.55	7.47	0.15	22.08	8.90	7.82	0.11
19.02	8.56	7.48	0.14	22.14	8.91	7.82	0.11
19.08	8.57	7.48	0.14	22.20	8.91	7.83	0.11
19.14	8.57	7.49	0.14	22.26	8.92	7.83	0.10
19.20	8.58	7.50	0.14	22.32	8.93	7.84	0.10
19.26	8.59	7.51	0.14	22.38	8.93	7.85	0.10
19.32	8.60	7.51	0.14	22.44	8.94	7.85	0.10
19.38	8.60	7.52	0.14	22.50	8.94	7.86	0.10
19.44	8.61	7.53	0.14	22.56	8.95	7.86	0.10
19.50	8.62	7.54	0.14	22.62	8.95	7.87	0.10
19.56	8.63	7.54	0.14	22.68	8.96	7.87	0.10
19.62	8.63	7.55	0.14	22.74	8.96	7.88	0.10
19.68	8.64	7.56	0.13	22.80	8.97	7.88	0.10
19.74	8.65	7.57	0.13	22.86	8.98	7.89	0.10
19.80	8.66	7.57	0.13	22.92	8.98	7.89	0.10
19.86	8.66	7.58	0.13	22.98	8.99	7.90	0.10
19.92	8.67	7.59	0.13	23.04	8.99	7.90	0.10
19.98	8.68	7.59	0.13	23.10	9.00	7.91	0.10
20.04	8.68	7.60	0.13	23.16	9.00	7.91	0.09
20.10	8.69	7.61	0.13	23.22	9.01	7.92	0.09
20.16	8.70	7.61	0.13	23.28	9.01	7.92	0.09
20.22	8.71	7.62	0.13	23.34	9.02	7.93	0.09
20.28	8.71	7.63	0.13	23.40	9.02	7.93	0.09
20.34	8.72	7.64	0.13	23.46	9.03	7.94	0.09
20.40	8.73	7.64	0.13	23.52	9.03	7.94	0.09
20.46	8.73	7.65	0.12	23.58	9.04	7.95	0.09
20.52	8.74	7.66	0.12	23.64	9.04	7.95	0.09
20.58	8.75	7.66	0.12	23.70	9.05	7.96	0.09
20.64	8.75	7.67	0.12	23.76	9.05	7.96	0.09
20.70	8.76	7.68	0.12	23.82	9.06	7.97	0.09
20.76	8.77	7.68	0.12	23.88	9.06	7.97	0.09
20.82	8.77	7.69	0.12	23.94	9.07	7.98	0.09
20.88	8.78	7.70	0.12	24.00	9.07	7.98	0.09
20.94	8.79	7.70	0.12				
21.00	8.79	7.71	0.12				
21.06	8.80	7.71	0.12				
21.12	8.81	7.72	0.12				
21.18	8.81	7.73	0.12				
21.24	8.82	7.73	0.12				
21.30	8.82	7.74	0.12				
21.36	8.83	7.75	0.11				
21.42	8.84	7.75	0.11				
21.48	8.84	7.76	0.11				
21.54	8.85	7.76	0.11				
21.60	8.86	7.77	0.11				
21.66	8.86	7.78	0.11				
21.72	8.87	7.78	0.11				
21.78	8.87	7.79	0.11				

Summary for Reach 4R: Design Point A

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.724 ac, 72.79% Impervious, Inflow Depth > 7.98" for 100 Year event
Inflow = 5.71 cfs @ 12.11 hrs, Volume= 0.481 af
Outflow = 5.71 cfs @ 12.11 hrs, Volume= 0.481 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Reach 4R: Design Point A

Hydrograph for Reach 4R: Design Point A

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	3.12	0.01		0.01
0.06	0.00		0.00	3.18	0.01		0.01
0.12	0.00		0.00	3.24	0.01		0.01
0.18	0.00		0.00	3.30	0.01		0.01
0.24	0.00		0.00	3.36	0.01		0.01
0.30	0.00		0.00	3.42	0.02		0.02
0.36	0.00		0.00	3.48	0.02		0.02
0.42	0.00		0.00	3.54	0.02		0.02
0.48	0.00		0.00	3.60	0.02		0.02
0.54	0.00		0.00	3.66	0.02		0.02
0.60	0.00		0.00	3.72	0.02		0.02
0.66	0.00		0.00	3.78	0.02		0.02
0.72	0.00		0.00	3.84	0.02		0.02
0.78	0.00		0.00	3.90	0.02		0.02
0.84	0.00		0.00	3.96	0.02		0.02
0.90	0.00		0.00	4.02	0.02		0.02
0.96	0.00		0.00	4.08	0.03		0.03
1.02	0.00		0.00	4.14	0.03		0.03
1.08	0.00		0.00	4.20	0.03		0.03
1.14	0.00		0.00	4.26	0.03		0.03
1.20	0.00		0.00	4.32	0.03		0.03
1.26	0.00		0.00	4.38	0.03		0.03
1.32	0.00		0.00	4.44	0.03		0.03
1.38	0.00		0.00	4.50	0.03		0.03
1.44	0.00		0.00	4.56	0.03		0.03
1.50	0.00		0.00	4.62	0.03		0.03
1.56	0.00		0.00	4.68	0.03		0.03
1.62	0.00		0.00	4.74	0.04		0.04
1.68	0.00		0.00	4.80	0.04		0.04
1.74	0.00		0.00	4.86	0.04		0.04
1.80	0.00		0.00	4.92	0.04		0.04
1.86	0.00		0.00	4.98	0.04		0.04
1.92	0.00		0.00	5.04	0.04		0.04
1.98	0.00		0.00	5.10	0.04		0.04
2.04	0.00		0.00	5.16	0.04		0.04
2.10	0.00		0.00	5.22	0.04		0.04
2.16	0.00		0.00	5.28	0.04		0.04
2.22	0.00		0.00	5.34	0.04		0.04
2.28	0.00		0.00	5.40	0.05		0.05
2.34	0.00		0.00	5.46	0.05		0.05
2.40	0.00		0.00	5.52	0.05		0.05
2.46	0.00		0.00	5.58	0.05		0.05
2.52	0.00		0.00	5.64	0.05		0.05
2.58	0.00		0.00	5.70	0.05		0.05
2.64	0.00		0.00	5.76	0.05		0.05
2.70	0.01		0.01	5.82	0.05		0.05
2.76	0.01		0.01	5.88	0.05		0.05
2.82	0.01		0.01	5.94	0.05		0.05
2.88	0.01		0.01	6.00	0.05		0.05
2.94	0.01		0.01	6.06	0.06		0.06
3.00	0.01		0.01	6.12	0.06		0.06
3.06	0.01		0.01	6.18	0.06		0.06

Hydrograph for Reach 4R: Design Point A (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
6.24	0.06		0.06	9.36	0.21		0.21
6.30	0.06		0.06	9.42	0.22		0.22
6.36	0.06		0.06	9.48	0.22		0.22
6.42	0.06		0.06	9.54	0.23		0.23
6.48	0.07		0.07	9.60	0.23		0.23
6.54	0.07		0.07	9.66	0.24		0.24
6.60	0.07		0.07	9.72	0.24		0.24
6.66	0.07		0.07	9.78	0.25		0.25
6.72	0.07		0.07	9.84	0.25		0.25
6.78	0.08		0.08	9.90	0.26		0.26
6.84	0.08		0.08	9.96	0.26		0.26
6.90	0.08		0.08	10.02	0.27		0.27
6.96	0.08		0.08	10.08	0.27		0.27
7.02	0.08		0.08	10.14	0.28		0.28
7.08	0.09		0.09	10.20	0.29		0.29
7.14	0.09		0.09	10.26	0.29		0.29
7.20	0.09		0.09	10.32	0.30		0.30
7.26	0.09		0.09	10.38	0.31		0.31
7.32	0.09		0.09	10.44	0.32		0.32
7.38	0.10		0.10	10.50	0.33		0.33
7.44	0.10		0.10	10.56	0.34		0.34
7.50	0.10		0.10	10.62	0.35		0.35
7.56	0.10		0.10	10.68	0.36		0.36
7.62	0.10		0.10	10.74	0.37		0.37
7.68	0.11		0.11	10.80	0.38		0.38
7.74	0.11		0.11	10.86	0.39		0.39
7.80	0.11		0.11	10.92	0.40		0.40
7.86	0.11		0.11	10.98	0.41		0.41
7.92	0.11		0.11	11.04	0.42		0.42
7.98	0.12		0.12	11.10	0.43		0.43
8.04	0.12		0.12	11.16	0.46		0.46
8.10	0.12		0.12	11.22	0.49		0.49
8.16	0.12		0.12	11.28	0.52		0.52
8.22	0.13		0.13	11.34	0.56		0.56
8.28	0.13		0.13	11.40	0.59		0.59
8.34	0.14		0.14	11.46	0.63		0.63
8.40	0.14		0.14	11.52	0.66		0.66
8.46	0.14		0.14	11.58	0.73		0.73
8.52	0.15		0.15	11.64	0.90		0.90
8.58	0.15		0.15	11.70	1.17		1.17
8.64	0.16		0.16	11.76	1.48		1.48
8.70	0.16		0.16	11.82	1.81		1.81
8.76	0.17		0.17	11.88	2.15		2.15
8.82	0.17		0.17	11.94	2.51		2.51
8.88	0.18		0.18	12.00	3.33		3.33
8.94	0.18		0.18	12.06	4.99		4.99
9.00	0.18		0.18	12.12	5.70		5.70
9.06	0.19		0.19	12.18	4.60		4.60
9.12	0.19		0.19	12.24	3.44		3.44
9.18	0.20		0.20	12.30	2.77		2.77
9.24	0.20		0.20	12.36	2.33		2.33
9.30	0.21		0.21	12.42	1.95		1.95

Hydrograph for Reach 4R: Design Point A (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
12.48	1.59		1.59	15.60	0.21		0.21
12.54	1.25		1.25	15.66	0.20		0.20
12.60	0.97		0.97	15.72	0.20		0.20
12.66	0.81		0.81	15.78	0.20		0.20
12.72	0.73		0.73	15.84	0.19		0.19
12.78	0.69		0.69	15.90	0.19		0.19
12.84	0.65		0.65	15.96	0.18		0.18
12.90	0.61		0.61	16.02	0.18		0.18
12.96	0.57		0.57	16.08	0.17		0.17
13.02	0.54		0.54	16.14	0.17		0.17
13.08	0.50		0.50	16.20	0.17		0.17
13.14	0.48		0.48	16.26	0.17		0.17
13.20	0.47		0.47	16.32	0.16		0.16
13.26	0.45		0.45	16.38	0.16		0.16
13.32	0.44		0.44	16.44	0.16		0.16
13.38	0.44		0.44	16.50	0.16		0.16
13.44	0.43		0.43	16.56	0.16		0.16
13.50	0.42		0.42	16.62	0.15		0.15
13.56	0.41		0.41	16.68	0.15		0.15
13.62	0.40		0.40	16.74	0.15		0.15
13.68	0.39		0.39	16.80	0.15		0.15
13.74	0.38		0.38	16.86	0.15		0.15
13.80	0.37		0.37	16.92	0.14		0.14
13.86	0.36		0.36	16.98	0.14		0.14
13.92	0.35		0.35	17.04	0.14		0.14
13.98	0.34		0.34	17.10	0.14		0.14
14.04	0.33		0.33	17.16	0.14		0.14
14.10	0.32		0.32	17.22	0.13		0.13
14.16	0.32		0.32	17.28	0.13		0.13
14.22	0.31		0.31	17.34	0.13		0.13
14.28	0.31		0.31	17.40	0.13		0.13
14.34	0.30		0.30	17.46	0.13		0.13
14.40	0.30		0.30	17.52	0.12		0.12
14.46	0.29		0.29	17.58	0.12		0.12
14.52	0.29		0.29	17.64	0.12		0.12
14.58	0.29		0.29	17.70	0.12		0.12
14.64	0.28		0.28	17.76	0.12		0.12
14.70	0.28		0.28	17.82	0.11		0.11
14.76	0.27		0.27	17.88	0.11		0.11
14.82	0.27		0.27	17.94	0.11		0.11
14.88	0.26		0.26	18.00	0.11		0.11
14.94	0.26		0.26	18.06	0.11		0.11
15.00	0.25		0.25	18.12	0.11		0.11
15.06	0.25		0.25	18.18	0.10		0.10
15.12	0.25		0.25	18.24	0.10		0.10
15.18	0.24		0.24	18.30	0.10		0.10
15.24	0.24		0.24	18.36	0.10		0.10
15.30	0.23		0.23	18.42	0.10		0.10
15.36	0.23		0.23	18.48	0.10		0.10
15.42	0.22		0.22	18.54	0.10		0.10
15.48	0.22		0.22	18.60	0.10		0.10
15.54	0.21		0.21	18.66	0.10		0.10

Hydrograph for Reach 4R: Design Point A (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
18.72	0.10		0.10	21.84	0.07		0.07
18.78	0.10		0.10	21.90	0.07		0.07
18.84	0.10		0.10	21.96	0.07		0.07
18.90	0.10		0.10	22.02	0.07		0.07
18.96	0.10		0.10	22.08	0.07		0.07
19.02	0.10		0.10	22.14	0.07		0.07
19.08	0.10		0.10	22.20	0.07		0.07
19.14	0.09		0.09	22.26	0.07		0.07
19.20	0.09		0.09	22.32	0.07		0.07
19.26	0.09		0.09	22.38	0.07		0.07
19.32	0.09		0.09	22.44	0.07		0.07
19.38	0.09		0.09	22.50	0.07		0.07
19.44	0.09		0.09	22.56	0.07		0.07
19.50	0.09		0.09	22.62	0.07		0.07
19.56	0.09		0.09	22.68	0.07		0.07
19.62	0.09		0.09	22.74	0.07		0.07
19.68	0.09		0.09	22.80	0.07		0.07
19.74	0.09		0.09	22.86	0.07		0.07
19.80	0.09		0.09	22.92	0.06		0.06
19.86	0.09		0.09	22.98	0.06		0.06
19.92	0.09		0.09	23.04	0.06		0.06
19.98	0.09		0.09	23.10	0.06		0.06
20.04	0.09		0.09	23.16	0.06		0.06
20.10	0.09		0.09	23.22	0.06		0.06
20.16	0.08		0.08	23.28	0.06		0.06
20.22	0.08		0.08	23.34	0.06		0.06
20.28	0.08		0.08	23.40	0.06		0.06
20.34	0.08		0.08	23.46	0.06		0.06
20.40	0.08		0.08	23.52	0.06		0.06
20.46	0.08		0.08	23.58	0.06		0.06
20.52	0.08		0.08	23.64	0.06		0.06
20.58	0.08		0.08	23.70	0.06		0.06
20.64	0.08		0.08	23.76	0.06		0.06
20.70	0.08		0.08	23.82	0.06		0.06
20.76	0.08		0.08	23.88	0.06		0.06
20.82	0.08		0.08	23.94	0.06		0.06
20.88	0.08		0.08	24.00	0.06		0.06
20.94	0.08		0.08				
21.00	0.08		0.08				
21.06	0.08		0.08				
21.12	0.08		0.08				
21.18	0.08		0.08				
21.24	0.08		0.08				
21.30	0.08		0.08				
21.36	0.08		0.08				
21.42	0.08		0.08				
21.48	0.08		0.08				
21.54	0.07		0.07				
21.60	0.07		0.07				
21.66	0.07		0.07				
21.72	0.07		0.07				
21.78	0.07		0.07				

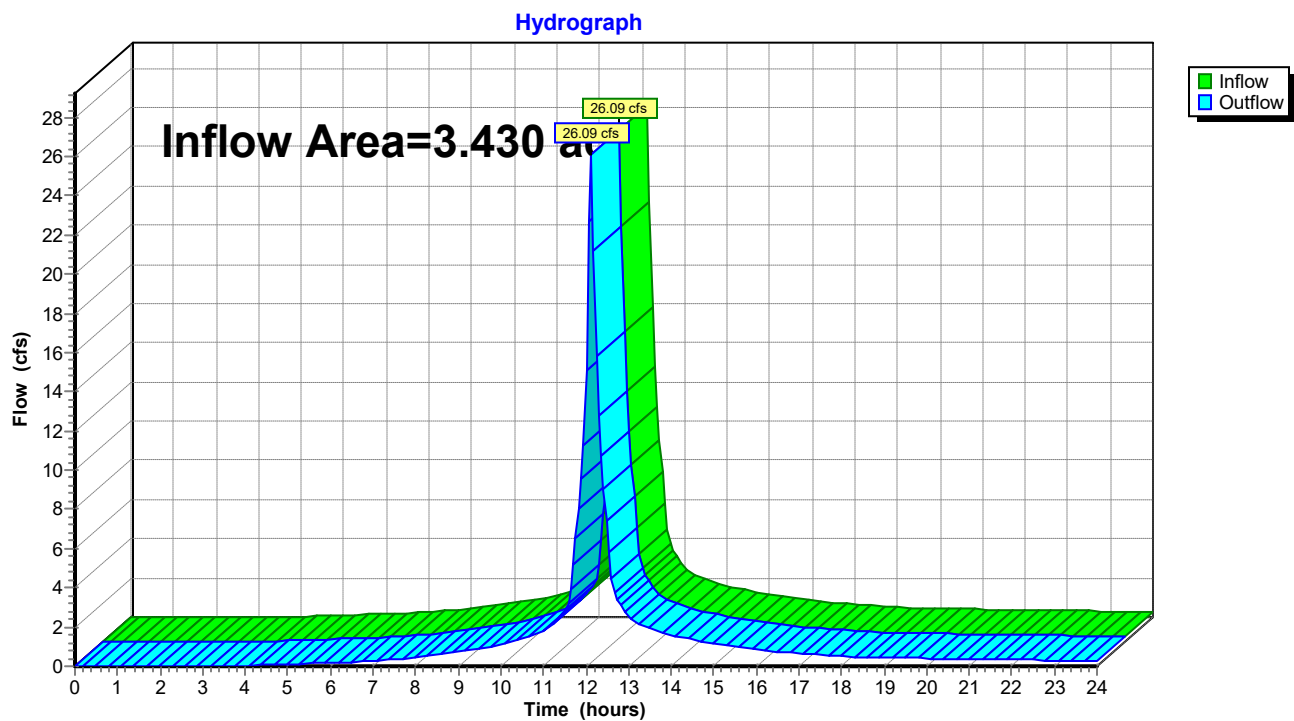
Summary for Reach 5R: Design Point B

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.430 ac, 56.15% Impervious, Inflow Depth > 7.49" for 100 Year event
 Inflow = 26.09 cfs @ 12.11 hrs, Volume= 2.140 af
 Outflow = 26.09 cfs @ 12.11 hrs, Volume= 2.140 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Reach 5R: Design Point B



Hydrograph for Reach 5R: Design Point B

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
0.00	0.00		0.00	3.12	0.00		0.00
0.06	0.00		0.00	3.18	0.00		0.00
0.12	0.00		0.00	3.24	0.00		0.00
0.18	0.00		0.00	3.30	0.00		0.00
0.24	0.00		0.00	3.36	0.00		0.00
0.30	0.00		0.00	3.42	0.01		0.01
0.36	0.00		0.00	3.48	0.01		0.01
0.42	0.00		0.00	3.54	0.01		0.01
0.48	0.00		0.00	3.60	0.02		0.02
0.54	0.00		0.00	3.66	0.02		0.02
0.60	0.00		0.00	3.72	0.02		0.02
0.66	0.00		0.00	3.78	0.03		0.03
0.72	0.00		0.00	3.84	0.03		0.03
0.78	0.00		0.00	3.90	0.03		0.03
0.84	0.00		0.00	3.96	0.04		0.04
0.90	0.00		0.00	4.02	0.04		0.04
0.96	0.00		0.00	4.08	0.04		0.04
1.02	0.00		0.00	4.14	0.05		0.05
1.08	0.00		0.00	4.20	0.05		0.05
1.14	0.00		0.00	4.26	0.05		0.05
1.20	0.00		0.00	4.32	0.06		0.06
1.26	0.00		0.00	4.38	0.06		0.06
1.32	0.00		0.00	4.44	0.06		0.06
1.38	0.00		0.00	4.50	0.07		0.07
1.44	0.00		0.00	4.56	0.07		0.07
1.50	0.00		0.00	4.62	0.08		0.08
1.56	0.00		0.00	4.68	0.08		0.08
1.62	0.00		0.00	4.74	0.08		0.08
1.68	0.00		0.00	4.80	0.09		0.09
1.74	0.00		0.00	4.86	0.09		0.09
1.80	0.00		0.00	4.92	0.09		0.09
1.86	0.00		0.00	4.98	0.10		0.10
1.92	0.00		0.00	5.04	0.10		0.10
1.98	0.00		0.00	5.10	0.11		0.11
2.04	0.00		0.00	5.16	0.11		0.11
2.10	0.00		0.00	5.22	0.11		0.11
2.16	0.00		0.00	5.28	0.12		0.12
2.22	0.00		0.00	5.34	0.12		0.12
2.28	0.00		0.00	5.40	0.13		0.13
2.34	0.00		0.00	5.46	0.13		0.13
2.40	0.00		0.00	5.52	0.13		0.13
2.46	0.00		0.00	5.58	0.14		0.14
2.52	0.00		0.00	5.64	0.14		0.14
2.58	0.00		0.00	5.70	0.15		0.15
2.64	0.00		0.00	5.76	0.15		0.15
2.70	0.00		0.00	5.82	0.15		0.15
2.76	0.00		0.00	5.88	0.16		0.16
2.82	0.00		0.00	5.94	0.16		0.16
2.88	0.00		0.00	6.00	0.17		0.17
2.94	0.00		0.00	6.06	0.17		0.17
3.00	0.00		0.00	6.12	0.17		0.17
3.06	0.00		0.00	6.18	0.18		0.18

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Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
6.24	0.19		0.19	9.36	0.85		0.85
6.30	0.19		0.19	9.42	0.87		0.87
6.36	0.20		0.20	9.48	0.89		0.89
6.42	0.21		0.21	9.54	0.91		0.91
6.48	0.21		0.21	9.60	0.93		0.93
6.54	0.22		0.22	9.66	0.95		0.95
6.60	0.23		0.23	9.72	0.98		0.98
6.66	0.24		0.24	9.78	1.00		1.00
6.72	0.24		0.24	9.84	1.02		1.02
6.78	0.25		0.25	9.90	1.05		1.05
6.84	0.26		0.26	9.96	1.07		1.07
6.90	0.27		0.27	10.02	1.09		1.09
6.96	0.27		0.27	10.08	1.12		1.12
7.02	0.28		0.28	10.14	1.15		1.15
7.08	0.29		0.29	10.20	1.19		1.19
7.14	0.30		0.30	10.26	1.23		1.23
7.20	0.31		0.31	10.32	1.27		1.27
7.26	0.32		0.32	10.38	1.31		1.31
7.32	0.32		0.32	10.44	1.35		1.35
7.38	0.33		0.33	10.50	1.40		1.40
7.44	0.34		0.34	10.56	1.44		1.44
7.50	0.35		0.35	10.62	1.48		1.48
7.56	0.36		0.36	10.68	1.53		1.53
7.62	0.37		0.37	10.74	1.57		1.57
7.68	0.38		0.38	10.80	1.62		1.62
7.74	0.39		0.39	10.86	1.66		1.66
7.80	0.40		0.40	10.92	1.71		1.71
7.86	0.41		0.41	10.98	1.75		1.75
7.92	0.42		0.42	11.04	1.80		1.80
7.98	0.43		0.43	11.10	1.87		1.87
8.04	0.44		0.44	11.16	1.98		1.98
8.10	0.45		0.45	11.22	2.12		2.12
8.16	0.46		0.46	11.28	2.27		2.27
8.22	0.48		0.48	11.34	2.42		2.42
8.28	0.49		0.49	11.40	2.58		2.58
8.34	0.51		0.51	11.46	2.74		2.74
8.40	0.53		0.53	11.52	2.90		2.90
8.46	0.55		0.55	11.58	3.19		3.19
8.52	0.56		0.56	11.64	3.95		3.95
8.58	0.58		0.58	11.70	5.16		5.16
8.64	0.60		0.60	11.76	6.56		6.56
8.70	0.62		0.62	11.82	8.06		8.06
8.76	0.64		0.64	11.88	9.60		9.60
8.82	0.66		0.66	11.94	11.30		11.30
8.88	0.68		0.68	12.00	15.06		15.06
8.94	0.70		0.70	12.06	22.68		22.68
9.00	0.72		0.72	12.12	26.05		26.05
9.06	0.74		0.74	12.18	21.13		21.13
9.12	0.76		0.76	12.24	15.81		15.81
9.18	0.78		0.78	12.30	12.80		12.80
9.24	0.80		0.80	12.36	10.76		10.76
9.30	0.82		0.82	12.42	9.02		9.02

Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
12.48	7.39		7.39	15.60	0.98		0.98
12.54	5.81		5.81	15.66	0.96		0.96
12.60	4.50		4.50	15.72	0.94		0.94
12.66	3.77		3.77	15.78	0.91		0.91
12.72	3.41		3.41	15.84	0.89		0.89
12.78	3.18		3.18	15.90	0.87		0.87
12.84	3.00		3.00	15.96	0.85		0.85
12.90	2.83		2.83	16.02	0.83		0.83
12.96	2.66		2.66	16.08	0.81		0.81
13.02	2.50		2.50	16.14	0.80		0.80
13.08	2.34		2.34	16.20	0.78		0.78
13.14	2.23		2.23	16.26	0.77		0.77
13.20	2.17		2.17	16.32	0.76		0.76
13.26	2.12		2.12	16.38	0.76		0.76
13.32	2.07		2.07	16.44	0.75		0.75
13.38	2.03		2.03	16.50	0.74		0.74
13.44	1.98		1.98	16.56	0.73		0.73
13.50	1.94		1.94	16.62	0.72		0.72
13.56	1.90		1.90	16.68	0.71		0.71
13.62	1.85		1.85	16.74	0.70		0.70
13.68	1.81		1.81	16.80	0.69		0.69
13.74	1.77		1.77	16.86	0.68		0.68
13.80	1.72		1.72	16.92	0.67		0.67
13.86	1.68		1.68	16.98	0.66		0.66
13.92	1.64		1.64	17.04	0.65		0.65
13.98	1.59		1.59	17.10	0.65		0.65
14.04	1.55		1.55	17.16	0.64		0.64
14.10	1.51		1.51	17.22	0.63		0.63
14.16	1.48		1.48	17.28	0.62		0.62
14.22	1.46		1.46	17.34	0.61		0.61
14.28	1.44		1.44	17.40	0.60		0.60
14.34	1.42		1.42	17.46	0.59		0.59
14.40	1.39		1.39	17.52	0.58		0.58
14.46	1.37		1.37	17.58	0.57		0.57
14.52	1.35		1.35	17.64	0.56		0.56
14.58	1.33		1.33	17.70	0.55		0.55
14.64	1.31		1.31	17.76	0.55		0.55
14.70	1.29		1.29	17.82	0.54		0.54
14.76	1.27		1.27	17.88	0.53		0.53
14.82	1.25		1.25	17.94	0.52		0.52
14.88	1.23		1.23	18.00	0.51		0.51
14.94	1.21		1.21	18.06	0.50		0.50
15.00	1.19		1.19	18.12	0.49		0.49
15.06	1.17		1.17	18.18	0.49		0.49
15.12	1.14		1.14	18.24	0.48		0.48
15.18	1.12		1.12	18.30	0.48		0.48
15.24	1.10		1.10	18.36	0.48		0.48
15.30	1.08		1.08	18.42	0.48		0.48
15.36	1.06		1.06	18.48	0.47		0.47
15.42	1.04		1.04	18.54	0.47		0.47
15.48	1.02		1.02	18.60	0.47		0.47
15.54	1.00		1.00	18.66	0.47		0.47

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Hydrograph for Reach 5R: Design Point B (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Outflow (cfs)
18.72	0.46		0.46	21.84	0.34		0.34
18.78	0.46		0.46	21.90	0.34		0.34
18.84	0.46		0.46	21.96	0.34		0.34
18.90	0.45		0.45	22.02	0.33		0.33
18.96	0.45		0.45	22.08	0.33		0.33
19.02	0.45		0.45	22.14	0.33		0.33
19.08	0.45		0.45	22.20	0.33		0.33
19.14	0.44		0.44	22.26	0.33		0.33
19.20	0.44		0.44	22.32	0.32		0.32
19.26	0.44		0.44	22.38	0.32		0.32
19.32	0.44		0.44	22.44	0.32		0.32
19.38	0.43		0.43	22.50	0.32		0.32
19.44	0.43		0.43	22.56	0.31		0.31
19.50	0.43		0.43	22.62	0.31		0.31
19.56	0.42		0.42	22.68	0.31		0.31
19.62	0.42		0.42	22.74	0.31		0.31
19.68	0.42		0.42	22.80	0.31		0.31
19.74	0.42		0.42	22.86	0.30		0.30
19.80	0.41		0.41	22.92	0.30		0.30
19.86	0.41		0.41	22.98	0.30		0.30
19.92	0.41		0.41	23.04	0.30		0.30
19.98	0.41		0.41	23.10	0.30		0.30
20.04	0.40		0.40	23.16	0.29		0.29
20.10	0.40		0.40	23.22	0.29		0.29
20.16	0.40		0.40	23.28	0.29		0.29
20.22	0.40		0.40	23.34	0.29		0.29
20.28	0.39		0.39	23.40	0.29		0.29
20.34	0.39		0.39	23.46	0.28		0.28
20.40	0.39		0.39	23.52	0.28		0.28
20.46	0.39		0.39	23.58	0.28		0.28
20.52	0.38		0.38	23.64	0.28		0.28
20.58	0.38		0.38	23.70	0.28		0.28
20.64	0.38		0.38	23.76	0.27		0.27
20.70	0.38		0.38	23.82	0.27		0.27
20.76	0.38		0.38	23.88	0.27		0.27
20.82	0.37		0.37	23.94	0.27		0.27
20.88	0.37		0.37	24.00	0.27		0.27
20.94	0.37		0.37				
21.00	0.37		0.37				
21.06	0.37		0.37				
21.12	0.36		0.36				
21.18	0.36		0.36				
21.24	0.36		0.36				
21.30	0.36		0.36				
21.36	0.36		0.36				
21.42	0.35		0.35				
21.48	0.35		0.35				
21.54	0.35		0.35				
21.60	0.35		0.35				
21.66	0.35		0.35				
21.72	0.34		0.34				
21.78	0.34		0.34				

Summary for Pond 6P: Detention

Inflow Area = 1.094 ac, 69.84% Impervious, Inflow Depth > 7.98" for 100 Year event
 Inflow = 9.08 cfs @ 12.08 hrs, Volume= 0.727 af
 Outflow = 7.73 cfs @ 12.14 hrs, Volume= 0.718 af, Atten= 15%, Lag= 3.6 min
 Primary = 7.73 cfs @ 12.14 hrs, Volume= 0.718 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs
 Peak Elev= 215.84' @ 12.14 hrs Surf.Area= 1,404 sf Storage= 4,247 cf

Plug-Flow detention time= 36.7 min calculated for 0.718 af (99% of inflow)
 Center-of-Mass det. time= 28.2 min (797.0 - 768.8)

Volume	Invert	Avail.Storage	Storage Description
#1	212.66'	4,725 cf	ACF R-Tank LD 2.5 x 456 Inside= 15.7"W x 42.5"H => 4.42 sf x 2.35'L = 10.4 cf Outside= 15.7"W x 42.5"H => 4.65 sf x 2.35'L = 10.9 cf 456 Chambers in 19 Rows

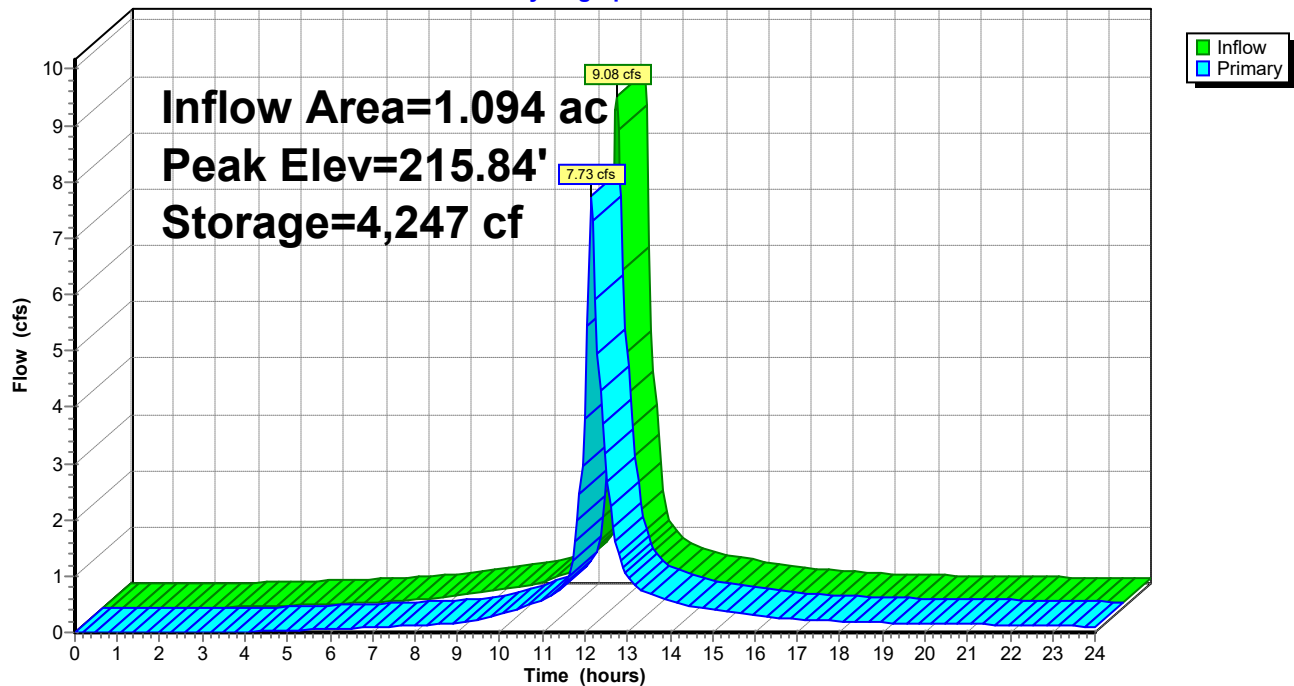
Device	Routing	Invert	Outlet Devices
#1	Primary	212.66'	3.0" Vert. Orifice/Grate C= 0.600
#2	Primary	213.38'	0.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#3	Primary	215.38'	1.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=7.44 cfs @ 12.14 hrs HW=215.80' (Free Discharge)

1=Orifice/Grate (Orifice Controls 0.41 cfs @ 8.36 fps)
 2=Broad-Crested Rectangular Weir (Weir Controls 6.24 cfs @ 5.16 fps)
 3=Broad-Crested Rectangular Weir (Weir Controls 0.79 cfs @ 1.90 fps)

Pond 6P: Detention

Hydrograph



Hydrograph for Pond 6P: Detention

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0	212.66	0.00
0.06	0.00	0	212.66	0.00
0.12	0.00	0	212.66	0.00
0.18	0.00	0	212.66	0.00
0.24	0.00	0	212.66	0.00
0.30	0.00	0	212.66	0.00
0.36	0.00	0	212.66	0.00
0.42	0.00	0	212.66	0.00
0.48	0.00	0	212.66	0.00
0.54	0.00	0	212.66	0.00
0.60	0.00	0	212.66	0.00
0.66	0.00	0	212.66	0.00
0.72	0.00	0	212.66	0.00
0.78	0.00	0	212.66	0.00
0.84	0.00	0	212.66	0.00
0.90	0.00	0	212.66	0.00
0.96	0.00	0	212.66	0.00
1.02	0.00	0	212.66	0.00
1.08	0.00	0	212.66	0.00
1.14	0.00	0	212.66	0.00
1.20	0.00	0	212.66	0.00
1.26	0.00	0	212.66	0.00
1.32	0.00	0	212.66	0.00
1.38	0.00	0	212.66	0.00
1.44	0.00	0	212.66	0.00
1.50	0.00	0	212.66	0.00
1.56	0.00	0	212.66	0.00
1.62	0.00	0	212.66	0.00
1.68	0.00	0	212.66	0.00
1.74	0.00	0	212.66	0.00
1.80	0.00	0	212.66	0.00
1.86	0.00	0	212.66	0.00
1.92	0.00	0	212.66	0.00
1.98	0.00	0	212.66	0.00
2.04	0.00	0	212.66	0.00
2.10	0.00	0	212.66	0.00
2.16	0.00	0	212.66	0.00
2.22	0.00	0	212.66	0.00
2.28	0.00	0	212.66	0.00
2.34	0.00	0	212.66	0.00
2.40	0.00	1	212.66	0.00
2.46	0.00	1	212.66	0.00
2.52	0.00	2	212.66	0.00
2.58	0.01	3	212.66	0.00
2.64	0.01	5	212.66	0.00
2.70	0.01	6	212.66	0.00
2.76	0.01	8	212.67	0.00
2.82	0.01	10	212.67	0.00
2.88	0.01	12	212.67	0.00
2.94	0.01	15	212.67	0.00
3.00	0.01	18	212.67	0.00
3.06	0.02	20	212.68	0.00

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
3.12	0.02	23	212.68	0.00
3.18	0.02	27	212.68	0.00
3.24	0.02	30	212.68	0.00
3.30	0.02	34	212.69	0.00
3.36	0.02	38	212.69	0.00
3.42	0.02	42	212.69	0.00
3.48	0.03	46	212.69	0.01
3.54	0.03	51	212.70	0.01
3.60	0.03	55	212.70	0.01
3.66	0.03	60	212.70	0.01
3.72	0.03	65	212.71	0.01
3.78	0.03	70	212.71	0.01
3.84	0.03	75	212.72	0.01
3.90	0.03	81	212.72	0.01
3.96	0.04	86	212.72	0.01
4.02	0.04	92	212.73	0.01
4.08	0.04	98	212.73	0.01
4.14	0.04	104	212.74	0.01
4.20	0.04	110	212.74	0.01
4.26	0.04	115	212.75	0.02
4.32	0.04	121	212.75	0.02
4.38	0.05	127	212.76	0.02
4.44	0.05	132	212.76	0.02
4.50	0.05	138	212.76	0.02
4.56	0.05	144	212.77	0.02
4.62	0.05	149	212.77	0.03
4.68	0.05	154	212.78	0.03
4.74	0.05	160	212.78	0.03
4.80	0.06	165	212.78	0.03
4.86	0.06	171	212.79	0.03
4.92	0.06	176	212.79	0.03
4.98	0.06	181	212.80	0.03
5.04	0.06	187	212.80	0.04
5.10	0.06	192	212.80	0.04
5.16	0.06	197	212.81	0.04
5.22	0.06	202	212.81	0.04
5.28	0.07	207	212.82	0.04
5.34	0.07	212	212.82	0.04
5.40	0.07	217	212.82	0.05
5.46	0.07	222	212.83	0.05
5.52	0.07	227	212.83	0.05
5.58	0.07	231	212.83	0.05
5.64	0.07	236	212.84	0.05
5.70	0.08	240	212.84	0.05
5.76	0.08	245	212.84	0.06
5.82	0.08	250	212.85	0.06
5.88	0.08	254	212.85	0.06
5.94	0.08	258	212.85	0.06
6.00	0.08	263	212.86	0.06
6.06	0.08	267	212.86	0.06
6.12	0.09	272	212.86	0.07
6.18	0.09	276	212.87	0.07

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
6.24	0.09	281	212.87	0.07
6.30	0.09	286	212.87	0.07
6.36	0.10	291	212.88	0.07
6.42	0.10	297	212.88	0.07
6.48	0.10	302	212.89	0.07
6.54	0.10	308	212.89	0.08
6.60	0.11	315	212.90	0.08
6.66	0.11	321	212.90	0.08
6.72	0.11	328	212.91	0.08
6.78	0.12	335	212.91	0.08
6.84	0.12	342	212.92	0.08
6.90	0.12	349	212.92	0.09
6.96	0.12	357	212.93	0.09
7.02	0.13	365	212.93	0.09
7.08	0.13	373	212.94	0.09
7.14	0.13	381	212.95	0.09
7.20	0.14	390	212.95	0.10
7.26	0.14	398	212.96	0.10
7.32	0.14	407	212.97	0.10
7.38	0.15	417	212.97	0.10
7.44	0.15	426	212.98	0.10
7.50	0.15	436	212.99	0.11
7.56	0.16	446	212.99	0.11
7.62	0.16	456	213.00	0.11
7.68	0.16	467	213.01	0.11
7.74	0.16	478	213.02	0.11
7.80	0.17	489	213.03	0.12
7.86	0.17	500	213.04	0.12
7.92	0.17	512	213.04	0.12
7.98	0.18	524	213.05	0.12
8.04	0.18	536	213.06	0.12
8.10	0.19	548	213.07	0.13
8.16	0.19	561	213.08	0.13
8.22	0.20	575	213.09	0.13
8.28	0.20	590	213.10	0.13
8.34	0.21	605	213.11	0.14
8.40	0.22	622	213.13	0.14
8.46	0.22	639	213.14	0.14
8.52	0.23	657	213.15	0.14
8.58	0.24	676	213.17	0.15
8.64	0.24	696	213.18	0.15
8.70	0.25	716	213.20	0.15
8.76	0.26	737	213.21	0.15
8.82	0.26	759	213.23	0.16
8.88	0.27	782	213.25	0.16
8.94	0.28	806	213.26	0.16
9.00	0.28	831	213.28	0.17
9.06	0.29	856	213.30	0.17
9.12	0.30	882	213.32	0.17
9.18	0.30	909	213.34	0.18
9.24	0.31	937	213.36	0.18
9.30	0.32	966	213.38	0.18

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
9.36	0.32	994	213.41	0.19
9.42	0.33	1,022	213.43	0.20
9.48	0.34	1,049	213.45	0.22
9.54	0.35	1,074	213.47	0.23
9.60	0.35	1,098	213.48	0.25
9.66	0.36	1,121	213.50	0.26
9.72	0.37	1,142	213.52	0.27
9.78	0.38	1,161	213.53	0.29
9.84	0.38	1,180	213.54	0.30
9.90	0.39	1,197	213.56	0.31
9.96	0.40	1,213	213.57	0.33
10.02	0.40	1,228	213.58	0.34
10.08	0.41	1,242	213.59	0.35
10.14	0.43	1,256	213.60	0.36
10.20	0.44	1,270	213.61	0.37
10.26	0.45	1,284	213.62	0.39
10.32	0.47	1,298	213.63	0.40
10.38	0.48	1,313	213.64	0.41
10.44	0.50	1,328	213.66	0.43
10.50	0.51	1,342	213.67	0.44
10.56	0.52	1,357	213.68	0.46
10.62	0.54	1,371	213.69	0.47
10.68	0.55	1,386	213.70	0.49
10.74	0.57	1,400	213.71	0.50
10.80	0.58	1,415	213.72	0.52
10.86	0.60	1,429	213.73	0.53
10.92	0.61	1,443	213.74	0.55
10.98	0.63	1,456	213.75	0.56
11.04	0.64	1,470	213.76	0.58
11.10	0.67	1,485	213.77	0.60
11.16	0.71	1,503	213.79	0.62
11.22	0.76	1,526	213.80	0.65
11.28	0.82	1,554	213.83	0.68
11.34	0.87	1,584	213.85	0.72
11.40	0.92	1,617	213.87	0.76
11.46	0.98	1,652	213.90	0.81
11.52	1.03	1,687	213.93	0.86
11.58	1.17	1,731	213.96	0.93
11.64	1.52	1,808	214.02	1.05
11.70	1.99	1,935	214.11	1.28
11.76	2.48	2,107	214.24	1.60
11.82	2.99	2,310	214.39	1.99
11.88	3.51	2,534	214.56	2.44
11.94	4.12	2,774	214.74	2.96
12.00	5.96	3,132	215.01	3.80
12.06	8.83	3,732	215.46	5.43
12.12	8.49	4,202	215.81	7.54
12.18	5.96	4,159	215.78	7.31
12.24	4.49	3,859	215.55	5.92
12.30	3.75	3,576	215.34	4.94
12.36	3.18	3,327	215.16	4.29
12.42	2.66	3,094	214.98	3.71

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
12.48	2.14	2,868	214.81	3.18
12.54	1.63	2,643	214.64	2.68
12.60	1.28	2,428	214.48	2.23
12.66	1.13	2,247	214.34	1.87
12.72	1.06	2,108	214.24	1.61
12.78	1.00	2,005	214.16	1.41
12.84	0.95	1,926	214.10	1.26
12.90	0.89	1,864	214.06	1.15
12.96	0.84	1,812	214.02	1.06
13.02	0.78	1,766	213.98	0.99
13.08	0.74	1,724	213.95	0.92
13.14	0.71	1,688	213.93	0.87
13.20	0.69	1,657	213.90	0.82
13.26	0.68	1,632	213.88	0.79
13.32	0.66	1,611	213.87	0.76
13.38	0.65	1,592	213.85	0.73
13.44	0.64	1,576	213.84	0.71
13.50	0.62	1,560	213.83	0.69
13.56	0.61	1,546	213.82	0.67
13.62	0.59	1,533	213.81	0.65
13.68	0.58	1,520	213.80	0.64
13.74	0.57	1,508	213.79	0.62
13.80	0.55	1,496	213.78	0.61
13.86	0.54	1,483	213.77	0.59
13.92	0.52	1,471	213.76	0.58
13.98	0.51	1,459	213.75	0.57
14.04	0.50	1,447	213.74	0.55
14.10	0.48	1,435	213.74	0.54
14.16	0.48	1,423	213.73	0.53
14.22	0.47	1,413	213.72	0.51
14.28	0.46	1,404	213.71	0.50
14.34	0.46	1,395	213.71	0.50
14.40	0.45	1,386	213.70	0.49
14.46	0.44	1,378	213.69	0.48
14.52	0.43	1,370	213.69	0.47
14.58	0.43	1,363	213.68	0.46
14.64	0.42	1,355	213.68	0.46
14.70	0.41	1,348	213.67	0.45
14.76	0.41	1,341	213.67	0.44
14.82	0.40	1,334	213.66	0.43
14.88	0.39	1,327	213.66	0.43
14.94	0.39	1,320	213.65	0.42
15.00	0.38	1,313	213.64	0.41
15.06	0.37	1,306	213.64	0.41
15.12	0.37	1,299	213.63	0.40
15.18	0.36	1,292	213.63	0.39
15.24	0.35	1,285	213.62	0.39
15.30	0.35	1,277	213.62	0.38
15.36	0.34	1,270	213.61	0.37
15.42	0.33	1,262	213.61	0.37
15.48	0.33	1,255	213.60	0.36
15.54	0.32	1,247	213.60	0.35

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
15.60	0.31	1,240	213.59	0.35
15.66	0.31	1,232	213.58	0.34
15.72	0.30	1,225	213.58	0.33
15.78	0.29	1,217	213.57	0.33
15.84	0.29	1,209	213.57	0.32
15.90	0.28	1,201	213.56	0.32
15.96	0.27	1,193	213.55	0.31
16.02	0.27	1,184	213.55	0.30
16.08	0.26	1,176	213.54	0.30
16.14	0.25	1,168	213.54	0.29
16.20	0.25	1,160	213.53	0.29
16.26	0.25	1,153	213.52	0.28
16.32	0.25	1,146	213.52	0.28
16.38	0.24	1,139	213.51	0.27
16.44	0.24	1,133	213.51	0.27
16.50	0.24	1,128	213.51	0.26
16.56	0.23	1,122	213.50	0.26
16.62	0.23	1,116	213.50	0.26
16.68	0.23	1,111	213.49	0.25
16.74	0.22	1,105	213.49	0.25
16.80	0.22	1,100	213.48	0.25
16.86	0.22	1,094	213.48	0.24
16.92	0.22	1,089	213.48	0.24
16.98	0.21	1,084	213.47	0.24
17.04	0.21	1,079	213.47	0.23
17.10	0.21	1,073	213.46	0.23
17.16	0.20	1,068	213.46	0.23
17.22	0.20	1,063	213.46	0.23
17.28	0.20	1,058	213.45	0.22
17.34	0.20	1,053	213.45	0.22
17.40	0.19	1,047	213.45	0.22
17.46	0.19	1,042	213.44	0.21
17.52	0.19	1,037	213.44	0.21
17.58	0.18	1,032	213.43	0.21
17.64	0.18	1,026	213.43	0.21
17.70	0.18	1,021	213.43	0.20
17.76	0.17	1,015	213.42	0.20
17.82	0.17	1,009	213.42	0.20
17.88	0.17	1,002	213.41	0.20
17.94	0.17	996	213.41	0.20
18.00	0.16	990	213.40	0.19
18.06	0.16	983	213.40	0.19
18.12	0.16	976	213.39	0.19
18.18	0.16	970	213.39	0.19
18.24	0.16	964	213.38	0.18
18.30	0.16	958	213.38	0.18
18.36	0.15	952	213.37	0.18
18.42	0.15	946	213.37	0.18
18.48	0.15	940	213.37	0.18
18.54	0.15	934	213.36	0.18
18.60	0.15	928	213.36	0.18
18.66	0.15	922	213.35	0.18

Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
18.72	0.15	916	213.35	0.18
18.78	0.15	910	213.34	0.18
18.84	0.15	904	213.34	0.18
18.90	0.15	898	213.33	0.17
18.96	0.15	892	213.33	0.17
19.02	0.14	886	213.32	0.17
19.08	0.14	879	213.32	0.17
19.14	0.14	873	213.31	0.17
19.20	0.14	867	213.31	0.17
19.26	0.14	860	213.31	0.17
19.32	0.14	854	213.30	0.17
19.38	0.14	848	213.30	0.17
19.44	0.14	841	213.29	0.17
19.50	0.14	835	213.29	0.17
19.56	0.14	828	213.28	0.17
19.62	0.14	822	213.28	0.17
19.68	0.13	815	213.27	0.16
19.74	0.13	809	213.27	0.16
19.80	0.13	802	213.26	0.16
19.86	0.13	796	213.26	0.16
19.92	0.13	789	213.25	0.16
19.98	0.13	783	213.25	0.16
20.04	0.13	776	213.24	0.16
20.10	0.13	770	213.24	0.16
20.16	0.13	763	213.23	0.16
20.22	0.13	757	213.23	0.16
20.28	0.13	750	213.22	0.16
20.34	0.13	744	213.22	0.16
20.40	0.13	738	213.21	0.15
20.46	0.12	731	213.21	0.15
20.52	0.12	725	213.20	0.15
20.58	0.12	719	213.20	0.15
20.64	0.12	713	213.19	0.15
20.70	0.12	706	213.19	0.15
20.76	0.12	700	213.19	0.15
20.82	0.12	694	213.18	0.15
20.88	0.12	688	213.18	0.15
20.94	0.12	682	213.17	0.15
21.00	0.12	676	213.17	0.15
21.06	0.12	670	213.16	0.15
21.12	0.12	665	213.16	0.14
21.18	0.12	659	213.15	0.14
21.24	0.12	653	213.15	0.14
21.30	0.12	647	213.15	0.14
21.36	0.11	641	213.14	0.14
21.42	0.11	636	213.14	0.14
21.48	0.11	630	213.13	0.14
21.54	0.11	625	213.13	0.14
21.60	0.11	619	213.12	0.14
21.66	0.11	614	213.12	0.14
21.72	0.11	608	213.12	0.14
21.78	0.11	603	213.11	0.13

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

Prepared by Tectonic Engineering

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Hydrograph for Pond 6P: Detention (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
21.84	0.11	597	213.11	0.13
21.90	0.11	592	213.10	0.13
21.96	0.11	587	213.10	0.13
22.02	0.11	581	213.10	0.13
22.08	0.11	576	213.09	0.13
22.14	0.11	571	213.09	0.13
22.20	0.11	566	213.08	0.13
22.26	0.10	560	213.08	0.13
22.32	0.10	555	213.08	0.13
22.38	0.10	550	213.07	0.13
22.44	0.10	545	213.07	0.13
22.50	0.10	540	213.07	0.12
22.56	0.10	535	213.06	0.12
22.62	0.10	530	213.06	0.12
22.68	0.10	526	213.05	0.12
22.74	0.10	521	213.05	0.12
22.80	0.10	516	213.05	0.12
22.86	0.10	511	213.04	0.12
22.92	0.10	506	213.04	0.12
22.98	0.10	502	213.04	0.12
23.04	0.10	497	213.03	0.12
23.10	0.10	492	213.03	0.12
23.16	0.09	488	213.03	0.12
23.22	0.09	483	213.02	0.12
23.28	0.09	479	213.02	0.11
23.34	0.09	474	213.02	0.11
23.40	0.09	470	213.01	0.11
23.46	0.09	465	213.01	0.11
23.52	0.09	461	213.01	0.11
23.58	0.09	456	213.00	0.11
23.64	0.09	452	213.00	0.11
23.70	0.09	448	213.00	0.11
23.76	0.09	444	212.99	0.11
23.82	0.09	439	212.99	0.11
23.88	0.09	435	212.99	0.11
23.94	0.09	431	212.98	0.10
24.00	0.09	427	212.98	0.10

Stage-Discharge for Pond 6P: Detention

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
212.66	0.00	213.70	0.49	214.74	2.96	215.78	7.32
212.68	0.00	213.72	0.51	214.76	3.02	215.80	7.46
212.70	0.00	213.74	0.54	214.78	3.08	215.82	7.60
212.72	0.01	213.76	0.57	214.80	3.14	215.84	7.74
212.74	0.01	213.78	0.61	214.82	3.21	215.86	7.89
212.76	0.02	213.80	0.64	214.84	3.27	215.88	8.04
212.78	0.03	213.82	0.67	214.86	3.33	215.90	8.19
212.80	0.04	213.84	0.71	214.88	3.39	215.92	8.34
212.82	0.05	213.86	0.74	214.90	3.45	215.94	8.50
212.84	0.05	213.88	0.78	214.92	3.52	215.96	8.65
212.86	0.06	213.90	0.82	214.94	3.58	215.98	8.81
212.88	0.07	213.92	0.85	214.96	3.65	216.00	8.98
212.90	0.08	213.94	0.89	214.98	3.71	216.02	9.15
212.92	0.09	213.96	0.93	215.00	3.77	216.04	9.31
212.94	0.09	213.98	0.97	215.02	3.84	216.06	9.49
212.96	0.10	214.00	1.02	215.04	3.91	216.08	9.66
212.98	0.10	214.02	1.06	215.06	3.97	216.10	9.84
213.00	0.11	214.04	1.11	215.08	4.04	216.12	10.02
213.02	0.11	214.06	1.16	215.10	4.10	216.14	10.20
213.04	0.12	214.08	1.20	215.12	4.17	216.16	10.39
213.06	0.12	214.10	1.25	215.14	4.24	216.18	10.57
213.08	0.13	214.12	1.30	215.16	4.31	216.20	10.75
213.10	0.13	214.14	1.35	215.18	4.37		
213.12	0.14	214.16	1.41	215.20	4.44		
213.14	0.14	214.18	1.46	215.22	4.51		
213.16	0.14	214.20	1.51	215.24	4.58		
213.18	0.15	214.22	1.55	215.26	4.65		
213.20	0.15	214.24	1.60	215.28	4.72		
213.22	0.16	214.26	1.65	215.30	4.79		
213.24	0.16	214.28	1.70	215.32	4.86		
213.26	0.16	214.30	1.75	215.34	4.93		
213.28	0.17	214.32	1.80	215.36	5.00		
213.30	0.17	214.34	1.85	215.38	5.08		
213.32	0.17	214.36	1.91	215.40	5.16		
213.34	0.18	214.38	1.96	215.42	5.24		
213.36	0.18	214.40	2.01	215.44	5.33		
213.38	0.18	214.42	2.06	215.46	5.43		
213.40	0.19	214.44	2.12	215.48	5.53		
213.42	0.20	214.46	2.17	215.50	5.63		
213.44	0.21	214.48	2.22	215.52	5.73		
213.46	0.23	214.50	2.28	215.54	5.84		
213.48	0.24	214.52	2.33	215.56	5.95		
213.50	0.26	214.54	2.39	215.58	6.06		
213.52	0.28	214.56	2.44	215.60	6.18		
213.54	0.29	214.58	2.50	215.62	6.30		
213.56	0.31	214.60	2.56	215.64	6.42		
213.58	0.34	214.62	2.61	215.66	6.54		
213.60	0.36	214.64	2.67	215.68	6.66		
213.62	0.38	214.66	2.73	215.70	6.79		
213.64	0.41	214.68	2.79	215.72	6.92		
213.66	0.43	214.70	2.84	215.74	7.05		
213.68	0.46	214.72	2.90	215.76	7.18		

2021-07-8 Post Orangetown Town Hall*Type III 24-hr 100 Year Rainfall=9.07"*

Prepared by Tectonic Engineering

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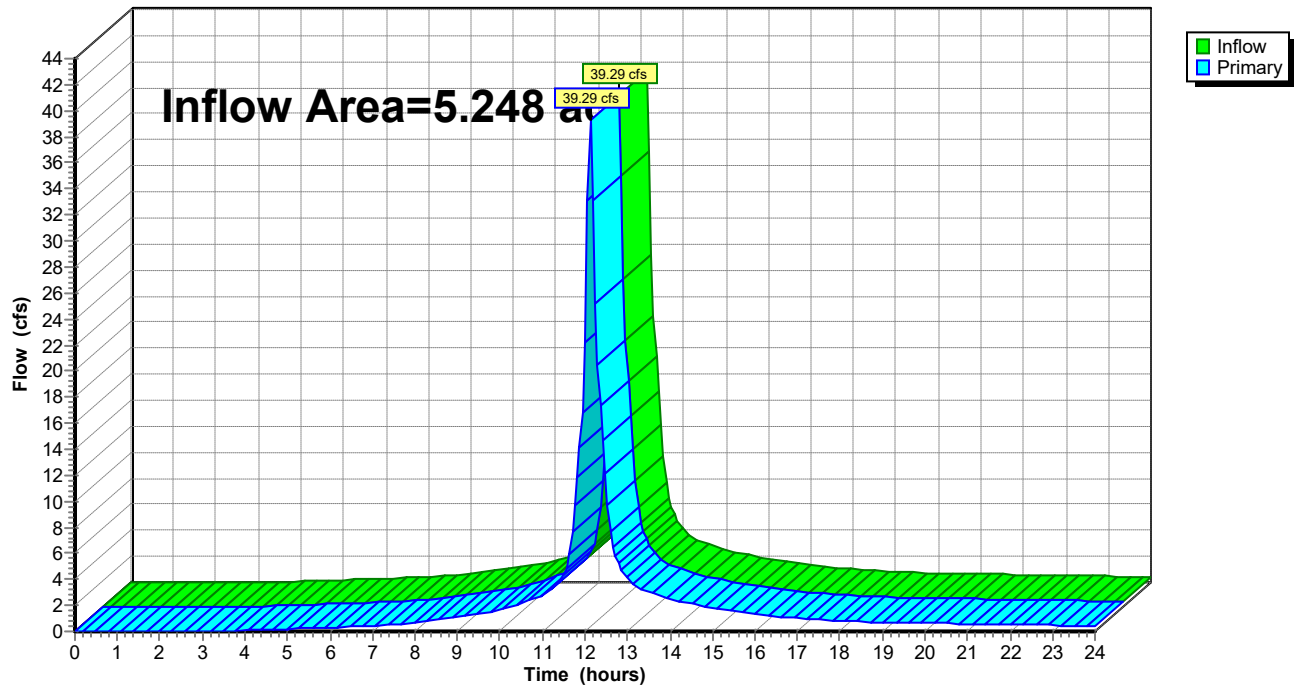
Stage-Area-Storage for Pond 6P: Detention

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
212.66	0	215.26	3,467
212.71	67	215.31	3,534
212.76	133	215.36	3,601
212.81	200	215.41	3,667
212.86	267	215.46	3,734
212.91	333	215.51	3,801
212.96	400	215.56	3,867
213.01	467	215.61	3,934
213.06	533	215.66	4,001
213.11	600	215.71	4,067
213.16	667	215.76	4,134
213.21	733	215.81	4,201
213.26	800	215.86	4,268
213.31	867	215.91	4,334
213.36	934	215.96	4,401
213.41	1,000	216.01	4,468
213.46	1,067	216.06	4,534
213.51	1,134	216.11	4,601
213.56	1,200	216.16	4,668
213.61	1,267		
213.66	1,334		
213.71	1,400		
213.76	1,467		
213.81	1,534		
213.86	1,600		
213.91	1,667		
213.96	1,734		
214.01	1,800		
214.06	1,867		
214.11	1,934		
214.16	2,000		
214.21	2,067		
214.26	2,134		
214.31	2,200		
214.36	2,267		
214.41	2,334		
214.46	2,400		
214.51	2,467		
214.56	2,534		
214.61	2,601		
214.66	2,667		
214.71	2,734		
214.76	2,801		
214.81	2,867		
214.86	2,934		
214.91	3,001		
214.96	3,067		
215.01	3,134		
215.06	3,201		
215.11	3,267		
215.16	3,334		
215.21	3,401		

Summary for Link 10L: DP-1

Inflow Area = 5.248 ac, 61.30% Impervious, Inflow Depth > 7.63" for 100 Year event
Inflow = 39.29 cfs @ 12.12 hrs, Volume= 3.339 af
Primary = 39.29 cfs @ 12.12 hrs, Volume= 3.339 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.06 hrs

Link 10L: DP-1**Hydrograph**

Hydrograph for Link 10L: DP-1

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.00	0.00	3.12	0.01	0.00	0.01
0.06	0.00	0.00	0.00	3.18	0.01	0.00	0.01
0.12	0.00	0.00	0.00	3.24	0.02	0.00	0.02
0.18	0.00	0.00	0.00	3.30	0.02	0.00	0.02
0.24	0.00	0.00	0.00	3.36	0.02	0.00	0.02
0.30	0.00	0.00	0.00	3.42	0.03	0.00	0.03
0.36	0.00	0.00	0.00	3.48	0.03	0.00	0.03
0.42	0.00	0.00	0.00	3.54	0.03	0.00	0.03
0.48	0.00	0.00	0.00	3.60	0.04	0.00	0.04
0.54	0.00	0.00	0.00	3.66	0.04	0.00	0.04
0.60	0.00	0.00	0.00	3.72	0.05	0.00	0.05
0.66	0.00	0.00	0.00	3.78	0.05	0.00	0.05
0.72	0.00	0.00	0.00	3.84	0.06	0.00	0.06
0.78	0.00	0.00	0.00	3.90	0.06	0.00	0.06
0.84	0.00	0.00	0.00	3.96	0.07	0.00	0.07
0.90	0.00	0.00	0.00	4.02	0.07	0.00	0.07
0.96	0.00	0.00	0.00	4.08	0.08	0.00	0.08
1.02	0.00	0.00	0.00	4.14	0.09	0.00	0.09
1.08	0.00	0.00	0.00	4.20	0.09	0.00	0.09
1.14	0.00	0.00	0.00	4.26	0.10	0.00	0.10
1.20	0.00	0.00	0.00	4.32	0.10	0.00	0.10
1.26	0.00	0.00	0.00	4.38	0.11	0.00	0.11
1.32	0.00	0.00	0.00	4.44	0.12	0.00	0.12
1.38	0.00	0.00	0.00	4.50	0.12	0.00	0.12
1.44	0.00	0.00	0.00	4.56	0.13	0.00	0.13
1.50	0.00	0.00	0.00	4.62	0.13	0.00	0.13
1.56	0.00	0.00	0.00	4.68	0.14	0.00	0.14
1.62	0.00	0.00	0.00	4.74	0.15	0.00	0.15
1.68	0.00	0.00	0.00	4.80	0.15	0.00	0.15
1.74	0.00	0.00	0.00	4.86	0.16	0.00	0.16
1.80	0.00	0.00	0.00	4.92	0.17	0.00	0.17
1.86	0.00	0.00	0.00	4.98	0.17	0.00	0.17
1.92	0.00	0.00	0.00	5.04	0.18	0.00	0.18
1.98	0.00	0.00	0.00	5.10	0.18	0.00	0.18
2.04	0.00	0.00	0.00	5.16	0.19	0.00	0.19
2.10	0.00	0.00	0.00	5.22	0.20	0.00	0.20
2.16	0.00	0.00	0.00	5.28	0.20	0.00	0.20
2.22	0.00	0.00	0.00	5.34	0.21	0.00	0.21
2.28	0.00	0.00	0.00	5.40	0.22	0.00	0.22
2.34	0.00	0.00	0.00	5.46	0.22	0.00	0.22
2.40	0.00	0.00	0.00	5.52	0.23	0.00	0.23
2.46	0.00	0.00	0.00	5.58	0.24	0.00	0.24
2.52	0.00	0.00	0.00	5.64	0.24	0.00	0.24
2.58	0.00	0.00	0.00	5.70	0.25	0.00	0.25
2.64	0.00	0.00	0.00	5.76	0.26	0.00	0.26
2.70	0.01	0.00	0.01	5.82	0.26	0.00	0.26
2.76	0.01	0.00	0.01	5.88	0.27	0.00	0.27
2.82	0.01	0.00	0.01	5.94	0.28	0.00	0.28
2.88	0.01	0.00	0.01	6.00	0.28	0.00	0.28
2.94	0.01	0.00	0.01	6.06	0.29	0.00	0.29
3.00	0.01	0.00	0.01	6.12	0.30	0.00	0.30
3.06	0.01	0.00	0.01	6.18	0.31	0.00	0.31

Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
6.24	0.32	0.00	0.32	9.36	1.25	0.00	1.25
6.30	0.32	0.00	0.32	9.42	1.29	0.00	1.29
6.36	0.33	0.00	0.33	9.48	1.33	0.00	1.33
6.42	0.34	0.00	0.34	9.54	1.37	0.00	1.37
6.48	0.36	0.00	0.36	9.60	1.41	0.00	1.41
6.54	0.37	0.00	0.37	9.66	1.45	0.00	1.45
6.60	0.38	0.00	0.38	9.72	1.49	0.00	1.49
6.66	0.39	0.00	0.39	9.78	1.53	0.00	1.53
6.72	0.40	0.00	0.40	9.84	1.57	0.00	1.57
6.78	0.41	0.00	0.41	9.90	1.61	0.00	1.61
6.84	0.42	0.00	0.42	9.96	1.65	0.00	1.65
6.90	0.43	0.00	0.43	10.02	1.69	0.00	1.69
6.96	0.44	0.00	0.44	10.08	1.74	0.00	1.74
7.02	0.46	0.00	0.46	10.14	1.79	0.00	1.79
7.08	0.47	0.00	0.47	10.20	1.85	0.00	1.85
7.14	0.48	0.00	0.48	10.26	1.91	0.00	1.91
7.20	0.49	0.00	0.49	10.32	1.97	0.00	1.97
7.26	0.51	0.00	0.51	10.38	2.04	0.00	2.04
7.32	0.52	0.00	0.52	10.44	2.10	0.00	2.10
7.38	0.53	0.00	0.53	10.50	2.17	0.00	2.17
7.44	0.54	0.00	0.54	10.56	2.24	0.00	2.24
7.50	0.56	0.00	0.56	10.62	2.31	0.00	2.31
7.56	0.57	0.00	0.57	10.68	2.37	0.00	2.37
7.62	0.58	0.00	0.58	10.74	2.44	0.00	2.44
7.68	0.60	0.00	0.60	10.80	2.51	0.00	2.51
7.74	0.61	0.00	0.61	10.86	2.58	0.00	2.58
7.80	0.62	0.00	0.62	10.92	2.65	0.00	2.65
7.86	0.64	0.00	0.64	10.98	2.73	0.00	2.73
7.92	0.65	0.00	0.65	11.04	2.80	0.00	2.80
7.98	0.66	0.00	0.66	11.10	2.90	0.00	2.90
8.04	0.68	0.00	0.68	11.16	3.05	0.00	3.05
8.10	0.69	0.00	0.69	11.22	3.25	0.00	3.25
8.16	0.71	0.00	0.71	11.28	3.47	0.00	3.47
8.22	0.74	0.00	0.74	11.34	3.70	0.00	3.70
8.28	0.76	0.00	0.76	11.40	3.94	0.00	3.94
8.34	0.78	0.00	0.78	11.46	4.18	0.00	4.18
8.40	0.81	0.00	0.81	11.52	4.43	0.00	4.43
8.46	0.83	0.00	0.83	11.58	4.84	0.00	4.84
8.52	0.86	0.00	0.86	11.64	5.90	0.00	5.90
8.58	0.88	0.00	0.88	11.70	7.61	0.00	7.61
8.64	0.91	0.00	0.91	11.76	9.65	0.00	9.65
8.70	0.93	0.00	0.93	11.82	11.86	0.00	11.86
8.76	0.96	0.00	0.96	11.88	14.19	0.00	14.19
8.82	0.99	0.00	0.99	11.94	16.78	0.00	16.78
8.88	1.02	0.00	1.02	12.00	22.20	0.00	22.20
8.94	1.04	0.00	1.04	12.06	33.10	0.00	33.10
9.00	1.07	0.00	1.07	12.12	39.29	0.00	39.29
9.06	1.10	0.00	1.10	12.18	33.04	0.00	33.04
9.12	1.13	0.00	1.13	12.24	25.16	0.00	25.16
9.18	1.16	0.00	1.16	12.30	20.51	0.00	20.51
9.24	1.19	0.00	1.19	12.36	17.37	0.00	17.37
9.30	1.22	0.00	1.22	12.42	14.68	0.00	14.68

2021-07-8 Post Orangetown Town Hall

Type III 24-hr 100 Year Rainfall=9.07"

Prepared by Tectonic Engineering

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Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
12.48	12.16	0.00	12.16	15.60	1.53	0.00	1.53
12.54	9.74	0.00	9.74	15.66	1.50	0.00	1.50
12.60	7.69	0.00	7.69	15.72	1.47	0.00	1.47
12.66	6.45	0.00	6.45	15.78	1.44	0.00	1.44
12.72	5.75	0.00	5.75	15.84	1.41	0.00	1.41
12.78	5.28	0.00	5.28	15.90	1.38	0.00	1.38
12.84	4.91	0.00	4.91	15.96	1.34	0.00	1.34
12.90	4.59	0.00	4.59	16.02	1.31	0.00	1.31
12.96	4.30	0.00	4.30	16.08	1.28	0.00	1.28
13.02	4.02	0.00	4.02	16.14	1.26	0.00	1.26
13.08	3.77	0.00	3.77	16.20	1.24	0.00	1.24
13.14	3.58	0.00	3.58	16.26	1.22	0.00	1.22
13.20	3.45	0.00	3.45	16.32	1.20	0.00	1.20
13.26	3.36	0.00	3.36	16.38	1.19	0.00	1.19
13.32	3.27	0.00	3.27	16.44	1.17	0.00	1.17
13.38	3.19	0.00	3.19	16.50	1.16	0.00	1.16
13.44	3.12	0.00	3.12	16.56	1.14	0.00	1.14
13.50	3.05	0.00	3.05	16.62	1.13	0.00	1.13
13.56	2.98	0.00	2.98	16.68	1.12	0.00	1.12
13.62	2.91	0.00	2.91	16.74	1.10	0.00	1.10
13.68	2.84	0.00	2.84	16.80	1.09	0.00	1.09
13.74	2.77	0.00	2.77	16.86	1.07	0.00	1.07
13.80	2.70	0.00	2.70	16.92	1.06	0.00	1.06
13.86	2.64	0.00	2.64	16.98	1.04	0.00	1.04
13.92	2.57	0.00	2.57	17.04	1.03	0.00	1.03
13.98	2.50	0.00	2.50	17.10	1.02	0.00	1.02
14.04	2.44	0.00	2.44	17.16	1.00	0.00	1.00
14.10	2.37	0.00	2.37	17.22	0.99	0.00	0.99
14.16	2.33	0.00	2.33	17.28	0.97	0.00	0.97
14.22	2.29	0.00	2.29	17.34	0.96	0.00	0.96
14.28	2.25	0.00	2.25	17.40	0.94	0.00	0.94
14.34	2.21	0.00	2.21	17.46	0.93	0.00	0.93
14.40	2.18	0.00	2.18	17.52	0.92	0.00	0.92
14.46	2.15	0.00	2.15	17.58	0.90	0.00	0.90
14.52	2.11	0.00	2.11	17.64	0.89	0.00	0.89
14.58	2.08	0.00	2.08	17.70	0.88	0.00	0.88
14.64	2.05	0.00	2.05	17.76	0.86	0.00	0.86
14.70	2.02	0.00	2.02	17.82	0.85	0.00	0.85
14.76	1.98	0.00	1.98	17.88	0.84	0.00	0.84
14.82	1.95	0.00	1.95	17.94	0.82	0.00	0.82
14.88	1.92	0.00	1.92	18.00	0.81	0.00	0.81
14.94	1.89	0.00	1.89	18.06	0.80	0.00	0.80
15.00	1.85	0.00	1.85	18.12	0.79	0.00	0.79
15.06	1.82	0.00	1.82	18.18	0.78	0.00	0.78
15.12	1.79	0.00	1.79	18.24	0.77	0.00	0.77
15.18	1.76	0.00	1.76	18.30	0.77	0.00	0.77
15.24	1.73	0.00	1.73	18.36	0.76	0.00	0.76
15.30	1.69	0.00	1.69	18.42	0.76	0.00	0.76
15.36	1.66	0.00	1.66	18.48	0.75	0.00	0.75
15.42	1.63	0.00	1.63	18.54	0.75	0.00	0.75
15.48	1.60	0.00	1.60	18.60	0.75	0.00	0.75
15.54	1.57	0.00	1.57	18.66	0.74	0.00	0.74

Hydrograph for Link 10L: DP-1 (continued)

Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)	Time (hours)	Inflow (cfs)	Elevation (feet)	Primary (cfs)
18.72	0.74	0.00	0.74	21.84	0.55	0.00	0.55
18.78	0.73	0.00	0.73	21.90	0.54	0.00	0.54
18.84	0.73	0.00	0.73	21.96	0.54	0.00	0.54
18.90	0.73	0.00	0.73	22.02	0.54	0.00	0.54
18.96	0.72	0.00	0.72	22.08	0.53	0.00	0.53
19.02	0.72	0.00	0.72	22.14	0.53	0.00	0.53
19.08	0.71	0.00	0.71	22.20	0.53	0.00	0.53
19.14	0.71	0.00	0.71	22.26	0.52	0.00	0.52
19.20	0.71	0.00	0.71	22.32	0.52	0.00	0.52
19.26	0.70	0.00	0.70	22.38	0.52	0.00	0.52
19.32	0.70	0.00	0.70	22.44	0.51	0.00	0.51
19.38	0.69	0.00	0.69	22.50	0.51	0.00	0.51
19.44	0.69	0.00	0.69	22.56	0.51	0.00	0.51
19.50	0.69	0.00	0.69	22.62	0.50	0.00	0.50
19.56	0.68	0.00	0.68	22.68	0.50	0.00	0.50
19.62	0.68	0.00	0.68	22.74	0.50	0.00	0.50
19.68	0.67	0.00	0.67	22.80	0.49	0.00	0.49
19.74	0.67	0.00	0.67	22.86	0.49	0.00	0.49
19.80	0.66	0.00	0.66	22.92	0.49	0.00	0.49
19.86	0.66	0.00	0.66	22.98	0.48	0.00	0.48
19.92	0.66	0.00	0.66	23.04	0.48	0.00	0.48
19.98	0.65	0.00	0.65	23.10	0.48	0.00	0.48
20.04	0.65	0.00	0.65	23.16	0.47	0.00	0.47
20.10	0.64	0.00	0.64	23.22	0.47	0.00	0.47
20.16	0.64	0.00	0.64	23.28	0.47	0.00	0.47
20.22	0.64	0.00	0.64	23.34	0.46	0.00	0.46
20.28	0.63	0.00	0.63	23.40	0.46	0.00	0.46
20.34	0.63	0.00	0.63	23.46	0.46	0.00	0.46
20.40	0.63	0.00	0.63	23.52	0.45	0.00	0.45
20.46	0.62	0.00	0.62	23.58	0.45	0.00	0.45
20.52	0.62	0.00	0.62	23.64	0.45	0.00	0.45
20.58	0.62	0.00	0.62	23.70	0.44	0.00	0.44
20.64	0.61	0.00	0.61	23.76	0.44	0.00	0.44
20.70	0.61	0.00	0.61	23.82	0.44	0.00	0.44
20.76	0.61	0.00	0.61	23.88	0.43	0.00	0.43
20.82	0.60	0.00	0.60	23.94	0.43	0.00	0.43
20.88	0.60	0.00	0.60	24.00	0.43	0.00	0.43
20.94	0.60	0.00	0.60				
21.00	0.59	0.00	0.59				
21.06	0.59	0.00	0.59				
21.12	0.59	0.00	0.59				
21.18	0.58	0.00	0.58				
21.24	0.58	0.00	0.58				
21.30	0.58	0.00	0.58				
21.36	0.57	0.00	0.57				
21.42	0.57	0.00	0.57				
21.48	0.57	0.00	0.57				
21.54	0.56	0.00	0.56				
21.60	0.56	0.00	0.56				
21.66	0.56	0.00	0.56				
21.72	0.55	0.00	0.55				
21.78	0.55	0.00	0.55				

APPENDIX D-III

	WATER QUALITY WORKSHEET		
	DATE: 3/25/2020	WO. NO. 10128	LOCATION: Orangetown, Rockland County, NY
PROJECT TITLE: Orangetown Town Hall Expansion	ESTIMATED BY: JM		APPROVED BY: CO

Total Disturbance Area	2.93	acres	
Total Disturbed Impervious Area	1.28	acres	
Total Proposed Impervious	1.85	acres	
Remaining Total Area	1.65	acres	
Total New Impervious	0.57	acres	

New Development

90% Rainfall Event Number (Fig 4.1)	P =	1.50	in	
0.05+0.009(I) (minimum Rv = 0.2)	Rv =	0.3619		
Total Drainage Area (New Development)	AT =	1.65	Ac	$W_{qv} = \frac{(p)(R_v)(A_T)}{12}$
Impervious Area	AI =	0.57	Ac	
Impervious Area Percentage	I =	35	%	
90% Rule	WQv =	0.074	Ac-ft	
Water Quality Volume	Wqv =	3,241	ft ³	972

Redevelopment

90% Rainfall Event Number (Fig 4.1)	P =	1.50	in	
0.05+0.009(I) (minimum Rv = 0.2)	Rv =	0.9535		
Total Drainage Area	AT =	1.28	Ac	$W_{qv} = \frac{(p)(R_v)(A_T)}{12}$
Impervious Area	AI =	1.28	Ac	
Impervious Area Percentage	I =	100	%	
90% Rule	WQv =	0.152	Ac-ft	
Water Quality Volume	WQV =	6,620	ft ³	

Drainage to Underground System

90% Rainfall Event Number (Fig 4.1)	P =	1.50	in	
0.05+0.009(I) (minimum Rv = 0.2)	Rv =	0.7164		
Total Drainage Area	AT =	1.09	Ac	
Impervious Area	AI =	0.81	Ac	
Impervious Area Percentage	I =	74	%	
90% Rule	WQv =	0.098	Ac-ft	
Water Quality Volume	WQV =	4,267	ft ³	
Water Quality Volume Provided in Cistern		3,700	ft ³	
WQv Credit Remaining		459	ft ³	(WQv Provided - WQv NewDevelopment)
(25%-Runoff Reduction) * 3		7%		(WQv Credit/ WQv Redevelopment)
%WQv treatment by Alternative practice		54%		

WQv treatment Requirement by Alternative practice	3,575	ft ³	
Alternative practice (Western Portion)	567	ft ³	
Alternative practice (Eastern Portion)	3,089	ft ³	
Total WQv Provided by Alternative Practice	3,657	ft ³	

54% of the Required Redevelopment WQv
 Runoff treated by HDS but not counted in cistern

WQv provided by Alternative Practice is greater than required.

PROJECT TITLE
Orangetown Town Hall

LOCATION
Orangetown, Rockland County, NY

Western Drainage to Cascade HDS

1.) Calculate peak WQv Flow to Cascade Unit and Diversion Structure

Worksheet based upon NYSDEC Design Manual, August 2005 Appendix B

90% Rainfall Event Number (Fig 4.1) P = 1.50 in
 area A = 1.09 Ac
 Water Quality Volume WQv = 4,267 ft³
 runoff volume Q = 1.08 in
 Curve Number CN = 96
 Ia = (200/CN) - 2 Ia = 0.09
 Ia/P Ia/P = 0.06
 qu (From Exhibits 4-I to 4-III)* qu = 650
 Qp = qu * A * WQv Qp = 1.19 cfs

2.) Size Diversion Structure

Size a low-flow orifice to pass the water quality storm (Qp = 1.13 cfs).

Orifice Coefficient C= 0.6 dimensionless
 Q = CA(2gh)^{1/2} ; Gravitational Constant g= 32.2 ft/s²
 Height above Orifice h 1.5 ft

$$1.13 \text{ cfs} = (0.6) (A) [(2) (32.2 \text{ ft/s}^2) (1.0')]^{1/2}$$

$$A = \frac{Q}{C(2gh)^{1/2}}$$

$$A = 0.202 \text{ ft}^2$$

$$R = \frac{0.254 \text{ ft}}{3.0} = 0.085 \text{ inches}$$

$$D = 6 \text{ inches}$$

A 6" pipe with a weir set 1.5 feet above the orifice would pass the peak WQv storm and divert the larger storms to the underground storage.



Water Quality Peak Flow Calculation (Eastern)

WO. NO.
10128.01

DATE
3/25/2020

SHEET
1 OF 1

PROJECT TITLE
Orangetown Town Hall

LOCATION
Orangetown, Rockland County, NY

Drainage to Eastern Hydrodynamic Separator

Worksheet based upon NYSDEC Design Manual, August 2015 Appendix B

90% Rainfall Event Number (Fig 4.1) $P = 1.50$ in
area $A = 0.72$ Ac
Water Quality Volume $WQ_v = 3,089$ ft³
runoff volume $Q = 1.18$ in
Curve Number $CN = 97$
 $I_a = (200/CN) - 2$ $I_a = 0.06$
 I_a/P $I_a/P = 0.04$
 q_u (From Exhibits 4-I to 4-III)* $q_u = 650$

$Q_p = q_u * A * WQ_v$ $Q_p = 0.86$ cfs

90% Rainfall Event Number (Fig 4.1) $P = 1.50$ in
 $0.05 + 0.009(I)$ (minimum $R_v = 0.2$) $R_v = 0.7880$
Total Drainage Area $A_T = 0.72$ Ac
Impervious Area $A_I = 0.59$ Ac
Impervious Area Percentage $I = 82$ %
90% Rule $W_{qv} = 0.070920$ Ac-ft
Water Quality Volume $WQ_v = 3,089.28$ ft³

WaterSense New Home Specification: Water Budget Tool (V 1.03)

This water budget tool shall be used to determine if the designed landscape meets Criteria 4.1.1 of the specification. Please refer to the WaterSense Water Budget Approach for additional information.

Your Name:
Builder Name:
Lot Number/Street Address:
City, State, Zip Code:



Peak Watering Month:
Obtain from Water Budget Data Finder at <https://www.epa.gov/watersense/water-budget-data-finder>

Is an irrigation system being installed on this site?

This worksheet determines the baseline and the landscape water allowance (LWA) for a site based on its peak watering month.

The baseline is the amount of water required by the site during the peak watering month if watered at 100 percent of reference evapotranspiration (ET_o). The following formula is used to calculate the baseline:

$$Baseline = ET_o \times A \times C_u$$

Where:

ET_o = Local reference evapotranspiration (inches/month)

A = Landscaped area (square feet)

C_u = Conversion factor (0.6233 for results in gallons/month)

The LWA is the water allotment for the site. The following formula is used to calculate the LWA:

$$LWA = 0.70 \times Baseline$$

Where:

LWA = Landscape water allowance (gallons/month)

Baseline = ET_o x landscaped area x 0.6233

To calculate the Baseline and LWA for a site, enter the designed landscaped area and average monthly reference evapotranspiration for the site's peak watering month. (Enter data in white cells only.)

STEP 1A - ENTER THE LANDSCAPED AREA (A)

Area of the designed landscape (square feet)

STEP 1B - ENTER THE AVERAGE MONTHLY REFERENCE EVAPOTRANSPIRATION (ET_o)

Average monthly reference ET (inches/month) for the site's peak watering month

Obtain from Water Budget Data Finder at <https://www.epa.gov/watersense/water-budget-data-finder>

OUTPUT - BASELINE FOR THE SITE

Monthly baseline (gallons/month) based on the site's peak watering month

OUTPUT - WATER ALLOWANCE FOR THE SITE

Monthly landscape water allowance (gallons/month) based on the site's peak watering month

Next Step: Click on the next tab labeled *Part 2 - LWR* to calculate the landscape water requirement.

WaterSense New Home Specification: Water Budget Tool (V 1.03)

This water budget tool shall be used to determine if the designed landscape meets Criteria 4.1.1 of the specification. Please refer to the WaterSense Water Budget Approach for additional information.

Your Name: _____
Builder Name: _____
Lot Number/Street Address: _____
City, State, Zip Code: _____

Peak Watering Month: June

Is an irrigation system being installed on this site? yes

**This worksheet determines the monthly landscape water requirement (LWR) for a site based on its peak watering month.**

The monthly LWR is the water requirement specific to the designed landscape. The sum of the LWRs for each hydrozone equals the site LWR. The following formula is used to calculate the LWR for each hydrozone:

$$LWR_H = \frac{1}{DU_{LQ}} \times [(ET_o \times K_L) - R_a] \times A \times C_u$$

Where:
LWR_H = Landscape water requirement for the hydrozone (gallons/month)
DU_{LQ} = Lower quarter distribution uniformity
ET_o = Local reference evapotranspiration (inches/month)
K_L = Landscape coefficient for the type of plant in that hydrozone (dimensionless)
R_a = Allowable rainfall, designated by WaterSense as 25% of average peak monthly rainfall (R)
A = Area of the hydrozone (square feet)
C_u = Conversion factor (0.6233 for results in gallons/month)

To calculate the LWR for the site, enter the information requested below for the site's peak watering month. (Enter data in white cells only.)

STEP 2A - ENTER THE AVERAGE MONTHLY RAINFALL (R) AT THE SITE FOR THE PEAK WATERING MONTH IDENTIFIED IN PART 1

3.42 Average monthly rainfall (inches/month) for the site's peak watering month

Obtain from Water Budget Data Finder at <https://www.epa.gov/watersense/water-budget-data-finder>

STEP 2B - COMPLETE TABLE 1 BELOW (enter data in white cells only)

Enter the area of the hydrozone (square feet). The total area must equal the landscaped area entered in Step 1A.

Choose the plant type from the dropdown list (source data is displayed in Table 2).

Choose the irrigation type from the dropdown list (source data is displayed in Table 3; guidance is displayed in Table 4 and Table 5).

Table 1. Landscape Water Requirement

Zone	Hydrozone/Landscape Feature Area (sq. ft.)	Plant Type or Landscape Feature	Landscape Coefficient (K _L)	Irrigation Type	Distribution Uniformity (DU _{LQ})	LWR _H (gall/month)
1	15,500	Turfgrass - High water requirement	0.8	Fixed Spray	65%	61,017
2	500	Trees - High water requirement	0.9	Fixed Spray	65%	2,266
3						-
4						-
5						-
6						-
7						-
8						-
9						-
10						-
11						-
12						-
13						-
14						-
15						-
Total Area =		15,000	Landscape Water Requirement for the Site (gal/month)			63,283

Table 2. Plant Type or Landscape Feature and Associated Landscape Coefficient

Plant Type or Landscape Feature	K _L		
	Water Requirements		
	Low	Medium	High
Trees	0.2	0.5	0.9
Shrubs	0.2	0.5	0.7
Groundcover	0.2	0.5	0.7
Turfgrass	0.6	0.7	0.8
Pool, Spa, or Water Feature			0.8
Permeable Hardscape			0
Nonvegetated Softscape			0

Source: Based on LEED for Homes Rating System 2008.

Table 3. Distribution Uniformity

Irrigation Type	DU _{LQ} or EU*
Drip - Standard	70%
Drip - Press Comp	90%
Fixed Spray	65%
Microspray	70%
Rotor	70%
No Irrigation	NA

Lower quarter distribution uniformity (DU_{LQ}) applies to sprinkler zones, and emission uniformity (EU) applies to drip/microirrigation zones. Source: (The Irrigation Association, October 2001) in Landscape Irrigation Scheduling and Water Management, IA, 2005.

Table 4. Appropriate Irrigation Types - Landscaped Areas with Irrigation Systems

IF THE PLANT TYPE IS:	THEN THE IRRIGATION TYPE CAN BE:			
	Drip - Standard	Drip - Press Comp	Fixed Spray	Microspray*
Trees	x	x		x
Shrubs	x	x		x
Groundcover	x	x		x
Turfgrass	x	x	x	x

* Microspray may only be used on vegetation other than turfgrass if it meets the definition according to the ASABE/ICC 882-2014 Landscape Irrigation Sprinkler and Emitter Standard. "Microspray: A microirrigation emission device with one or more orifices to convert irrigation water pressure to water discharge with a flow rate not to exceed 30 gallons per hour (113.5 liters per hour) at the largest area of coverage available for the nozzle series when operated at 30 psi (208.9 kPa). Microsprays are inclusive of "microbubblers," "microspinners" and "microspray jets."

Table 5. Appropriate Irrigation Types - Landscaped Areas without Irrigation Systems

IF THE PLANT TYPE OR LANDSCAPE FEATURE IS:	THEN THE IRRIGATION TYPE SHALL BE:		
	Drip - Standard	Fixed Spray	No Irrigation
Trees, Shrubs, or Groundcover with Low Water Requirements (K _L = 0.2)	x		
Trees, Shrubs, or Groundcover with Medium or High Water Requirements (K _L > 0.2)		x	
Turfgrass with Low, Medium, or High Water Requirements (K _L > 0.2)		x	
Pool, Spa, or Water Feature		x	
Permeable Hardscape			x
Nonvegetated Softscape			x

*Please see additional information in the WaterSense Water Budget Approach for landscapes installed without irrigation systems.

OUTPUT - WATER REQUIREMENT FOR THE SITE

63,283 Monthly landscape water requirement (gallons/month) based on the site's peak watering month

Next Step: Click on the next tab labeled **Part 3 - Results** to view the results.

WaterSense New Home Specification: Water Budget Tool (V 1.03)

This water budget tool shall be used to determine if the designed landscape meets Criteria 4.1.1 of the specification.
Please refer to the WaterSense Water Budget Approach for additional information.

Your Name:
Builder Name:
Lot Number/Street Address:
City, State, Zip Code:

Peak Watering Month:

Is an irrigation system being installed on this site?



This worksheet determines if the designed landscape meets the water budget.

If the landscape water requirement is LESS than the landscape water allowance, then the water budget criterion is met.

If the landscape water requirement is GREATER than the landscape water allowance, then the landscape and/or irrigation system needs to be redesigned to use less water.

STEP 3A - REVIEW THE LWA AND LWR FROM PART 1 AND PART 2

LWA (gallons/month) LWR (gallons/month)

STEP 3B - REVIEW THE TOTAL AREA OF TURFGRASS* IN THE DESIGNED LANDSCAPE FROM STEP 2B

The designed landscape contains square feet of turfgrass.* This is of the landscaped area.

*This includes the area of any pools, spas, and/or water features, designated by WaterSense to be counted as turfgrass.

OUTPUT - DOES THE DESIGNED LANDSCAPE MEET THE WATER BUDGET?

If YES, then the water budget criterion is met.

If NO, then the landscape and/or irrigation system needs to be redesigned to use less water.

The designed landscape water requirement is a reduction in water use from the baseline calculated in Part 1.



State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bureau of Nonpoint Pollution Control

Division of Water Quality

401-02B

Post Office Box 420

Trenton, New Jersey 08625-0420

609-633-7021 Fax: 609-777-0432

http://www.state.nj.us/dep/dwq/bnpc_home.htm

PHILIP D. MURPHY
Governor

SHEILA Y. OLIVER
Lt. Governor

CATHERINE R. MCCABE
Commissioner

October 01, 2019

Derek M. Berg
Director – Stormwater Regulatory Management - East
Contech Engineered Solutions LLC
71 US Route 1, Suite F
Scarborough, ME 04074

Re: MTD Lab Certification
Cascade Separator™
On-line Installation

TSS Removal Rate 50%

Dear Mr. Berg:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7(c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). Contech Engineered Solutions, LLC (Contech) has requested an MTD Laboratory Certification for the Cascade Separator™ stormwater treatment system.

The project falls under the “Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology” dated January 25, 2013. The applicable protocol is the “New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device” dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification Appendix (dated September 2019) for this device is published online at <http://www.njcat.org/verification-process/technology-verification-database.html>.

The NJDEP certifies the use of the Cascade Separator™ stormwater treatment system at a TSS removal rate of 50% when designed, operated, and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.
2. The Cascade Separator™ shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in item 6 below.
3. This Cascade Separator™ cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.
4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual, which can be found online at www.njstormwater.org.
5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the Cascade Separator™. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at <https://www.conteches.com/Portals/0/Documents/Maintenance%20Guides/Cascade-Maintenance%20Guide.pdf?ver=2018-11-05-093254-300> for any changes to the maintenance requirements.
6. Sizing Requirement:

The example below demonstrates the sizing procedure for the Cascade Separator™:

Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a Cascade Separator™. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

Maximum Treatment Flow Rate (MTFR) Evaluation:

The site runoff (Q) was based on the following:

time of concentration = 10 minutes

i = 3.2 in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)

c = 0.99 (runoff coefficient for impervious)

$Q = ciA = 0.99 \times 3.2 \times 0.25 = 0.79 \text{ cfs}$

Given the site runoff is 0.79 cfs and based on Table A-1 below, the Cascade Separator™ Model CS-4 with an MTFR of 1.80 cfs would be the smallest model approved that could be used for this site to remove 50% of the TSS from the impervious area without exceeding the MTFR.

The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the Verification Appendix under Table A-1.

Table A-1 Cascade Separator™ Models and Associated MTFRs

Model	Manhole Diameter (ft)	MTFR (cfs)	50% Maximum Sediment Storage Area Volume (ft³)
CS-4	4	1.80	9.4
CS-5	5	2.81	14.7
CS-6	6	4.05	21.2
CS-8	8	7.20	37.7
CS-10	10	11.3	58.9
CS-12	12	16.2	84.8

A detailed maintenance plan is mandatory for any project with a stormwater BMP subject to the Stormwater Management rules under N.J.A.C. 7:8. The plan must include all of the items identified in the Maintenance requirements section of the Stormwater Management rules under N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Brian Salvo of my office at (609) 633-7021.

Sincerely,



Gabriel Mahon, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

cc: Chron File
Richard Magee, NJCAT
Jim Murphy, NJDEP-BNPC
Vince Mazzei, NJDEP - DLUR
Brian Salvo, NJDEP - BNPC

APPENDIX D-IV



Practical Solutions, Exceptional Service

FLOATATION CALCULATION WORKSHEET

WO. NO.
10128.01

DATE
7/15/2021

SHEET

1 OF 3

PROJECT TITLE

Orangetown Addition and Alterations

LOCATION

Town of Orangetown, NY

ESTIMATED BY

JM

APPROVED BY

COM

REF DRAWING(S)

1. Groundwater elevation:

- Observed Groundwater at approximate elevation 205.50 feet. See geotechnical report for full discussion on subsurface conditions.
- A factor of safety to account for seasonal high groundwater was included in the following calculations. As a result, 209.0' will be conservatively used as the groundwater elevation.

At proposed cistern:

Existing Ground Elevation	=	Building Footprint	(per plan)
Proposed Ground Elvation	=	218.80 feet	(per plan)
Groundwater Elevation	=	209.00 feet	(Per Geotech Report)

2. Cistern floatation:

Ground elevation	=	218.80 ft	
Ground water elevation	=	209.00 ft	
Base of Cistern	=	207.15 ft	
Submerged into ground water	=	1.85 ft	(Base Elev. - Gnd. Water Elev.)

FLOATATION CALCULATION WORKSHEET

WO. NO.
10128.01

DATE
7/15/2021

SHEET

2 OF 3

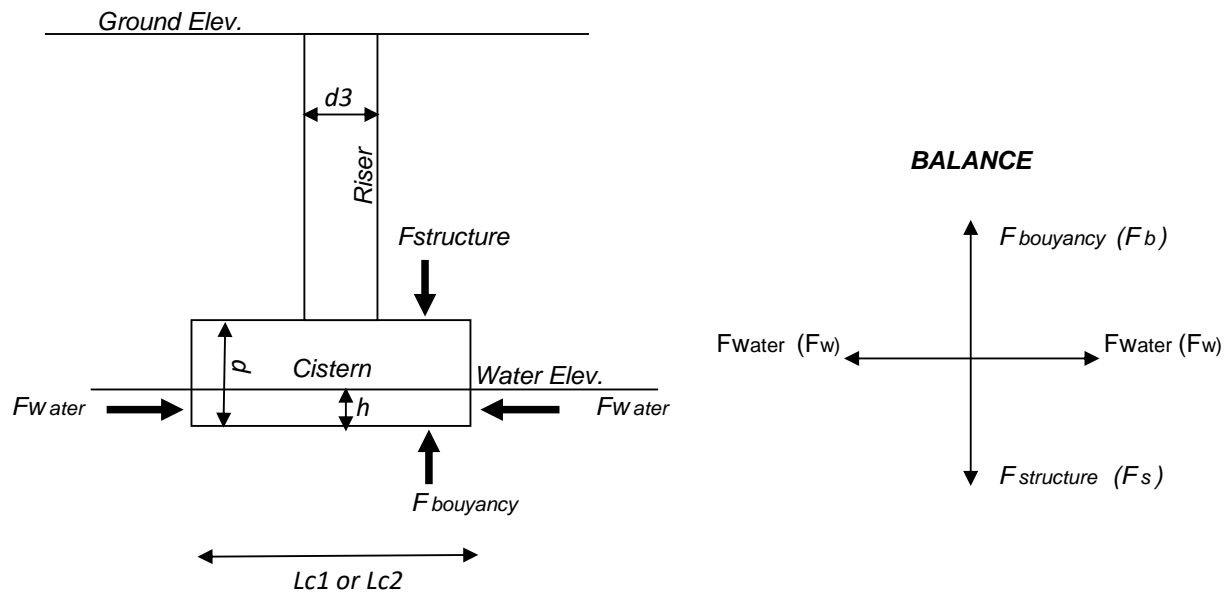
PROJECT TITLE
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Egn 1. $F_{Water} = F_{water}$ (equal forces due to symmetry)

Egn 2. $F_s - F_b \geq 0$ (for no floatation)

$F_b = \text{Pressure } (P) \times \text{Area } (A)$

$P = \text{Specific weight of water } (\gamma_w) \times \text{Gravity } (g) \times \text{Height } (h)$

$A = L \times W$ ("L" and "W" of each chamber)

Egn 3. $F_b = (\gamma_w) \times (g) \times (h) \times (L \times W)$

Egn 4. $F_s = \text{Mass of Cistern } (M_s) \times (g)$

FLOATATION CALCULATION WORKSHEET

WO. NO.
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SHEET

3 OF 3

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Substituting Eqn 3 and Eqn 4 into Eqn 2

Eqn 5. $(M_s \times g) - (\gamma_w \times g \times h \times L \times W) \geq 0$ (divide by g)

Eqn 6. $(M_s) - (\gamma_w \times h \times L \times W) \geq 0$

Large Chamber (2 total)

Small Chamber (1 total)

$\gamma_w = 62.4 \text{ lbs/ft}^3$ $\gamma_w = 62.4 \text{ lbs/ft}^3$ <===== (One Chamber)

$L = 48 \text{ feet}$ $L = 40 \text{ feet}$

$W = 6.00 \text{ feet}$ $W = 6.00 \text{ feet}$

$h = 1.85 \text{ feet}$ $h = 1.85 \text{ feet}$ (Gnd. Water Elev. - Base Elev.)

One Large Chamber = 33246.72 lbs
Solving for M_s :

One Small Chamber = 27705.6 lbs

$M_s \geq 94,199 \text{ lbs}$ to prevent floatation

M_s = Mass of Structure

Using Equation 6:

$(M_s) = (\gamma_c \times h \times L \times W)$

(1 Chamber/riser)====> $\gamma_c = 60 \text{ lbs/ft}^3$ (Specific Weight of Polyethylene)

$\gamma = 100 \text{ lbs/ft}^4$ (Specific Weight of Soil)

$d1 = 6 \text{ feet}$ (Outer Chamber Diameter)

$d2 = 5.5 \text{ feet}$ (Inner Chamber Diameter)

$d3 = 3 \text{ feet}$ (Outer Riser Diameter)

$d4 = 2.6 \text{ feet}$ (Inner Riser Diameter)

$Pi = 3.142$

$Lc1 = 48.00 \text{ feet}$ (Length of Large Chamber)

$Lc2 = 40.00 \text{ feet}$ (Length of Small Chamber)

$Lr = 5.65 \text{ feet}$ (Length of Riser)

$Msc = 36851 \text{ lbs}$ (Total Mass of 3 Chambers)

$Msr = 1789 \text{ lbs}$ (Mass of 3 Risers)

$Mg = 461040 \text{ lbs}$ (Mass of Ground Above All Chambers)

$M_s = 499,680 \text{ lbs}$ (Approximate Weight of Chamber and Ground Above)

Note: $M_s > M_b$, Therefore the cistern is stable within the high groundwater table and does not need additional anchoring.

APPENDIX D- V

Project Description

File Name	2021-07-20 West Hydraflow.SPF
Description	Orangetown Town Hall Additions and
	Alterations.

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Apr 07, 2020	00:00:00
End Analysis On	Apr 07, 2020	01:00:00
Start Reporting On	Apr 07, 2020	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins.....	5
Nodes.....	9
<i>Junctions</i>	1
<i>Outfalls</i>	2
<i>Flow Diversions</i>	0
<i>Inlets</i>	5
<i>Storage Nodes</i>	1
Links.....	8
<i>Channels</i>	0
<i>Pipes</i>	6
<i>Pumps</i>	0
<i>Orifices</i>	1
<i>Weirs</i>	1
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period.....	100 year(s)
--------------------	-------------

Subbasin Summary

SN	Subbasin ID	Area	Weighted Runoff Coefficient	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-1C	0.18	0.7900	0.93	0.74	0.13	1.59	0 00:05:00
2	Sub-2C	0.37	0.9900	0.93	0.92	0.34	4.10	0 00:05:00
3	Sub-3C-1	0.18	0.8400	0.93	0.78	0.14	1.65	0 00:05:00
4	Sub-4C-1	0.29	0.8700	0.93	0.81	0.24	2.83	0 00:05:00
5	Sub-4C-2	0.07	0.5100	0.93	0.48	0.03	0.42	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	HDS-2C	Junction	212.86	218.90	212.86	218.90	0.00	7.57	214.01	0.00	4.89	0 00:00	0.00	0.00
2	Cistern	Outfall	212.05					1.40	212.05					
3	Out-01	Outfall	212.66					6.17	212.66					
4	Diversion-1C	Storage Node	212.70	218.80	212.70		0.00	7.57	215.03				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Reported	Surcharged Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	STMLink-2	Pipe	HDS-2C	Diversion-1C	16.00	212.86	212.70	1.0000	18.000	0.0120	7.57	11.38	0.67	6.97	0.89	0.60	0.00	Calculated
2	STMLink-3	Pipe	FI-3C	HDS-2C	54.00	213.40	212.86	1.0000	15.000	0.0120	7.57	7.00	1.08	6.70	1.20	0.96	0.00	> CAPACITY
3	STMLink-4	Pipe	CB-4C	FI-3C	37.00	213.94	213.40	1.4600	15.000	0.0120	7.63	8.45	0.90	7.82	0.93	0.74	0.00	Calculated
4	STMLink-5	Pipe	CB-5C	CB-4C	27.00	214.29	213.94	1.3000	15.000	0.0120	4.85	7.97	0.61	6.81	0.70	0.56	0.00	Calculated
5	STMLink-6	Pipe	CB-6C	CB-5C	67.00	215.63	214.29	2.0000	15.000	0.0120	3.23	9.90	0.33	7.23	0.49	0.39	0.00	Calculated
6	STMLink-7	Pipe	Roofline	CB-6C	33.00	216.73	216.21	1.5800	8.000	0.0120	1.78	1.64	1.08	6.29	0.67	1.00	6.00	SURCHARGED
7	Orifice-01	Orifice	Diversion-1C	Cistern		212.70	212.05		6.000		1.40							
8	Diversion-Weir	Weir	Diversion-1C	Out-01		212.70	212.66				6.17							

Inlet Summary

SN Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation	Max (Rim) Elevation	Initial Water Elevation	Ponded Area	Peak Flow	Peak Flow Intercepted by Inlet	Peak Flow Bypassing Inlet	Inlet Efficiency during Peak Flow	Allowable Spread	Max Gutter Spread during Peak	Max Gutter Water Elev. during Peak
					(ft)	(ft)	(ft)	(ft²)	(cfs)	(cfs)	(cfs)	(%)	(ft)	(ft)	(ft)
1 CB-4C	FHWA HEC-22 GENERIC	N/A	On Sag	1	213.94	218.72	213.94	10.00	2.83	N/A	N/A	N/A	7.00	15.51	219.03
2 CB-5C	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.29	218.36	214.29	10.00	1.65	N/A	N/A	N/A	7.00	11.04	218.58
3 CB-6C	FHWA HEC-22 GENERIC	N/A	On Sag	1	215.63	218.63	215.63	10.00	1.59	N/A	N/A	N/A	7.00	10.81	218.85
4 FI-3C	FHWA HEC-22 GENERIC	N/A	On Sag	1	213.40	218.90	213.40	10.00	0.42	N/A	N/A	N/A	7.00	3.45	218.97
5 Roofline	FHWA HEC-22 GENERIC	N/A	On Sag	1	216.73	219.06	216.43	10.00	4.10	N/A	N/A	N/A	7.00	19.64	219.45

Subbasin Hydrology

Subbasin : Sub-1C

Input Data

Area (ac) 0.18
Weighted Runoff Coefficient 0.7900

Runoff Coefficient

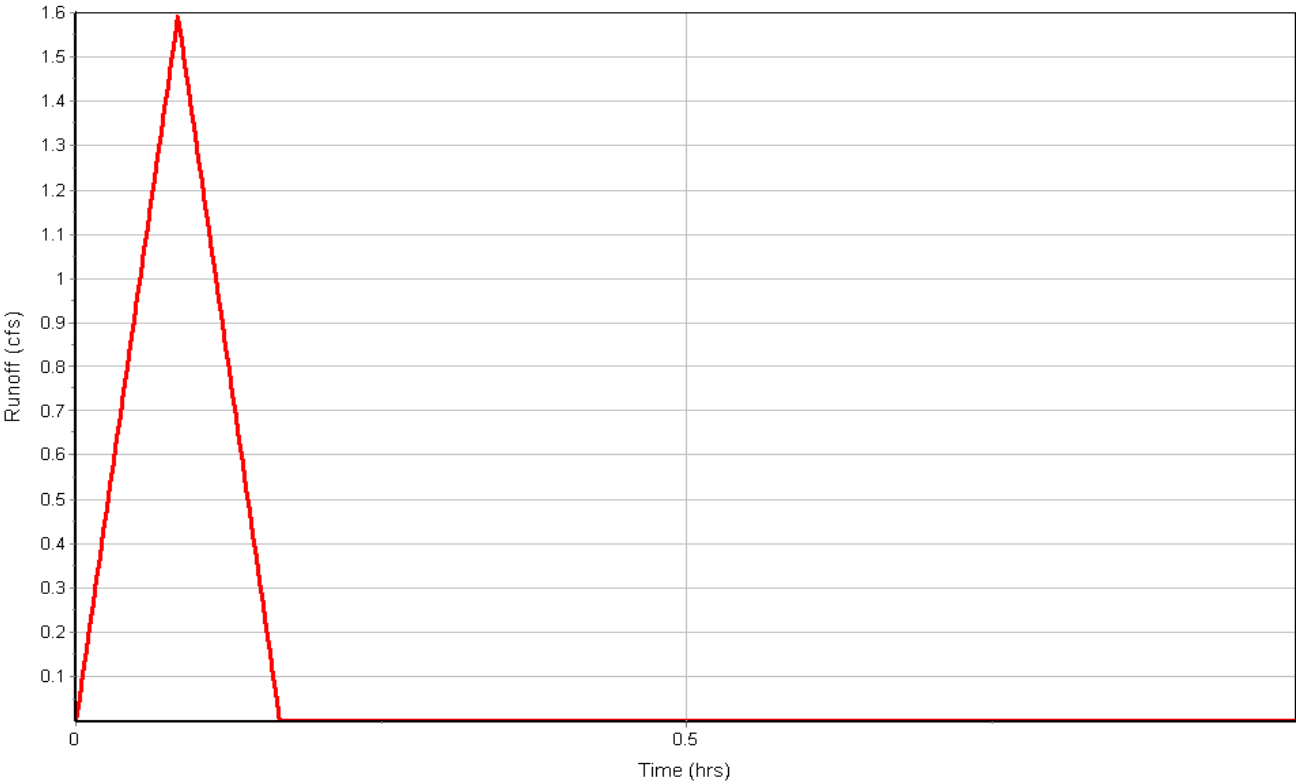
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.11	-	0.99
-	0.08	-	0.51
Composite Area & Weighted Runoff Coeff.	0.19		0.79

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.74
Peak Runoff (cfs) 1.59
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.7900
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-1C

Runoff Hydrograph



Subbasin : Sub-2C

Input Data

Area (ac) 0.37
Weighted Runoff Coefficient 0.9900

Runoff Coefficient

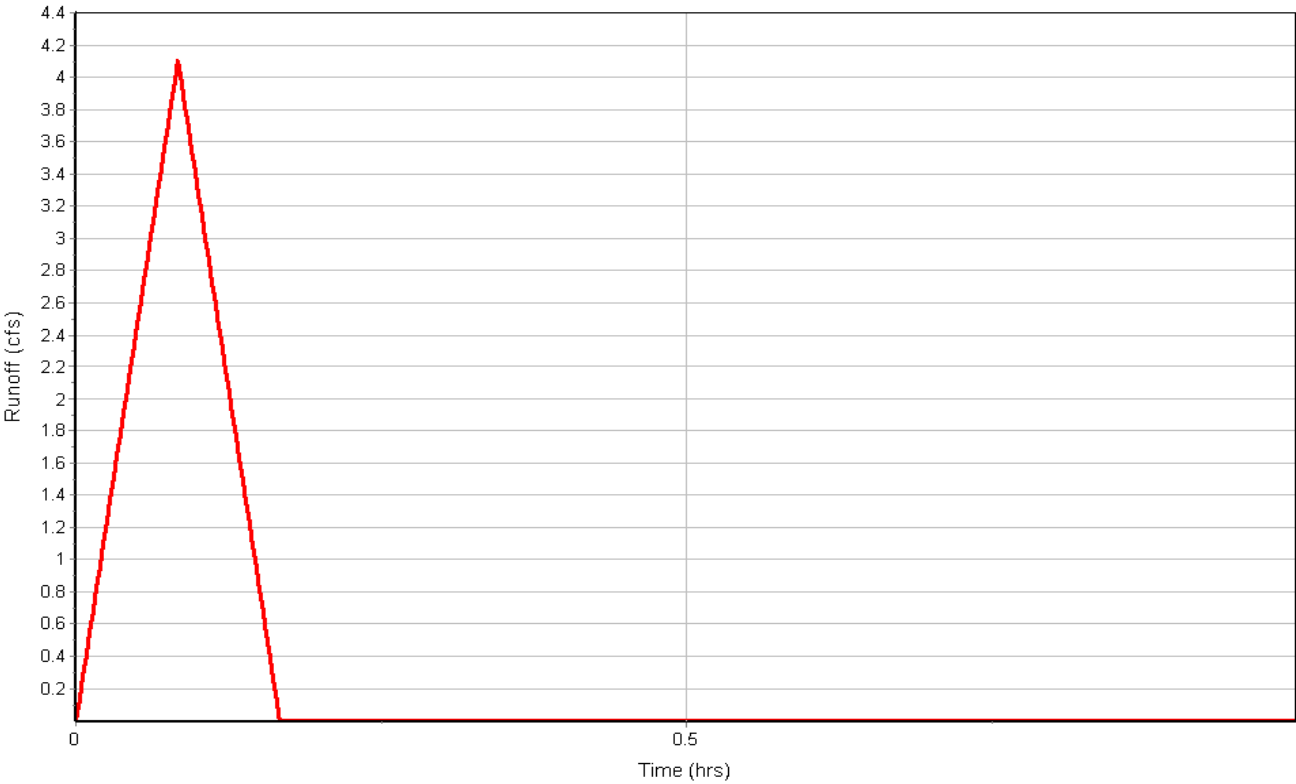
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.37	-	0.99
Composite Area & Weighted Runoff Coeff.	0.37		0.99

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.92
Peak Runoff (cfs) 4.10
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.9900
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-2C

Runoff Hydrograph



Subbasin : Sub-3C-1

Input Data

Area (ac) 0.18
Weighted Runoff Coefficient 0.8400

Runoff Coefficient

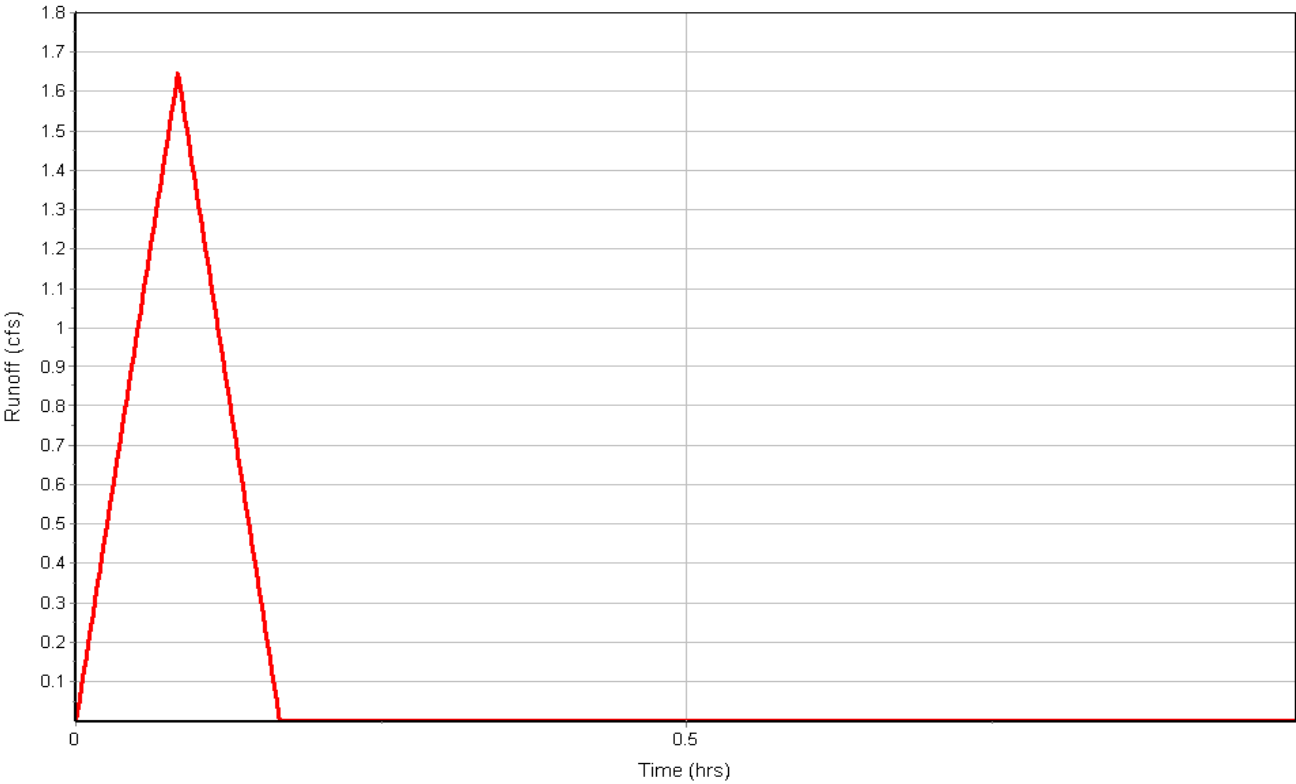
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.12	-	0.99
-	0.06	-	0.51
Composite Area & Weighted Runoff Coeff.	0.18		0.84

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.78
Peak Runoff (cfs) 1.65
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.8400
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-3C-1

Runoff Hydrograph



Subbasin : Sub-4C-1

Input Data

Area (ac) 0.29
Weighted Runoff Coefficient 0.8700

Runoff Coefficient

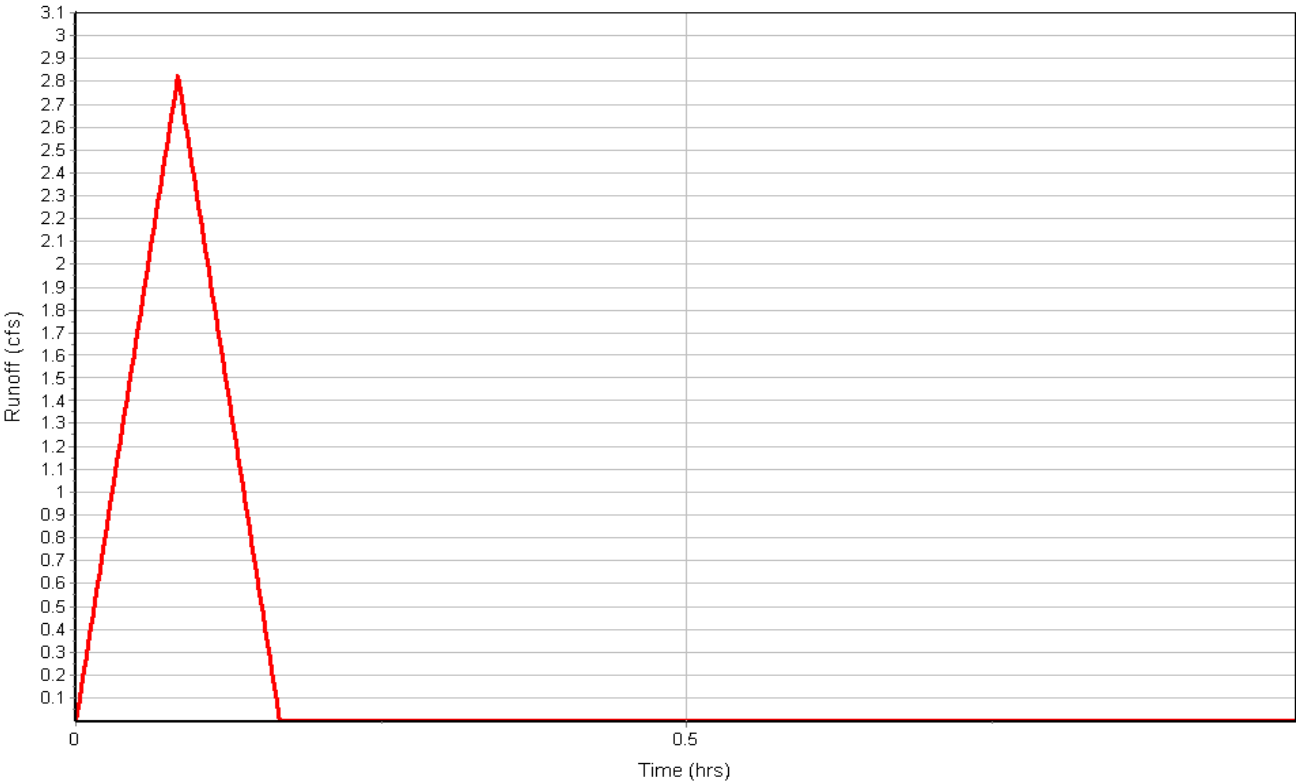
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.08	-	0.51
-	0.22	-	0.99
Composite Area & Weighted Runoff Coeff.	0.30		0.87

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.81
Peak Runoff (cfs) 2.83
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.8700
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-4C-1

Runoff Hydrograph



Subbasin : Sub-4C-2

Input Data

Area (ac) 0.07
Weighted Runoff Coefficient 0.5100

Runoff Coefficient

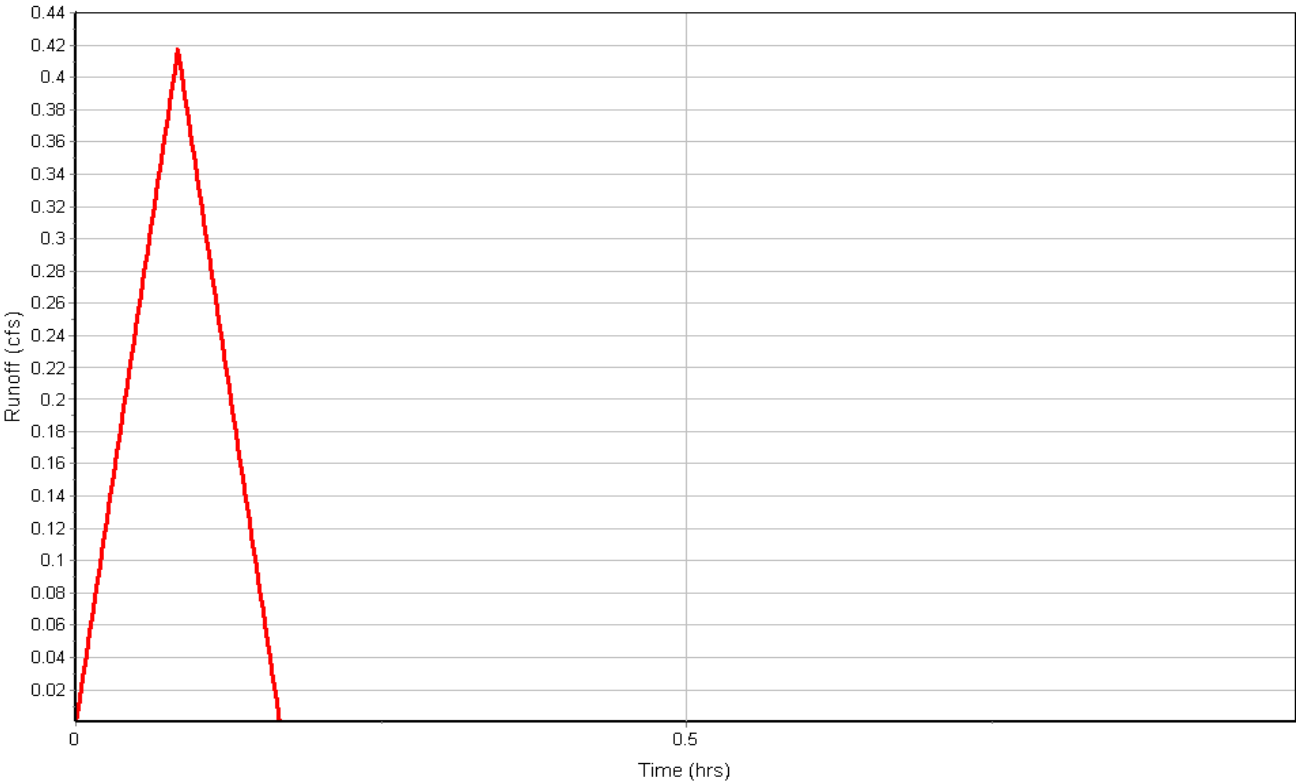
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.05	-	0.51
Composite Area & Weighted Runoff Coeff.	0.05		0.51

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.48
Peak Runoff (cfs) 0.42
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.5100
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-4C-2

Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	HDS-2C	212.86	218.90	6.04	212.86	0.00	218.90	0.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
		(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1	HDS-2C	7.57	0.00	214.01	1.15	0.00	4.89	212.99	0.13	0 00:05	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate	No. of Barrels
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(in)	(in)					(cfs)		
1	STMLink-2	16.00	212.86	0.00	212.70	0.00	0.16	1.0000	CIRCULAR	18.000	18.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
2	STMLink-3	54.00	213.40	0.00	212.86	0.00	0.54	1.0000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
3	STMLink-4	37.00	213.94	0.00	213.40	0.00	0.54	1.4600	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	STMLink-5	27.00	214.29	0.00	213.94	0.00	0.35	1.3000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
5	STMLink-6	67.00	215.63	0.00	214.29	0.00	1.34	2.0000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
6	STMLink-7	33.00	216.73	0.00	216.21	0.58	0.52	1.5800	CIRCULAR	8.040	8.040	0.0120	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	STMLink-2	7.57	0 00:05	11.38	0.67	6.97	0.04	0.89	0.60	0.00		Calculated
2	STMLink-3	7.57	0 00:05	7.00	1.08	6.70	0.13	1.20	0.96	0.00		> CAPACITY
3	STMLink-4	7.63	0 00:05	8.45	0.90	7.82	0.08	0.93	0.74	0.00		Calculated
4	STMLink-5	4.85	0 00:05	7.97	0.61	6.81	0.07	0.70	0.56	0.00		Calculated
5	STMLink-6	3.23	0 00:05	9.90	0.33	7.23	0.15	0.49	0.39	0.00		Calculated
6	STMLink-7	1.78	0 00:02	1.64	1.08	6.29	0.09	0.67	1.00	6.00		SURCHARGED

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft²)	Grate Clogging Factor (%)
1	CB-4C	FHWA HEC-22 GENERIC	N/A	On Sag	1	213.94	218.72	4.78	213.94	0.00	10.00	0.00
2	CB-5C	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.29	218.36	4.07	214.29	0.00	10.00	0.00
3	CB-6C	FHWA HEC-22 GENERIC	N/A	On Sag	1	215.63	218.63	3.00	215.63	0.00	10.00	0.00
4	FI-3C	FHWA HEC-22 GENERIC	N/A	On Sag	1	213.40	218.90	5.50	213.40	0.00	10.00	0.00
5	Roofline	FHWA HEC-22 GENERIC	N/A	On Sag	1	216.73	219.06	2.33	216.43	-0.30	10.00	0.00

Roadway & Gutter Input

SN	Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1	CB-4C	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
2	CB-5C	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
3	CB-6C	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
4	FI-3C	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
5	Roofline	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00

Inlet Results

SN	Element ID	Peak Flow	Peak Lateral Inflow	Peak Flow Intercepted by Inlet	Peak Flow Bypassing Inlet	Inlet Efficiency during Peak Flow	Max Gutter Spread during Peak Flow	Max Gutter Water Elev. during Peak Flow	Max Gutter Water Depth during Peak Flow	Time of Max Depth Occurrence	Total Flooded Volume	Total Time Flooded
		(cfs)	(cfs)	(cfs)	(cfs)	(%)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	CB-4C	2.83	2.83	N/A	N/A	N/A	15.51	219.03	0.31	0 00:05	0.00	0.00
2	CB-5C	1.65	1.65	N/A	N/A	N/A	11.04	218.58	0.22	0 00:05	0.00	0.00
3	CB-6C	1.59	1.59	N/A	N/A	N/A	10.81	218.85	0.22	0 00:02	0.00	0.00
4	FI-3C	0.42	0.42	N/A	N/A	N/A	3.45	218.97	0.07	0 00:04	0.00	0.00
5	Roofline	4.10	4.10	N/A	N/A	N/A	19.64	219.45	0.39	0 00:02	0.00	0.00

Storage Nodes

Storage Node : Diversion-1C

Input Data

Invert Elevation (ft)	212.70
Max (Rim) Elevation (ft)	218.80
Max (Rim) Offset (ft)	6.10
Initial Water Elevation (ft)	212.70
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 Diversion-Weir	Rectangular	No	214.20	1.50	3.00	4.60	2.70

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Orifice-01	Side	CIRCULAR	No	6.00			212.70	0.61

Output Summary Results

Peak Inflow (cfs)	7.57
Peak Lateral Inflow (cfs)	0.00
Peak Outflow (cfs)	7.57
Peak Exfiltration Flow Rate (cfm)	0.00
Max HGL Elevation Attained (ft)	215.03
Max HGL Depth Attained (ft)	2.33
Average HGL Elevation Attained (ft)	213.02
Average HGL Depth Attained (ft)	0.32
Time of Max HGL Occurrence (days hh:mm)	0 00:05
Total Exfiltration Volume (1000-ft³)	0.000
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	2021-07-20 East Hydraflow.SPF
Description	Orangetown Town Hall Additions and
	Alterations

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Rational
Time of Concentration (TOC) Method	User-Defined
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Apr 07, 2020	00:00:00
End Analysis On	Apr 07, 2020	01:00:00
Start Reporting On	Apr 07, 2020	00:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins.....	9
Nodes.....	13
<i>Junctions</i>	3
<i>Outfalls</i>	1
<i>Flow Diversions</i>	0
<i>Inlets</i>	9
<i>Storage Nodes</i>	0
Links.....	12
<i>Channels</i>	0
<i>Pipes</i>	12
<i>Pumps</i>	0
<i>Orifices</i>	0
<i>Weirs</i>	0
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period.....	100 year(s)
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Subbasin Summary

SN	Subbasin ID	Area	Weighted Runoff Coefficient	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Sub-01	0.13	0.8700	0.93	0.81	0.11	1.30	0 00:05:00
2	Sub-02	0.17	0.9000	0.93	0.84	0.15	1.74	0 00:05:00
3	Sub-03	0.39	7.4000	0.93	6.91	2.69	32.32	0 00:05:00
4	Sub-1B	0.89	0.9600	0.93	0.90	0.80	9.57	0 00:05:00
5	Sub-7A-2	0.00	0.0000	0.93	0.00	0.00	0.00	0 00:05:00
6	Sub-7A-3	0.00	0.0000	0.93	0.00	0.00	0.00	0 00:05:00
7	Sub-7B	0.20	0.7500	0.93	0.70	0.14	1.68	0 00:05:00
8	Sub-8A	0.00	0.0000	0.93	0.00	0.00	0.00	0 00:05:00
9	Sub-DP	0.21	0.5700	0.93	0.53	0.11	1.34	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	CS-MH-3A	Junction	205.46	211.54	205.46	211.54	0.00	7.57	206.71	0.00	4.83	0 00:00	0.00	0.00
2	DMH-2A	Junction	204.49	211.65	204.49	211.65	0.00	14.34	209.39	0.00	2.26	0 00:00	0.00	0.00
3	OCS-3B	Junction	212.61	218.25	212.61	218.25	10.00	5.05	213.40	0.00	4.85	0 00:00	0.00	0.00
4	CB-1A	Outfall	203.43					15.44	204.55					

Link Summary

SN Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Reported Surcharged Condition
				(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)
1 Link-02	Pipe	FI-2B	CB-1B	183.00	212.57	209.21	1.8400	15.000	0.0120	5.03	9.48	0.53	7.98	0.65	0.52	0.00 Calculated
2 Link-03	Pipe	CB-1B	DMH-2A	19.00	209.21	208.78	2.2600	15.000	0.0120	5.03	10.53	0.48	8.48	0.61	0.49	0.00 Calculated
3 Link-04	Pipe	CB-4A	CS-MH-3A	57.00	206.03	205.46	1.0000	15.000	0.0120	7.57	7.00	1.08	6.94	1.25	1.00	7.00 SURCHARGED
4 Link-05	Pipe	CS-MH-3A	DMH-2A	5.00	205.46	205.36	2.0000	15.000	0.0120	7.59	9.90	0.77	8.90	0.82	0.66	0.00 Calculated
5 STMLink-13	Pipe	1B	DMH-2A	162.00	206.17	204.99	0.7300	18.000	0.0230	5.48	5.07	1.08	6.47	1.50	1.00	4.00 SURCHARGED
6 STMLink-14	Pipe	Existing-Inlet-3	FI-2B	34.00	214.05	212.69	4.0000	12.000	0.0230	1.63	4.03	0.40	4.87	0.44	0.44	0.00 Calculated
7 STMLink-15	Pipe	Existing-Inlet-2	Existing-Inlet-3	58.00	214.41	213.95	0.7900	15.000	0.0230	1.63	2.88	0.57	2.46	0.67	0.54	0.00 Calculated
8 STMLink-16	Pipe	Existing-Inlet-1	Existing-Inlet-2	20.00	214.81	214.41	2.0000	15.000	0.0230	1.67	5.16	0.32	3.76	0.49	0.39	0.00 Calculated
9 STMLink-17	Pipe	OCS-3B	FI-2B	4.00	212.61	212.57	1.0000	15.000	0.0120	5.05	7.00	0.72	12.29	0.79	0.63	0.00 Calculated
10 STMLink-2	Pipe	DMH-2A	CB-1A	113.00	204.49	203.43	0.9400	24.000	0.0120	14.33	23.74	0.60	7.93	1.12	0.56	0.00 Calculated
11 STMLink-7	Pipe	CB-5A	CB-4A	105.00	210.00	208.95	1.0000	15.000	0.0120	1.27	7.00	0.18	6.21	0.36	0.29	0.00 Calculated
12 STMLink-8	Pipe	CB-4A-1	CB-4A	107.00	207.10	206.03	1.0000	15.000	0.0120	7.56	7.00	1.08	11.13	1.25	1.00	7.00 SURCHARGED

Inlet Summary

SN Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation	Max (Rim) Elevation	Initial Water Elevation	Ponded Area	Peak Flow	Peak Flow Intercepted	Peak Flow Bypassing	Inlet Efficiency during Peak Flow	Allowable Spread	Max Gutter Spread during Peak Flow	Max Gutter Water Elev. during Peak Flow
					(ft)	(ft)	(ft)	(ft²)	(cfs)	(cfs)	(cfs)	(%)	(ft)	(ft)	(ft)
1 1B	FHWA HEC-22 GENERIC	N/A	On Sag	1	206.17	210.07	206.17	10.00	9.57	N/A	N/A	N/A	7.00	64.80	211.11
2 CB-1B	FHWA HEC-22 GENERIC	N/A	On Sag	1	209.21	211.71	209.21	10.00	0.00	N/A	N/A	N/A	7.00	0.00	211.71
3 CB-4A	FHWA HEC-22 GENERIC	N/A	On Sag	1	206.03	211.19	206.03	10.00	1.74	N/A	N/A	N/A	7.00	10.43	211.40
4 CB-4A-1	FHWA HEC-22 GENERIC	N/A	On Sag	1	207.10	210.10	207.10	10.00	32.32	N/A	N/A	N/A	7.00	410.84	218.05
5 CB-5A	FHWA HEC-22 GENERIC	N/A	On Sag	1	210.00	213.00	210.00	10.00	1.30	N/A	N/A	N/A	7.00	8.70	213.17
6 Existing-Inlet-1	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.81	218.82	214.81	10.00	1.68	N/A	N/A	N/A	7.00	11.18	219.04
7 Existing-Inlet-2	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.41	218.40	214.41	10.00	0.00	N/A	N/A	N/A	7.00	0.00	218.40
8 Existing-Inlet-3	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.05	217.70	214.05	10.00	0.00	N/A	N/A	N/A	7.00	0.00	217.70
9 FI-2B	FHWA HEC-22 GENERIC	N/A	On Sag	1	212.57	218.30	212.57	10.00	0.00	N/A	N/A	N/A	7.00	0.00	218.30

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 0.13
Weighted Runoff Coefficient 0.8700

Runoff Coefficient

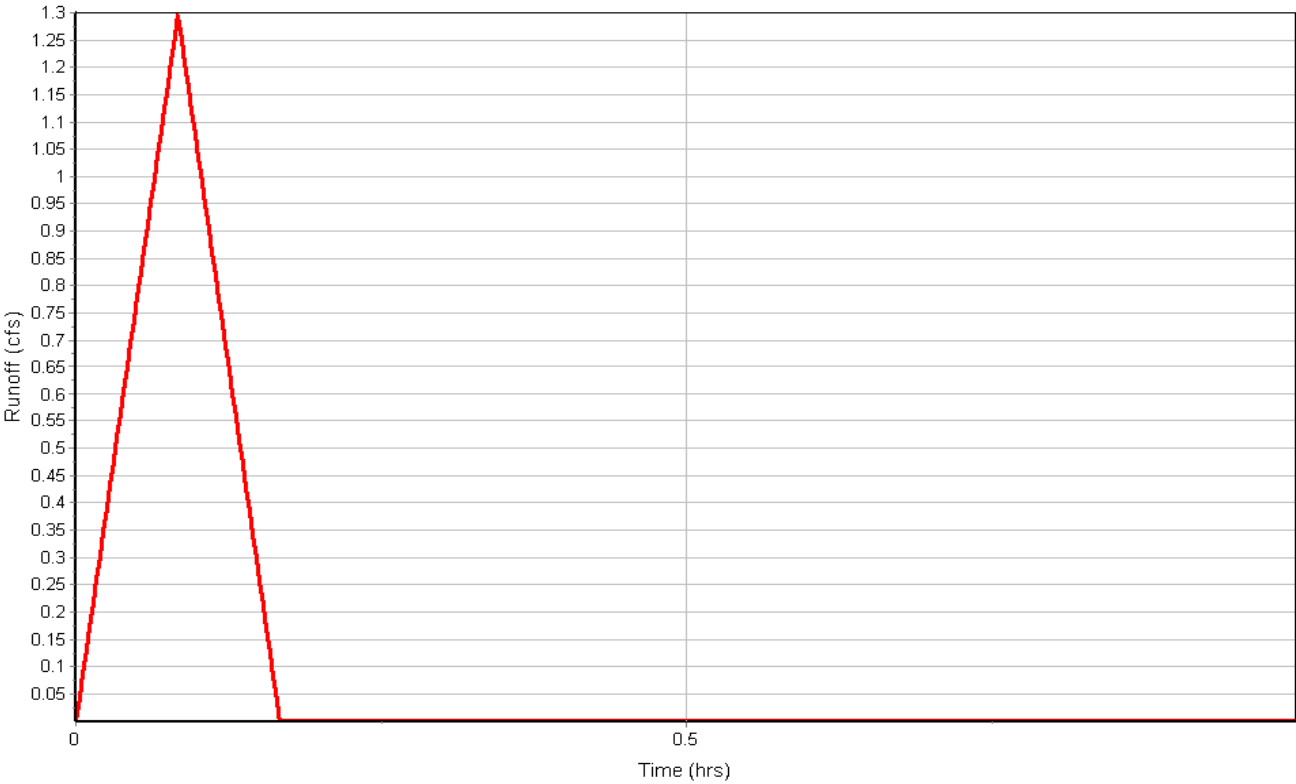
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.10	-	0.99
-	0.03	-	0.51
Composite Area & Weighted Runoff Coeff.	0.13		0.87

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.81
Peak Runoff (cfs) 1.30
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.8700
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-01

Runoff Hydrograph



Subbasin : Sub-02

Input Data

Area (ac) 0.17
Weighted Runoff Coefficient 0.9000

Runoff Coefficient

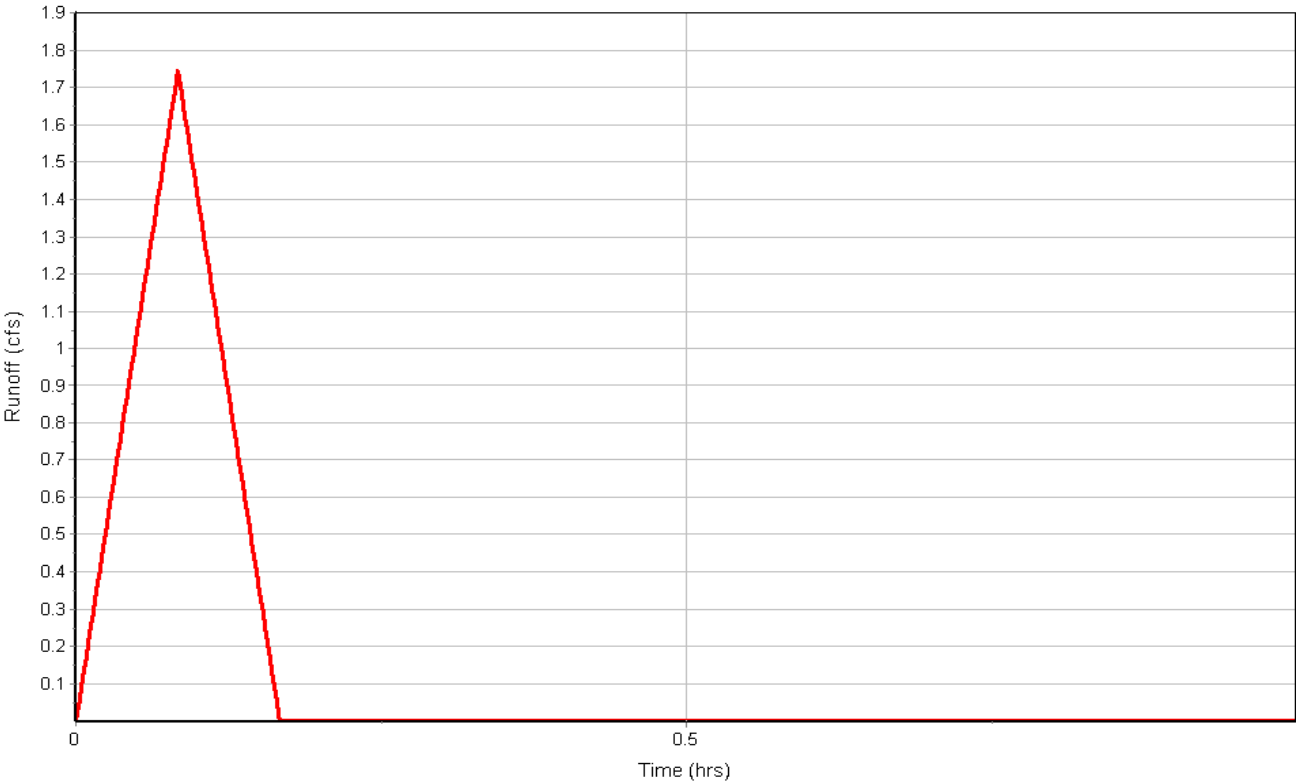
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.03	-	0.51
-	0.14	-	0.99
Composite Area & Weighted Runoff Coeff.	0.17		0.90

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.84
Peak Runoff (cfs) 1.74
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.9000
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-02

Runoff Hydrograph



Subbasin : Sub-03

Input Data

Area (ac) 0.39
Weighted Runoff Coefficient 7.4000

Runoff Coefficient

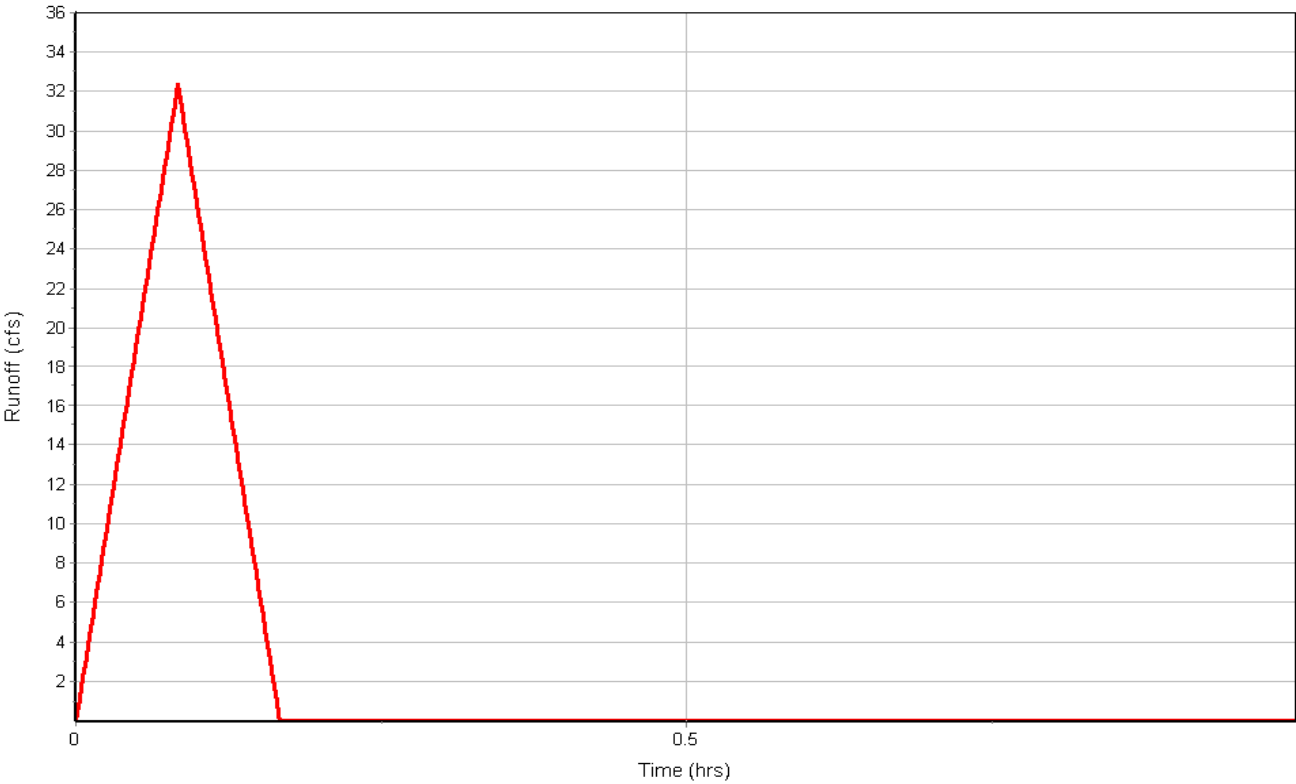
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.34	-	0.99
-	0.05	-	51.00
Composite Area & Weighted Runoff Coeff.	0.39		7.40

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 6.91
Peak Runoff (cfs) 32.32
Rainfall Intensity 11.200
Weighted Runoff Coefficient 7.4000
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-03

Runoff Hydrograph



Subbasin : Sub-1B

Input Data

Area (ac) 0.89
Weighted Runoff Coefficient 0.9600

Runoff Coefficient

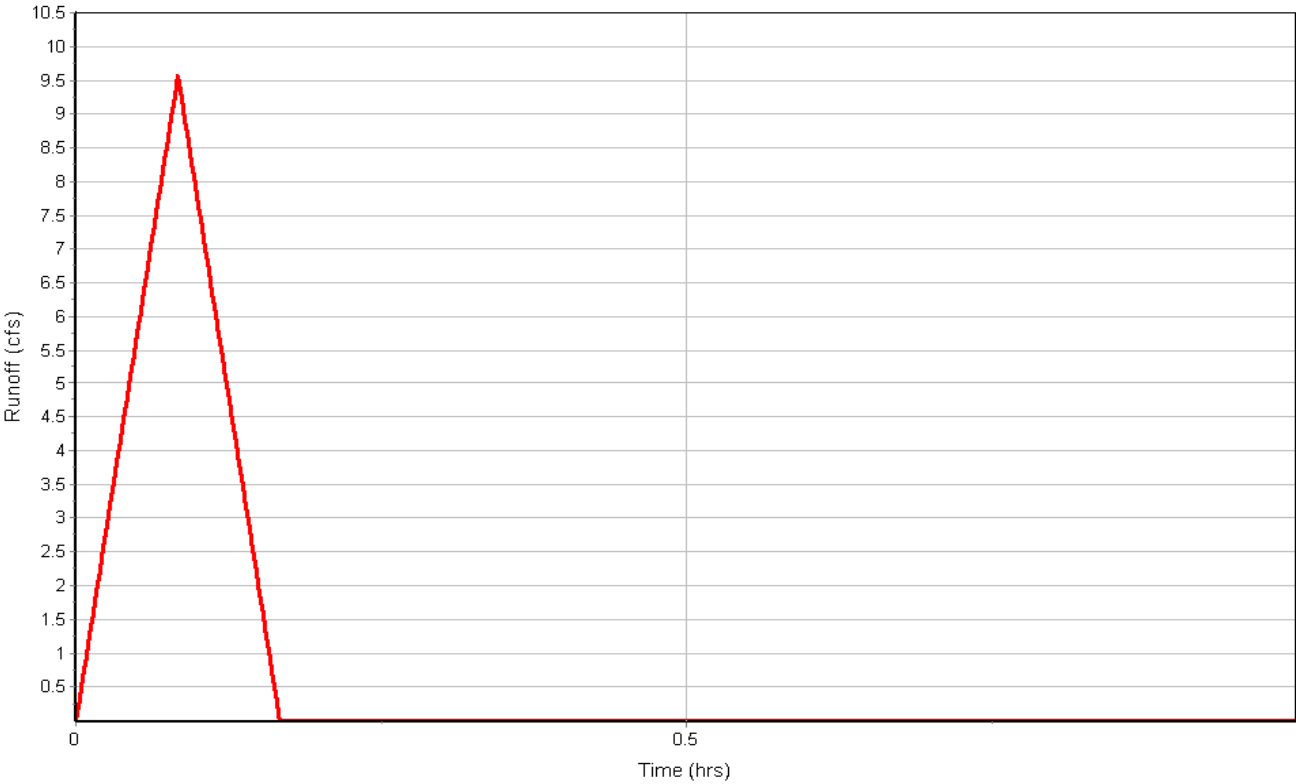
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	-	0.51
-	0.83	-	0.99
Composite Area & Weighted Runoff Coeff.	0.89		0.96

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.90
Peak Runoff (cfs) 9.57
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.9600
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-1B

Runoff Hydrograph



Subbasin : Sub-7A-2

Input Data

Area (ac) 0.00
Weighted Runoff Coefficient 0.0000

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.00	-	0.51
Composite Area & Weighted Runoff Coeff.	0.00		0

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.00
Peak Runoff (cfs) 0.00
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.0000
Time of Concentration (days hh:mm:ss) 0 00:05:00

Runoff Hydrograph



Subbasin : Sub-7A-3

Input Data

Area (ac) 0.00
Weighted Runoff Coefficient 0.0000

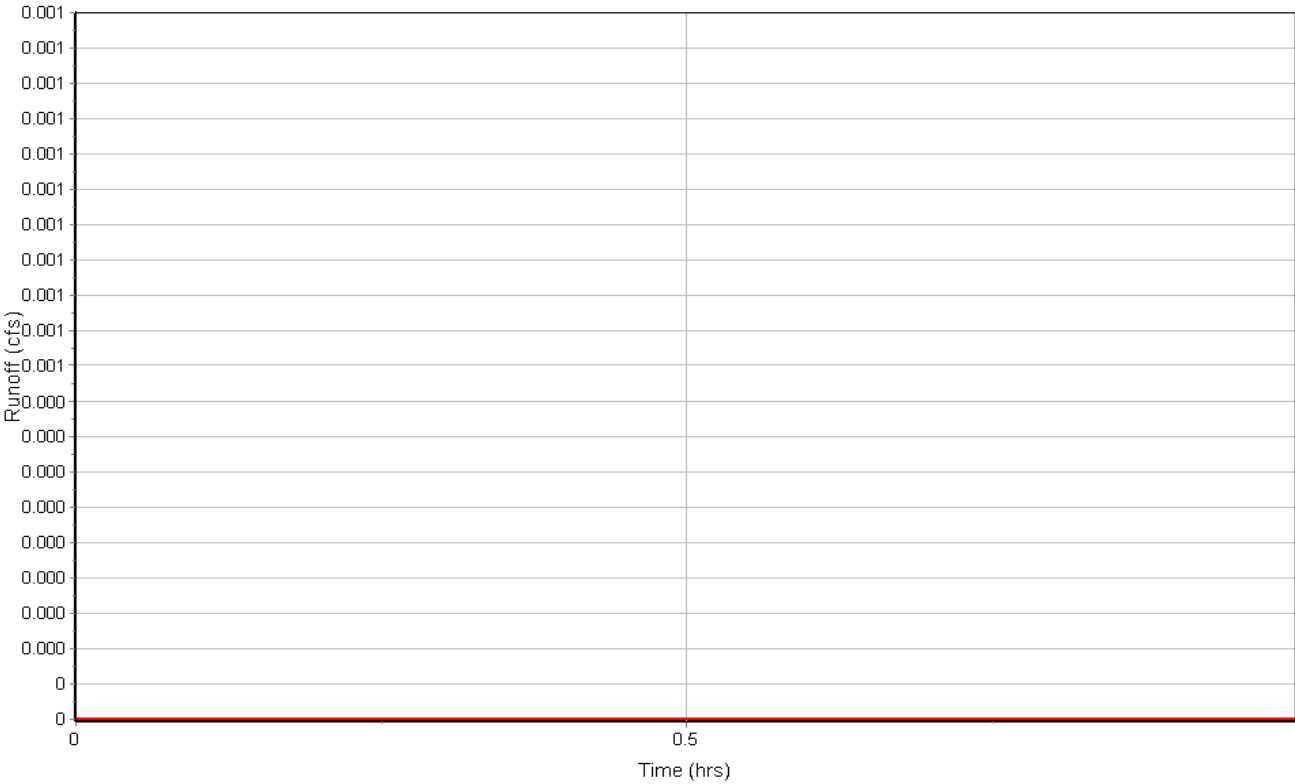
Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.00	-	0.51
Composite Area & Weighted Runoff Coeff.	0.00		0

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.00
Peak Runoff (cfs) 0.00
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.0000
Time of Concentration (days hh:mm:ss) 0 00:05:00

Runoff Hydrograph



Subbasin : Sub-7B

Input Data

Area (ac) 0.20
Weighted Runoff Coefficient 0.7500

Runoff Coefficient

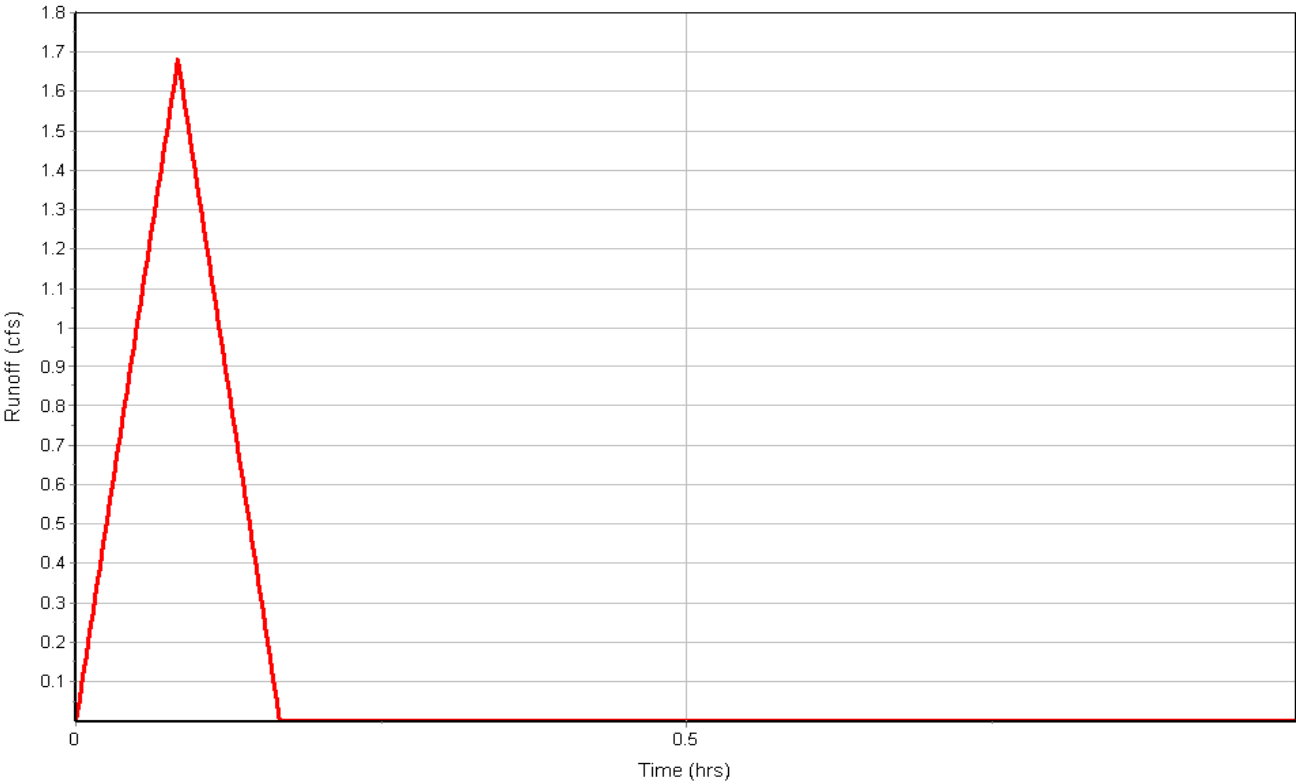
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.10	-	0.99
-	0.10	-	0.51
Composite Area & Weighted Runoff Coeff.	0.20		0.75

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.70
Peak Runoff (cfs) 1.68
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.7500
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-7B

Runoff Hydrograph



Subbasin : Sub-8A

Input Data

Area (ac) 0.00
Weighted Runoff Coefficient 0.0000

Runoff Coefficient

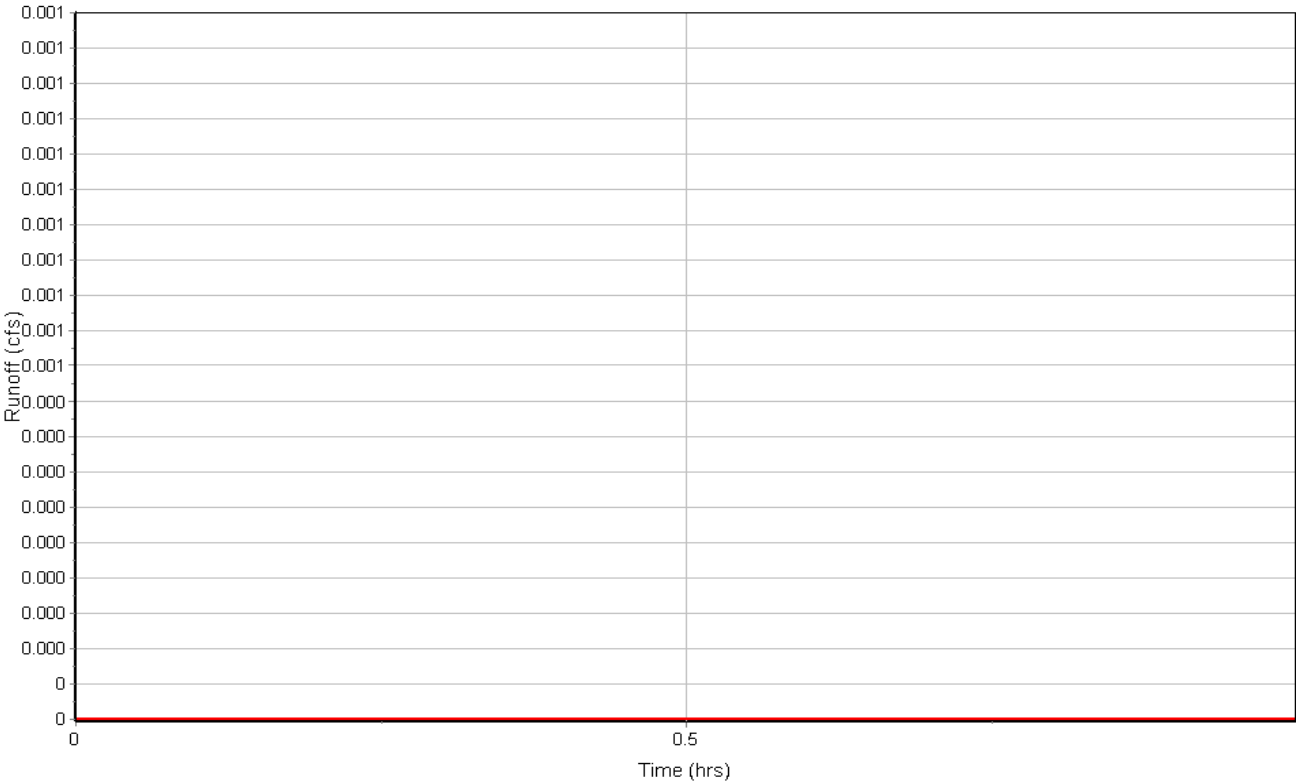
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.00	-	0.55
Composite Area & Weighted Runoff Coeff.	0.00		0

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.00
Peak Runoff (cfs) 0.00
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.0000
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-8A

Runoff Hydrograph



Subbasin : Sub-DP

Input Data

Area (ac) 0.21
Weighted Runoff Coefficient 0.5700

Runoff Coefficient

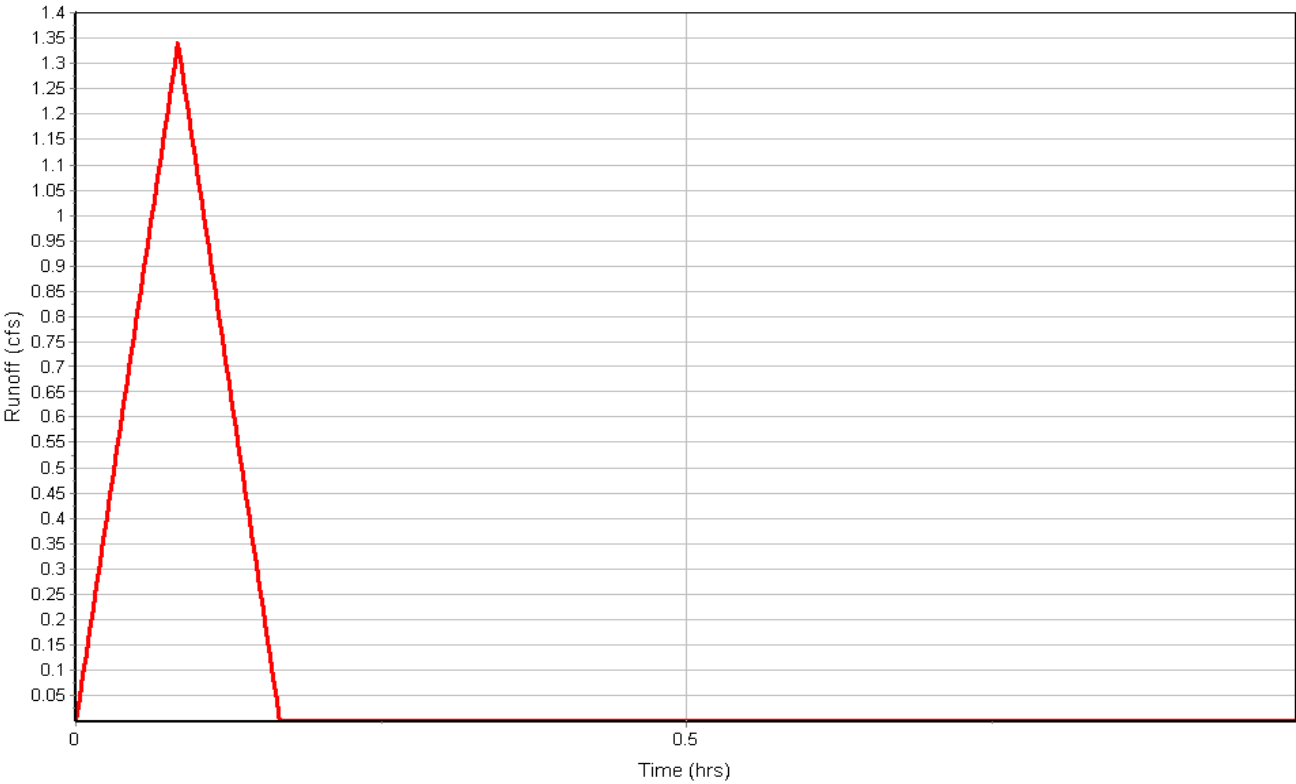
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.21	-	0.57
Composite Area & Weighted Runoff Coeff.	0.21		0.57

Subbasin Runoff Results

Total Rainfall (in) 0.93
Total Runoff (in) 0.53
Peak Runoff (cfs) 1.34
Rainfall Intensity 11.200
Weighted Runoff Coefficient 0.5700
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-DP

Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation	Ground/Rim (Max) Elevation	Ground/Rim (Max) Offset	Initial Water Elevation	Initial Water Depth	Surcharge Elevation	Surcharge Depth	Ponded Area	Minimum Pipe Cover
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft²)	(in)
1	CS-MH-3A	205.46	211.54	6.08	205.46	0.00	211.54	0.00	0.00	57.96
2	DMH-2A	204.49	211.65	7.16	204.49	0.00	211.65	0.00	0.00	19.44
3	OCS-3B	212.61	218.25	5.64	212.61	0.00	218.25	0.00	10.00	52.68

Junction Results

SN	Element ID	Peak Inflow	Peak Lateral Inflow	Max HGL Elevation Attained	Max HGL Depth Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Average HGL Elevation Attained	Average HGL Depth Attained	Time of Max HGL Occurrence	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
		(cfs)	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(days hh:mm)	(days hh:mm)	(ac-in)	(min)
1	CS-MH-3A	7.57	0.00	206.71	1.25	0.00	4.83	205.65	0.19	0 00:02	0 00:00	0.00	0.00
2	DMH-2A	14.34	0.00	209.39	4.90	0.00	2.26	209.19	4.70	0 00:40	0 00:00	0.00	0.00
3	OCS-3B	5.05	5.05	213.40	0.79	0.00	4.85	213.11	0.50	0 00:40	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length	Inlet Invert Elevation	Inlet Invert Offset	Outlet Invert Elevation	Outlet Invert Offset	Total Drop	Average Pipe Slope	Pipe Shape	Pipe Diameter or Height	Pipe Width	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate	No. of Barrels
		(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(%)		(in)	(in)					(cfs)		
1	Link-02	183.00	212.57	0.00	209.21	0.00	3.36	1.8400	CIRCULAR	15.000	15.000	0.0120	0.5000	0.6000	0.0000	0.00	No	1
2	Link-03	19.00	209.21	0.00	208.78	4.29	0.43	2.2600	CIRCULAR	15.000	15.000	0.0120	0.5000	1.0000	0.0000	0.00	No	1
3	Link-04	57.00	206.03	0.00	205.46	0.00	0.57	1.0000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
4	Link-05	5.00	205.46	0.00	205.36	0.87	0.10	2.0000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.5000	0.0000	0.00	No	1
5	STMLink-13	162.00	206.17	0.00	204.99	0.50	1.18	0.7300	CIRCULAR	18.000	18.000	0.0230	0.5000	1.0000	0.0000	0.00	No	1
6	STMLink-14	34.00	214.05	0.00	212.69	0.12	1.36	4.0000	CIRCULAR	12.000	12.000	0.0230	0.5000	0.8000	0.0000	0.00	No	1
7	STMLink-15	58.00	214.41	0.00	213.95	-0.10	0.46	0.7900	CIRCULAR	15.000	15.000	0.0230	0.5000	0.6000	0.0000	0.00	No	1
8	STMLink-16	20.00	214.81	0.00	214.41	0.00	0.40	2.0000	CIRCULAR	15.000	15.000	0.0230	0.5000	0.5000	0.0000	0.00	No	1
9	STMLink-17	4.00	212.61	0.00	212.57	0.00	0.04	1.0000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.8000	0.0000	0.00	No	1
10	STMLink-2	113.00	204.49	0.00	203.43	0.00	1.06	0.9400	CIRCULAR	24.000	24.000	0.0120	0.5000	1.0000	0.0000	0.00	No	1
11	STMLink-7	105.00	210.00	0.00	208.95	2.92	1.05	1.0000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.9000	0.0000	0.00	No	1
12	STMLink-8	107.00	207.10	0.00	206.03	0.00	1.07	1.0000	CIRCULAR	15.000	15.000	0.0120	0.5000	0.9000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	Link-02	5.03	0 00:40	9.48	0.53	7.98	0.38	0.65	0.52	0.00		Calculated
2	Link-03	5.03	0 00:40	10.53	0.48	8.48	0.04	0.61	0.49	0.00		Calculated
3	Link-04	7.57	0 00:02	7.00	1.08	6.94	0.14	1.25	1.00	7.00		SURCHARGED
4	Link-05	7.59	0 00:09	9.90	0.77	8.90	0.01	0.82	0.66	0.00		Calculated
5	STMLink-13	5.48	0 00:03	5.07	1.08	6.47	0.42	1.50	1.00	4.00		SURCHARGED
6	STMLink-14	1.63	0 00:05	4.03	0.40	4.87	0.12	0.44	0.44	0.00		Calculated
7	STMLink-15	1.63	0 00:05	2.88	0.57	2.46	0.39	0.67	0.54	0.00		Calculated
8	STMLink-16	1.67	0 00:05	5.16	0.32	3.76	0.09	0.49	0.39	0.00		Calculated
9	STMLink-17	5.05	0 00:40	7.00	0.72	12.29	0.01	0.79	0.63	0.00		Calculated
10	STMLink-2	14.33	0 00:06	23.74	0.60	7.93	0.24	1.12	0.56	0.00		Calculated
11	STMLink-7	1.27	0 00:05	7.00	0.18	6.21	0.28	0.36	0.29	0.00		Calculated
12	STMLink-8	7.56	0 00:01	7.00	1.08	11.13	0.16	1.25	1.00	7.00		SURCHARGED

Inlet Input

SN	Element ID	Inlet Manufacturer	Manufacturer Part Number	Inlet Location	Number of Inlets	Catchbasin Invert Elevation (ft)	Max (Rim) Elevation (ft)	Inlet Depth (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Ponded Area (ft²)	Grate Clogging Factor (%)
1	1B	FHWA HEC-22 GENERIC	N/A	On Sag	1	206.17	210.07	3.90	206.17	0.00	10.00	0.00
2	CB-1B	FHWA HEC-22 GENERIC	N/A	On Sag	1	209.21	211.71	2.50	209.21	0.00	10.00	0.00
3	CB-4A	FHWA HEC-22 GENERIC	N/A	On Sag	1	206.03	211.19	5.16	206.03	0.00	10.00	0.00
4	CB-4A-1	FHWA HEC-22 GENERIC	N/A	On Sag	1	207.10	210.10	3.00	207.10	0.00	10.00	0.00
5	CB-5A	FHWA HEC-22 GENERIC	N/A	On Sag	1	210.00	213.00	3.00	210.00	0.00	10.00	0.00
6	Existing-Inlet-1	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.81	218.82	4.01	214.81	0.00	10.00	0.00
7	Existing-Inlet-2	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.41	218.40	3.99	214.41	0.00	10.00	0.00
8	Existing-Inlet-3	FHWA HEC-22 GENERIC	N/A	On Sag	1	214.05	217.70	3.65	214.05	0.00	10.00	0.00
9	FI-2B	FHWA HEC-22 GENERIC	N/A	On Sag	1	212.57	218.30	5.73	212.57	0.00	10.00	0.00

Roadway & Gutter Input

SN Element ID	Roadway Longitudinal Slope (ft/ft)	Roadway Cross Slope (ft/ft)	Roadway Manning's Roughness	Gutter Cross Slope (ft/ft)	Gutter Width (ft)	Gutter Depression (in)	Allowable Spread (ft)
1 1B	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
2 CB-1B	N/A	0.0200	0.0110	0.0620	2.00	0.0656	7.00
3 CB-4A	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
4 CB-4A-1	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
5 CB-5A	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
6 Existing-Inlet-1	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
7 Existing-Inlet-2	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
8 Existing-Inlet-3	N/A	0.0200	0.0110	0.0200	2.00	0.0000	7.00
9 FI-2B	N/A	0.0200	0.0130	0.0200	2.00	0.0000	7.00

Inlet Results

SN Element ID	Peak Flow	Peak Lateral Inflow	Peak Flow Intercepted by Inlet	Peak Flow Bypassing Inlet	Inlet Efficiency during Peak Flow	Max Gutter Spread during Peak Flow	Max Gutter Water Elev. during Peak Flow	Max Gutter Water Depth during Peak Flow	Time of Max Depth Occurrence	Total Flooded Volume	Total Time Flooded
	(cfs)	(cfs)	(cfs)	(cfs)	(%)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1 1B	9.57	9.57	N/A	N/A	N/A	64.80	211.11	1.04	0 00:02	0.00	0.00
2 CB-1B	0.00	0.00	N/A	N/A	N/A	0.00	211.71	0.00	0 00:40	0.00	0.00
3 CB-4A	1.74	1.74	N/A	N/A	N/A	10.43	211.40	0.21	0 00:05	0.00	0.00
4 CB-4A-1	32.32	32.32	N/A	N/A	N/A	410.84	218.05	7.95	0 00:01	0.00	0.00
5 CB-5A	1.30	1.30	N/A	N/A	N/A	8.70	213.17	0.17	0 00:05	0.00	0.00
6 Existing-Inlet-1	1.68	1.68	N/A	N/A	N/A	11.18	219.04	0.22	0 00:05	0.00	0.00
7 Existing-Inlet-2	0.00	0.00	N/A	N/A	N/A	0.00	218.40	0.00	0 00:05	0.00	0.00
8 Existing-Inlet-3	0.00	0.00	N/A	N/A	N/A	0.00	217.70	0.00	0 00:05	0.00	0.00
9 FI-2B	0.00	0.00	N/A	N/A	N/A	0.00	218.30	0.00	0 00:40	0.00	0.00

APPENDIX E

STANDARD AND SPECIFICATIONS FOR CONSTRUCTION ROAD STABILIZATION



Definition & Scope

The stabilization of temporary construction access routes, on-site vehicle transportation routes, and construction parking areas to control erosion on temporary construction routes and parking areas.

Conditions Where Practice Applies

All traffic routes and parking areas for temporary use by construction traffic.

Design Criteria

Construction roads should be located to reduce erosion potential, minimize impact on existing site resources, and maintain operations in a safe manner. Highly erosive soils, wet or rocky areas, and steep slopes should be avoided. Roads should be routed where seasonal water tables are deeper than 18 inches. Surface runoff and control should be in accordance with other standards.

Road Grade – A maximum grade of 12% is recommended, although grades up to 15% are possible for short distances.

Road Width – 12 foot minimum for one-way traffic or 24 foot minimum for two-way traffic.

Side Slope of Road Embankment – 2:1 or flatter.

Ditch Capacity – On-site roadside ditch and culvert capacities shall be the 10 yr. peak runoff.

Composition – Use a 6-inch layer of NYS DOT sub-base Types 1,2,3, 4 or equivalent as specified in NYSDOT Standard Specifications.

Construction Specifications

1. Clear and strip roadbed and parking areas of all vegetation, roots, and other objectionable material.
2. Locate parking areas on naturally flat areas as available. Keep grades sufficient for drainage, but not more than 2 to 3 percent.
3. Provide surface drainage and divert excess runoff to stabilized areas.
4. Maintain cut and fill slopes to 2:1 or flatter and stabilized with vegetation as soon as grading is accomplished.
5. Spread 6-inch layer of sub-base material evenly over the full width of the road and smooth to avoid depressions.
6. Provide appropriate sediment control measures to prevent offsite sedimentation.

Maintenance

Inspect construction roads and parking areas periodically for condition of surface. Top dress with new gravel as needed. Check ditches for erosion and sedimentation after rainfall events. Maintain vegetation in a healthy, vigorous condition. Areas producing sediment should be treated immediately.

STANDARD AND SPECIFICATIONS FOR SILT FENCE



Definition & Scope

A **temporary** barrier of geotextile fabric installed on the contours across a slope used to intercept sediment laden runoff from small drainage areas of disturbed soil by temporarily ponding the sediment laden runoff allowing settling to occur. The maximum period of use is limited by the ultraviolet stability of the fabric (approximately one year).

Conditions Where Practice Applies

A silt fence may be used subject to the following conditions:

1. Maximum allowable slope length and fence length will not exceed the limits shown in the Design Criteria for the specific type of silt fence used ; and
2. Maximum ponding depth of 1.5 feet behind the fence; and
3. Erosion would occur in the form of sheet erosion; and
4. There is no concentration of water flowing to the barrier; and
5. Soil conditions allow for proper keying of fabric, or other anchorage, to prevent blowouts.

Design Criteria

1. Design computations are not required for installations of 1 month or less. Longer installation periods should be designed for expected runoff.
2. All silt fences shall be placed as close to the disturbed area as possible, but at least 10 feet from the toe of a slope steeper than 3H:1V, to allow for maintenance and

roll down. The area beyond the fence must be undisturbed or stabilized.

3. The type of silt fence specified for each location on the plan shall not exceed the maximum slope length and maximum fence length requirements shown in the following table:

		Slope Length/Fence Length (ft.)		
Slope	Steepness	Standard	Reinforced	Super
<2%	< 50:1	300/1500	N/A	N/A
2-10%	50:1 to 10:1	125/1000	250/2000	300/2500
10-20%	10:1 to 5:1	100/750	150/1000	200/1000
20-33%	5:1 to 3:1	60/500	80/750	100/1000
33-50%	3:1 to 2:1	40/250	70/350	100/500
>50%	> 2:1	20/125	30/175	50/250

Standard Silt Fence (SF) is fabric rolls stapled to wooden stakes driven 16 inches in the ground.

Reinforced Silt Fence (RSF) is fabric placed against welded wire fabric with anchored steel posts driven 16 inches in the ground.

Super Silt Fence (SSF) is fabric placed against chain link fence as support backing with posts driven 3 feet in the ground.

4. Silt fence shall be removed as soon as the disturbed area has achieved final stabilization.

The silt fence shall be installed in accordance with the appropriate details. Where ends of filter cloth come together, they shall be overlapped, folded and stapled to prevent sediment bypass. Butt joints are not acceptable. A detail of the silt fence shall be shown on the plan. See Figure 5.30 on page 5.56 for Reinforced Silt Fence as an example of details to be provided.

Criteria for Silt Fence Materials

1. Silt Fence Fabric: The fabric shall meet the following specifications unless otherwise approved by the appropriate erosion and sediment control plan approval authority. Such approval shall not constitute statewide acceptance.

Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	110	ASTM D 4632
Elongation at Failure (%)	20	ASTM D 4632
Mullen Burst Strength (PSI)	300	ASTM D 3786
Puncture Strength (lbs)	60	ASTM D 4833
Minimum Trapezoidal Tear Strength (lbs)	50	ASTM D 4533
Flow Through Rate (gal/min/sf)	25	ASTM D 4491
Equivalent Opening Size	40-80	US Std Sieve ASTM D 4751
Minimum UV Residual (%)	70	ASTM D 4355

Super Silt Fence

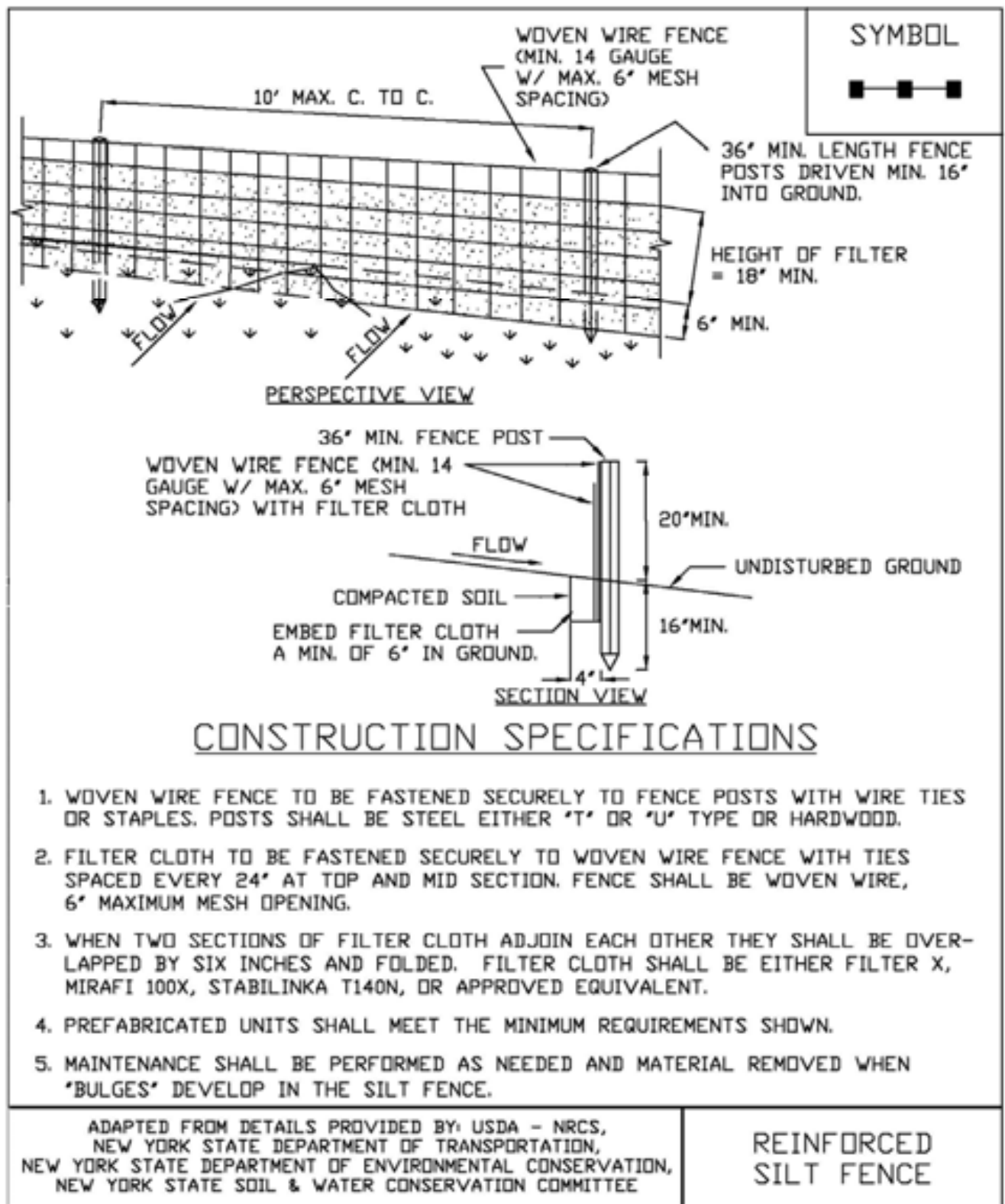


2. Fence Posts (for fabricated units): The length shall be a minimum of 36 inches long. Wood posts will be of sound quality hardwood with a minimum cross sectional area of 3.5 square inches. Steel posts will be standard T and U section weighing not less than 1.00 pound per linear foot. Posts for super silt fence shall be standard chain link fence posts.
3. Wire Fence for reinforced silt fence: Wire fencing shall be a minimum 14 gage with a maximum 6 in. mesh opening, or as approved.
4. Prefabricated silt fence is acceptable as long as all material specifications are met.

Reinforced Silt Fence



Figure 5.30
Reinforced Silt Fence



STANDARD AND SPECIFICATIONS FOR PROTECTING VEGETATION DURING CONSTRUCTION



Definition & Scope

The protection of trees, shrubs, ground cover and other vegetation from damage by construction equipment. In order to preserve existing vegetation determined to be important for soil erosion control, water quality protection, shade, screening, buffers, wildlife habitat, wetland protection, and other values.

Conditions Where Practices Applies

On planned construction sites where valued vegetation exists and needs to be preserved.

Design Criteria

1. Planning Considerations

A. Inventory:

1) Property boundaries, topography, vegetation and soils information should be gathered. Identify potentially high erosion areas, areas with tree windthrow potential, etc. A vegetative cover type map should be made on a copy of a topographic map which shows other natural and manmade features. Vegetation that is desirable to preserve because of its value for screening, shade, critical erosion control, endangered species, aesthetics, etc., should be identified and marked on the map.

2) Based upon this data, general statements should be prepared about the present condition, potential problem areas, and unique features of the property.

B. Planning:

1) After engineering plans (plot maps) are prepared, another field review should take place and

recommendations made for the vegetation to be saved. Minor adjustments in location of roads, dwellings, and utilities may be needed. Construction on steep slopes, erodible soils, wetlands, and streams should be avoided. Clearing limits should be delineated (See "Determine Limits of Clearing and Grading" on page 2.2).

2) Areas to be seeded and planted should be identified. Remaining vegetation should blend with their surroundings and/or provide special function such as a filter strip, buffer zone, or screen.

3) Trees and shrubs of special seasonal interest, such as flowering dogwood, red maple, striped maple, serviceberry, or shadbush, and valuable potential shade trees should be identified and marked for special protective treatment as appropriate.

4) Trees to be cut should be marked on the plans. If timber can be removed for salable products, a forester should be consulted for marketing advice.

5) Trees that may become a hazard to people, personal property, or utilities should be removed. These include trees that are weak-wooded, disease-prone, subject to windthrow, or those that have severely damaged root systems.

6) The vigor of remaining trees may be improved by a selective thinning. A forester should be consulted for implementing this practice.

2. Measures to Protect Vegetation

A. Limit soil placement over existing tree and shrub roots to a maximum of 3 inches. Soils with loamy texture and good structure should be used.

B. Use retaining walls and terraces to protect roots of trees and shrubs when grades are lowered. Lowered grades should start no closer than the dripline of the tree. For narrow-canopied trees and shrubs, the stem diameter in inches is converted to feet and doubled, such that a 10 inch tree should be protected to 20 feet.

C. Trenching across tree root systems should be the same minimum distance from the trunk, as in "B". Tunnels under root systems for underground utilities should start 18 inches or deeper below the normal ground surface. Tree roots which must be severed should be cut clean. Backfill material that will be in contact with the roots should be topsoil or a prepared planting soil mixture.

D. Construct sturdy fences, or barriers, of wood, steel, or other protective material around valuable

vegetation for protection from construction equipment. Place barriers far enough away from trees, but not less than the specifications in "B", so that tall equipment such as backhoes and dump trucks do not contact tree branches.

E. Construction limits should be identified and clearly marked to exclude equipment.

F. Avoid spills of oil/gas and other contaminants.

G. Obstructive and broken branches should be pruned properly. The branch collar on all branches whether living or dead should not be damaged. The 3 or 4 cut method should be used on all branches larger than two inches at the cut. First cut about one-third the way through the underside of the limb (about 6-12 inches from the tree trunk). Then (approximately an inch further out) make a second cut through the limb from the upper side. When the branch is removed, there is no splintering of the main tree trunk. Remove the stub. If the branch is larger than 5-6 inches in diameter, use the four cut system. Cuts 1 and 2 remain the same and cut 3 should be from the underside of the limb, on the outside of the branch collar. Cut 4 should be from the top and in alignment with the 3rd cut. Cut 3 should be 1/4 to 1/3 the way through the limb. This will prevent the bark from peeling down the trunk. Do not paint the cut surface.

H. Penalties for damage to valuable trees, shrubs, and herbaceous plants should be clearly spelled out in the contract.

PROTECTING TREES IN HEAVY USE AREAS

The compaction of soil over the roots of trees and shrubs by the trampling of recreationists, vehicular traffic, etc., reduces oxygen, water, and nutrient uptake by feeder roots. This weakens and may eventually kill the plants. Table 2.6 rates the "Susceptibility of Tree Species to Compaction."

Where heavy compaction is anticipated, apply and maintain a 3 to 4 inch layer of undecayed wood chips or 2 inches of No. 2 washed, crushed gravel. In addition, use of a wooden or plastic mat may be used to lessen compaction, if applicable.

Table 2.6
Susceptibility of Tree Species to Compaction¹

Resistant:

Box elder.....	<i>Acer negundo</i>	Willows.....	<i>Salix spp.</i>
Green ash.....	<i>Fraxinus pennsylvanica</i>	Honey locust.....	<i>Gleditsia triacanthos</i>
Red elm.....	<i>Ulmus rubra</i>	Eastern cottonwood.....	<i>Populus deltoides</i>
Hawthornes.....	<i>Crataegus spp.</i>	Swamp white oak.....	<i>Quercus bicolor</i>
Bur oak.....	<i>Quercus macrocarpa</i>	Hophornbeam.....	<i>Ostrya virginiana</i>
Northern white cedar....	<i>Thuja occidentalis</i>		

Intermediate:

Red maple.....	<i>Acer rubrum</i>	Sweetgum.....	<i>Liquidambar styraciflua</i>
Silver maple.....	<i>Acer saccharinum</i>	Norway maple.....	<i>Acer platanoides</i>
Hackberry.....	<i>Celtis occidentalis</i>	Shagbark hickory.....	<i>Carya ovata</i>
Black gum.....	<i>Nyssa sylvatica</i>	London plane.....	<i>Platanus x hybrida</i>
Red oak.....	<i>Quercus rubra</i>	Pin oak.....	<i>Quercus palustris</i>
Basswood.....	<i>Tilia americana</i>		

Susceptible:

Sugar maple.....	<i>Acer saccharum</i>	Austrian Pine.....	<i>Pinus nigra</i>
White pine.....	<i>Pinus strobus</i>	White ash.....	<i>Fraxinus americana</i>
Blue spruce.....	<i>Picea pungens</i>	Paper birch.....	<i>Betula papyrifera</i>
White oak.....	<i>Quercus alba</i>	Mountain ash.....	<i>Sorbus aucuparia</i>
Red pine.....	<i>Pinus resinosa</i>	Japanese maple.....	<i>Acer palmatum</i>

¹ If a tree species does not appear on the list, insufficient information is available to rate it for this purpose.

STANDARD AND SPECIFICATIONS FOR STORM DRAIN INLET PROTECTION



Definition & Scope

A **temporary** barrier with low permeability, installed around inlets in the form of a fence, berm or excavation around an opening, detaining water and thereby reducing the sediment content of sediment laden water by settling thus preventing heavily sediment laden water from entering a storm drain system.

Conditions Where Practice Applies

This practice shall be used where the drainage area to an inlet is disturbed, it is not possible to temporarily divert the storm drain outfall into a trapping device, and watertight blocking of inlets is not advisable. **It is not to be used in place of sediment trapping devices.** This practice shall be used with an upstream buffer strip if placed at a storm drain inlet on a paved surface. It may be used in conjunction with storm drain diversion to help prevent siltation of pipes installed with low slope angle.

Types of Storm Drain Inlet Practices

There are five (5) specific types of storm drain inlet protection practices that vary according to their function, location, drainage area, and availability of materials:

- I. Excavated Drop Inlet Protection
- II. Fabric Drop Inlet Protection
- III. Stone & Block Drop Inlet Protection
- IV. Paved Surface Inlet Protection
- V. Manufactured Insert Inlet Protection

Design Criteria

Drainage Area – The drainage area for storm drain inlets shall not exceed one acre. Erosion control/temporary stabilization measures must be implemented on the disturbed

drainage area tributary to the inlet. The crest elevations of these practices shall provide storage and minimize bypass flow.

Type I – Excavated Drop Inlet Protection

This practice is generally used during initial overlot grading after the storm drain trunk line is installed.

Limit the drainage area to the inlet device to 1 acre. Excavated side slopes shall be no steeper than 2:1. The minimum depth shall be 1 foot and the maximum depth 2 feet as measured from the crest of the inlet structure. Shape the excavated basin to fit conditions with the longest dimension oriented toward the longest inflow area to provide maximum trap efficiency. The capacity of the excavated basin should be established to contain 900 cubic feet per acre of disturbed area. Weep holes, protected by fabric and stone, should be provided for draining the temporary pool.

Inspect and clean the excavated basin after every storm. Sediment should be removed when 50 percent of the storage volume is achieved. This material should be incorporated into the site in a stabilized manner.

Type II – Fabric Drop Inlet Protection



This practice is generally used during final elevation grading phases after the storm drain system is completed.

Limit the drainage area to 1 acre per inlet device. Land area slope immediately surrounding this device should not exceed 1 percent. The maximum height of the fabric above the inlet crest shall not exceed 1.5 feet unless reinforced.

The top of the barrier should be maintained to allow overflow to drop into the drop inlet and not bypass the inlet to

unprotected lower areas. Support stakes for fabric shall be a minimum of 3 feet long, spaced a maximum 3 feet apart. They should be driven close to the inlet so any overflow drops into the inlet and not on the unprotected soil. Improved performance and sediment storage volume can be obtained by excavating the area.

Inspect the fabric barrier after each rain event and make repairs as needed. Remove sediment from the pool area as necessary with care not to undercut or damage the filter fabric. Upon stabilization of the drainage area, remove all materials and unstable sediment and dispose of properly. Bring the adjacent area of the drop inlet to grade, smooth and compact and stabilize in the appropriate manner to the site.

Type III – Stone and Block Drop Inlet Protection

This practice is generally used during the initial and intermediate overlot grading of a construction site.

Limit the drainage area to 1 acre at the drop inlet. The stone barrier should have a minimum height of 1 foot and a maximum height of 2 feet. Do not use mortar. The height should be limited to prevent excess ponding and bypass flow.

Recess the first course of blocks at least 2 inches below the crest opening of the storm drain for lateral support. Subsequent courses can be supported laterally if needed by placing a 2x4 inch wood stud through the block openings perpendicular to the course. The bottom row should have a few blocks oriented so flow can drain through the block to dewater the basin area.

The stone should be placed just below the top of the blocks on slopes of 2:1 or flatter. Place hardware cloth of wire mesh with ½ inch openings over all block openings to hold stone in place.

As an optional design, the concrete blocks may be omitted and the entire structure constructed of stone, ringing the outlet (“doughnut”). The stone should be kept at a 3:1 slope toward the inlet to keep it from being washed into the inlet. A level area 1 foot wide and four inches below the crest will further prevent wash. Stone on the slope toward the inlet should be at least 3 inches in size for stability and 1 inch or smaller away from the inlet to control flow rate. The elevation of the top of the stone crest must be maintained 6 inches lower than the ground elevation down slope from the inlet to ensure that all storm flows pass over the stone into the storm drain and not past the structure. Temporary diking should be used as necessary to prevent bypass flow.

The barrier should be inspected after each rain event and repairs made where needed. Remove sediment as necessary to provide for accurate storage volume for subsequent rains. Upon stabilization of contributing drainage area, remove all

materials and any unstable soil and dispose of properly.

Bring the disturbed area to proper grade, smooth, compact and stabilize in a manner appropriate to the site.

Type IV – Paved Surface Inlet Protection



This practice is generally used after pavement construction has been done while final grading and soil stabilization is occurring. These practices should be used with upstream buffer strips in linear construction applications, and with temporary surface stabilization for overlot areas, to reduce the sediment load at the practice. This practice includes sand bags, compost filter socks, geo-tubes filled with ballast, and manufactured surface barriers. Pea gravel can also be used in conjunction with these practices to improve performance. When the inlet is not at a low point, and is offset from the pavement or gutter line, protection should be selected and installed so that flows are not diverted around the inlet.



The drainage area should be limited to 1 acre at the drain inlet. All practices will be placed at the inlet perimeter or beyond to maximize the flow capacity of the inlet. Practices shall be weighted, braced, tied, or otherwise anchored to prevent movement or shifting of location on paved surfaces. Traffic safety shall be integrated with the use of this practice. All practices should be marked with traffic safety cones as appropriate. Structure height shall not cause flooding or by-pass flow that would cause additional erosion.

The structure should be inspected after every storm event. Any sediment should be removed and disposed of on the site. Any broken or damaged components should be replaced. Check all materials for proper anchorage and secure as necessary.

Type V - Manufactured Insert Inlet Protection



The drainage area shall be limited to 1 acre at the drain inlet. All inserts will be installed and anchored in accordance with the manufacturers recommendations and design details. The fabric portion of the structure will equal or exceed the performance standard for the silt fence fabric. The inserts will be installed to preserve a minimum of 50 percent of the open, unobstructed design flow area of the storm drain inlet opening to maintain capacity for storm events.

Figure 5.31
Excavated Drop Inlet Protection

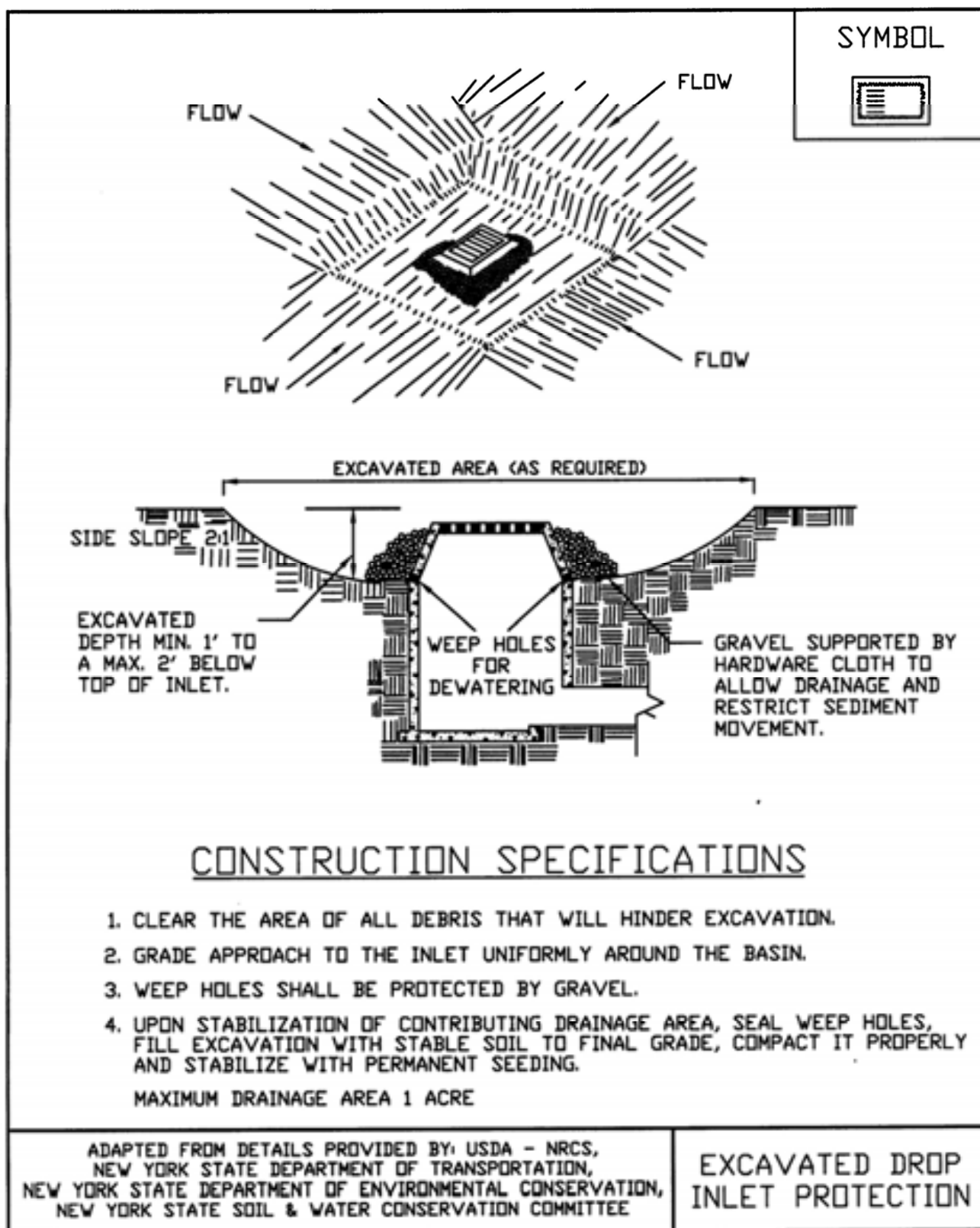


Figure 5.32
Fabric Drop Inlet Protection

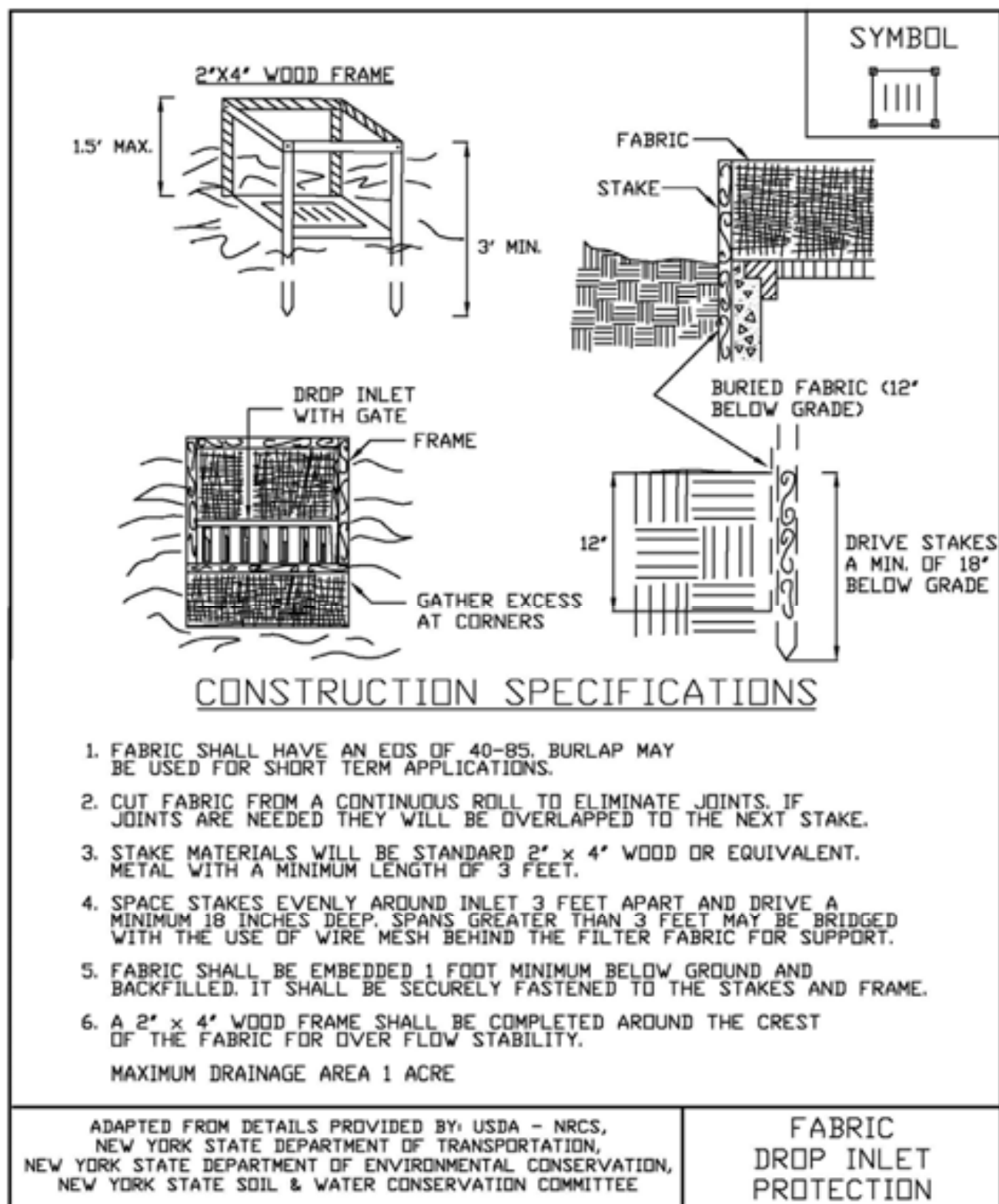
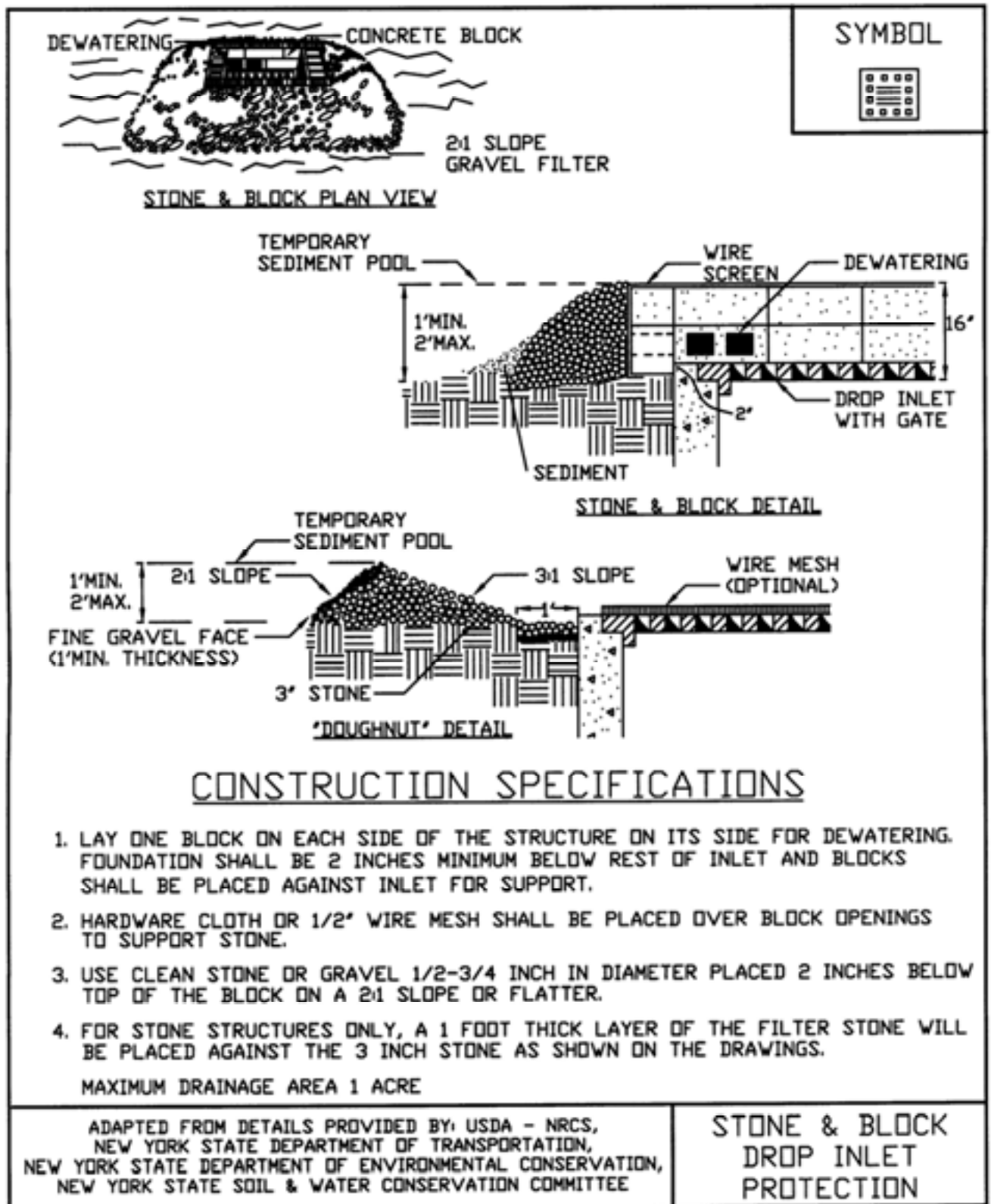


Figure 5.33
Stone & Block Drop Inlet Protection



STANDARD AND SPECIFICATIONS FOR CONCRETE TRUCK WASHOUT



Definition & Scope

A temporary excavated or above ground lined constructed pit where concrete truck mixers and equipment can be washed after their loads have been discharged, to prevent highly alkaline runoff from entering storm drainage systems or leaching into soil.

Conditions Where Practice Applies

Washout facilities shall be provided for every project where concrete will be poured or otherwise formed on the site. This facility will receive highly alkaline wash water from the cleaning of chutes, mixers, hoppers, vibrators, placing equipment, trowels, and screeds. Under no circumstances will wash water from these operations be allowed to infiltrate into the soil or enter surface waters.

Design Criteria

Capacity: The washout facility should be sized to contain solids, wash water, and rainfall and sized to allow for the evaporation of the wash water and rainfall. Wash water shall be estimated at 7 gallons per chute and 50 gallons per hopper of the concrete pump truck and/or discharging drum. The minimum size shall be 8 feet by 8 feet at the bottom and 2 feet deep. If excavated, the side slopes shall be 2 horizontal to 1 vertical.

Location: Locate the facility a minimum of 100 feet from drainage swales, storm drain inlets, wetlands, streams and other surface waters. Prevent surface water from entering the structure except for the access road. Provide appropriate access with a gravel access road sloped down to the structure. Signs shall be placed to direct drivers to the facility after their load is discharged.

Liner: All washout facilities will be lined to prevent

leaching of liquids into the ground. The liner shall be plastic sheeting with a minimum thickness of 10 mils with no holes or tears, and anchored beyond the top of the pit with an earthen berm, sand bags, stone, or other structural appurtenance except at the access point.

If pre-fabricated washouts are used they must ensure the capture and containment of the concrete wash and be sized based on the expected frequency of concrete pours. They shall be sited as noted in the location criteria.

Maintenance

- All concrete washout facilities shall be inspected daily. Damaged or leaking facilities shall be deactivated and repaired or replaced immediately. Excess rainwater that has accumulated over hardened concrete should be pumped to a stabilized area, such as a grass filter strip.
- Accumulated hardened material shall be removed when 75% of the storage capacity of the structure is filled. Any excess wash water shall be pumped into a containment vessel and properly disposed of off site.
- Dispose of the hardened material off-site in a construction/demolition landfill. On-site disposal may be allowed if this has been approved and accepted as part of the projects SWPPP. In that case, the material should be recycled as specified, or buried and covered with a minimum of 2 feet of clean compacted earthfill that is permanently stabilized to prevent erosion.
- The plastic liner shall be replaced with each cleaning of the washout facility.
- Inspect the project site frequently to ensure that no concrete discharges are taking place in non-designated areas.

STANDARD AND SPECIFICATIONS FOR DUST CONTROL



dust control (see Section 3).

Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

Spray adhesives – These are products generally composed of polymers in a liquid or solid form that are mixed with water to form an emulsion that is sprayed on the soil surface with typical hydroseeding equipment. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations for the specific soils on the site. In no case should the application of these adhesives be made on wet soils or if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators and others working with the material.

Definition & Scope

The control of dust resulting from land-disturbing activities, to prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.

Conditions Where Practice Applies

On construction roads, access points, and other disturbed areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Design Criteria

Construction operations should be scheduled to minimize the amount of area disturbed at one time. Buffer areas of vegetation should be left where practical. Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the NYSDEC.

No polymer application shall take place without written approval from the NYSDEC.

Construction Specifications

A. Non-driving Areas – These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

Vegetative Cover – For disturbed areas not subject to traffic, vegetation provides the most practical method of

B. Driving Areas – These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Sprinkling – The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access route to provide short term limited dust control.

Polymer Additives – These polymers are mixed with water and applied to the driving surface by a water truck with a gravity feed drip bar, spray bar or automated distributor truck. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations. Incorporation of the emulsion into the soil will be done to the appropriate depth based on expected traffic. Compaction after incorporation will be by vibratory roller to a minimum of 95%. The prepared surface shall be moist and no application of the polymer will be made if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators working with the material.

Barriers – Woven geo-textiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.

Windbreak – A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height. Preserve existing wind barrier vegetation as much as practical.

Maintenance

Maintain dust control measures through dry weather periods until all disturbed areas are stabilized.

STANDARD AND SPECIFICATIONS FOR SEDIMENT TRAP



Definition & Scope

A **temporary** sediment control device formed by excavation and/or embankment to intercept sediment-laden runoff and trap the sediment in order to protect drainageways, properties, and rights-of-way below the sediment trap from sedimentation.

Conditions Where Practice Applies

A sediment trap is usually installed in a drainageway, at a storm drain inlet, or other points of collection from a disturbed area for one construction season.

Sediment traps should be used to artificially break up the natural drainage area into smaller sections where a larger device (sediment basin) would be less effective.

Design Criteria

If the drainage area to the proposed trap location exceeds 5 acres, or the trap is in place beyond one construction season, or any of the additional design criteria presented here cannot be met, a full Sediment Basin must be used. See Standard and Specification for Sediment Basin on page 5.19.

Drainage Area

The maximum drainage area for all sediment traps shall be 5 acres.

Location

Sediment traps shall be located so that they can be installed prior to grading or filling in the drainage area they are to protect. Traps must **not be located any closer than 20 feet** from a proposed building foundation if the trap is to func-

tion during building construction. Locate traps to obtain maximum storage benefit from the terrain and for ease of cleanout and disposal of the trapped sediment.

Trap Size

The volume of a sediment trap as measured at the elevation of the crest of the outlet shall be at least 3,600 cubic feet per acre of drainage area. A minimum length to width ratio of 2:1 should be provided. The volume of a constructed trap shall be calculated using standard mathematical procedures. The volume of a natural sediment trap may be approximated by the equation: Volume (cu.ft.) = 0.4 x surface area (sq.ft.) x maximum depth (ft.).

Trap Cleanout

Sediment shall be removed and the trap restored to the original dimensions when the sediment has accumulated to $\frac{1}{2}$ of the design depth of traps I-II, and $\frac{1}{3}$ the depth for trap III. Sediment removed from the trap shall be deposited in a protected area and in such a manner that it will not erode.

Embankment

All earth embankments for sediment traps shall not exceed five (5) feet in height as measured at the low point of the original ground along the centerline of the embankment. Embankments shall have a minimum four (4) foot wide top and side slopes of 2:1 or flatter. The embankment shall be compacted by traversing with equipment while it is being constructed. The embankment shall be stabilized with seed and mulch as soon as it is completed.

The elevation of the top of any dike directing water to any sediment trap will equal or exceed the maximum height of the outlet structure along the entire length of the trap.

Excavation

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Excavated portions of sediment traps shall have 1:1 or flatter slopes.

Outlet

The outlet shall be designed, constructed, and maintained in such a manner that sediment does not leave the trap and that erosion at or below the outlet does not occur.

Sediment traps must outlet onto stabilized (preferable undisturbed) ground, into a watercourse, stabilized channel, or into a storm drain system. Distance between inlet and outlet should be maximized to the longest length practicable.

All traps must be seeded and mulched immediately after construction.

Trap Details Needed on Erosion and Sediment Control Plans

Each trap shall be delineated on the plans in such a manner that it will not be confused with any other features. Each trap on a plan shall indicate all the information necessary to properly construct and maintain the structure. If the drawings are such that this information cannot be delineated on the drawings, then a table shall be developed. If a table is developed, then each trap on a plan shall have a number and the numbers shall be consecutive.

The following information shall be shown for each trap in a summary table format on the plans.

1. Trap number
2. Type of trap
3. Drainage area
4. Storage required
5. Storage provided (if applicable)
6. Outlet length or pipe sizes
7. Storage depth below outlet or cleanout elevation
8. Embankment height and elevation (if applicable)

Type of Sediment Traps

There are three (3) specific types of sediment traps which vary according to their function, location, or drainage area.

- I. Pipe Outlet Sediment Trap
- II. Stone Outlet Sediment Trap
- III. Compost Filter Sock Sediment Trap

I. Pipe Outlet Sediment Trap

A Pipe Outlet Sediment Trap consists of a trap formed by embankment or excavation. The outlet for the trap is through a perforated riser and a pipe through the embankment. The outlet pipe and riser shall be made of steel, corrugated metal or other suitable material. The top of the embankment shall be at least 1 ½ feet above the crest of the riser. The preferred method of dewatering the sediment trap is by surface skimmer. See Dewatering Device Standard, page 5.10. If the riser alone is used for dewatering, the top 2/3 of the riser shall be perforated with one (1) inch nominal diameter holes or slits spaced six (6) inches vertically and horizontally placed in the concave portion of the corrugated pipe.

No holes or slits will be allowed within six (6) inches of the top of the horizontal barrel. All pipe connections shall be watertight. The riser shall be wrapped with ½ to ¼ inch hardware cloth wire then wrapped with filter cloth with a sieve size between #40-80 and secured with strapping or connecting band at the top and bottom of the cloth. The

cloth shall cover an area at least six (6) inches above the highest hole and six (6) inches below the lowest hole. The top of the riser pipe shall not be covered with filter cloth. The riser shall have a base with sufficient weight to prevent flotation of the riser. Two approved bases are:

1. A concrete base 12 in. thick with the riser embedded 9 in. into the concrete base, or
2. One quarter inch, minimum, thick steel plate attached to the riser by a continuous weld around the circumference of the riser to form a watertight connection. The plate shall have 2.5 feet of stone, gravel, or earth placed on it to prevent flotation. In either case, each side of the square base measurement shall be the riser diameter plus 24 inches.

Pipe outlet sediment traps shall be limited to a five (5) acre maximum drainage area. Pipe outlet sediment trap is interchangeable in the field with stone outlet provided that these sediment traps are constructed in accordance with the detail and specifications for that trap.

Select pipe diameter from the following table:
See details for Pipe Outlet Sediment Trap ST-I in Figure 5.25 and 5.26 on pages 5.49 and 5.50.

Optional sediment trap dewatering devices are shown on Figure 5.29 on Page 5.53.

Minimum Sizes

Barrel Diameter ¹ (in.)	Riser Diameter ¹ (in.)	Maximum Drainage Area (ac.)
12	15	1
15	18	2
18	21	3
21	24	4
21	27	5

¹ Barrel diameter may be same size as riser diameter



II. Stone Outlet Sediment Trap

A Stone Outlet Sediment Trap consists of a trap formed by an embankment or excavation. The outlet of this trap is over a stone section placed on level ground. The minimum length (feet) of the outlet shall be equal to four (4) times the drainage area (acres).

Required storage shall be 3,600 cubic feet per acre of drainage area.

The outlet crest (top of stone in weir section) shall be level, at least one (1) foot below top of embankment and no more than one (1) foot above ground beneath the outlet. Stone used in the outlet shall be small riprap (4 in. x 8 in.). To provide more efficient trapping effect, a layer of filter cloth should be embedded one (1) foot back into the upstream face of the outlet stone or a one (1) foot thick layer of two (2) inch or finer aggregate shall be placed on the upstream face of the outlet.

Stone Outlet Sediment Traps may be interchangeable in the field with pipe outlet sediment traps provided they are constructed in accordance with the detail and specifications for those traps. Stone outlet sediment traps shall be limited to a five (5) acre maximum drainage area.

See details for Stone Outlet Sediment Trap ST-II in Figure 5.27 on page 5.51



III. Compost Sock Sediment Trap

A compost sock sediment trap consists of a trap formed by creating an enclosure of geotextile mesh tubes filled with a compost filter media. These traps are used in locations where there is no opportunity to direct runoff into larger traps or well vegetated areas. This could occur at site entrances and access points or in tight areas due to construction boundary limits.

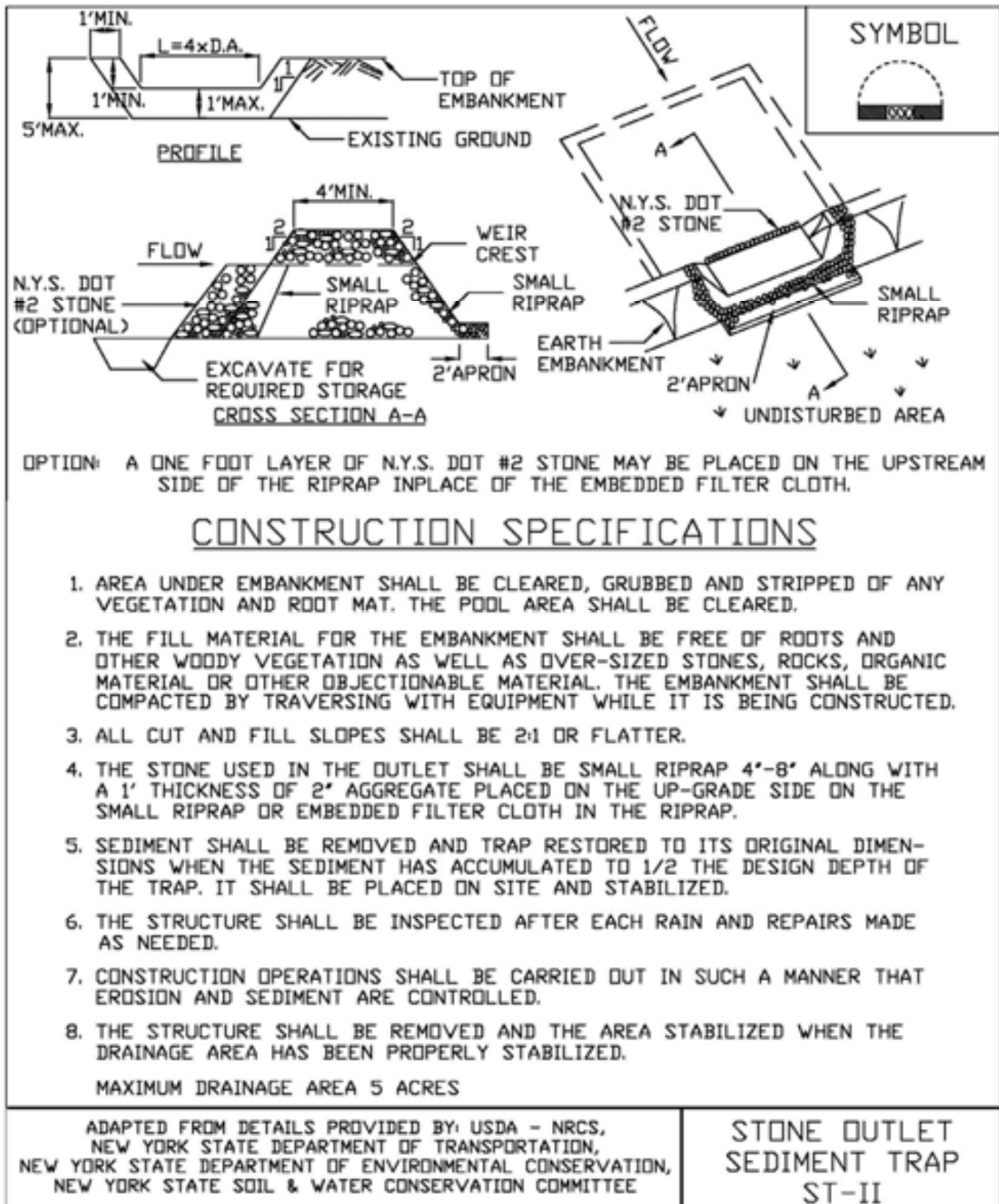
Surface runoff can be directed to the trap with standard conveyance practices. Groundwater or surface ponding in low areas can be pumped into the compost sock sediment trap with appropriate energy dissipation at the pump outlet to prevent scour.

Design criteria for Compost Sock Sediment Trap

1. The maximum drainage area tributary to the trap shall be 5 acres.
2. The minimum settled height above ground shall be 2.0 feet formed by staking 3 compost filter socks in a pyramid as shown in Figure 5.28 on page 5.52.
3. The storage volume provided in the compost sock sediment trap shall be 3,600 cubic feet per tributary drainage acre.
4. If necessary, additional storage area can be created by excavating a sump 1 foot deep beginning at least 5 feet away from the inside sock.
5. All compost filter sock materials, mesh, and compost, will meet the material specifications listed in the Compost Filter Sock standard. No spillway is required.
6. Compost filter sock sediment traps shall be inspected weekly and after every rainfall event. Sediment shall be removed when it reaches one third, $\frac{1}{3}$, the height of the trap.
7. The maximum limit of use for a compost sock sediment trap is one (1) year. The existing trap shall be replaced if there is a need for a trap beyond that time limit.
8. Upon completion of the work, the compost sock sediment trap shall be removed. The compost within the socks may be used during cleanup as a vegetative growth medium in accordance with the site stabilization plan.



Figure 5.27
Stone Outlet Sediment Trap: ST-II



STANDARD AND SPECIFICATIONS FOR SITE POLLUTION PREVENTION



Definition & Scope

A collection of management practices intended to control non-sediment pollutants associated with construction activities to prevent the generation of pollutants due to improper handling, storage, and spills and prevent the movement of toxic substances from the site into surface waters.

Conditions Where Practice Applies

On all construction sites where the earth disturbance exceeds 5,000 square feet, and involves the use of fertilizers, pesticides, petroleum based chemicals, fuels and lubricants, as well as sealers, paints, cleared woody vegetation, garbage, and sanitary wastes.

Design Criteria

The variety of pollutants on a particular site and the severity of their impacts depend on factors such as the nature of the construction activity, the physical characteristics of the construction site, and the proximity of water bodies and conveyances to the pollutant source.

1. All state and federal regulations shall be followed for the storage, handling, application, usage, and disposal of pesticides, fertilizers, and petroleum products.
2. Vehicle and construction equipment staging and maintenance areas will be located away from all drainage ways with their parking areas graded so the runoff from these areas is collected, contained and treated prior to discharge from the site.
3. Provide sanitary facilities for on-site personnel.
4. Store, cover, and isolate construction materials including topsoil, and chemicals, to prevent runoff of

pollutants and contamination of groundwater and surface waters.

5. Develop and implement a spill prevention and control plan. The plan should include NYSDEC's spill reporting and initial notification requirements.
6. Provide adequate disposal for solid waste including woody debris, stumps, and other construction waste and include these methods and directions in the construction details on the site construction drawings. Fill, woody debris, stumps and construction waste shall not be placed in regulated wetlands, streams or other surface waters.
7. Distribute or post informational material regarding proper handling, spill response, spill kit location, and emergency actions to be taken, to all construction personnel.
8. Refueling equipment shall be located at least 100 feet from all wetlands, streams and other surface waters.





SEDIMENT TRAP DESIGN
CAPACITY WORKSHEET

WO. NO.
10128.01

DATE
4/26/2021

SHEET 1 OF 4

PROJECT TITLE

Orangetown Town Hall Expansion

LOCATION

Orangeburg, Rockland County, NY 10962

ESTIMATED BY
JM, RCC

APPROVED BY
CO

REF DRAWING(S)
C-105, C-205

Sediment Trap A:

Drainage Area	=	2.2	ACRE
Cubic Volume Required*	=	3600	CF/(ACRE of drainage area)
Minimum Trap Storage**	=	7920	CF
Storage Provided	=	8084	CF

Sediment Trap B:

Drainage Area	=	3.0	ACRE
Cubic Volume Required*	=	3600	CF/(ACRE of drainage area)
Minimum Trap Storage**	=	10800	CF
Storage Provided	=	11420	CF

*Requirement is from the New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016 for Sediment Trap Sizing.

SEDIMENT TRAP DESIGN
DIMENSION WORKSHEET

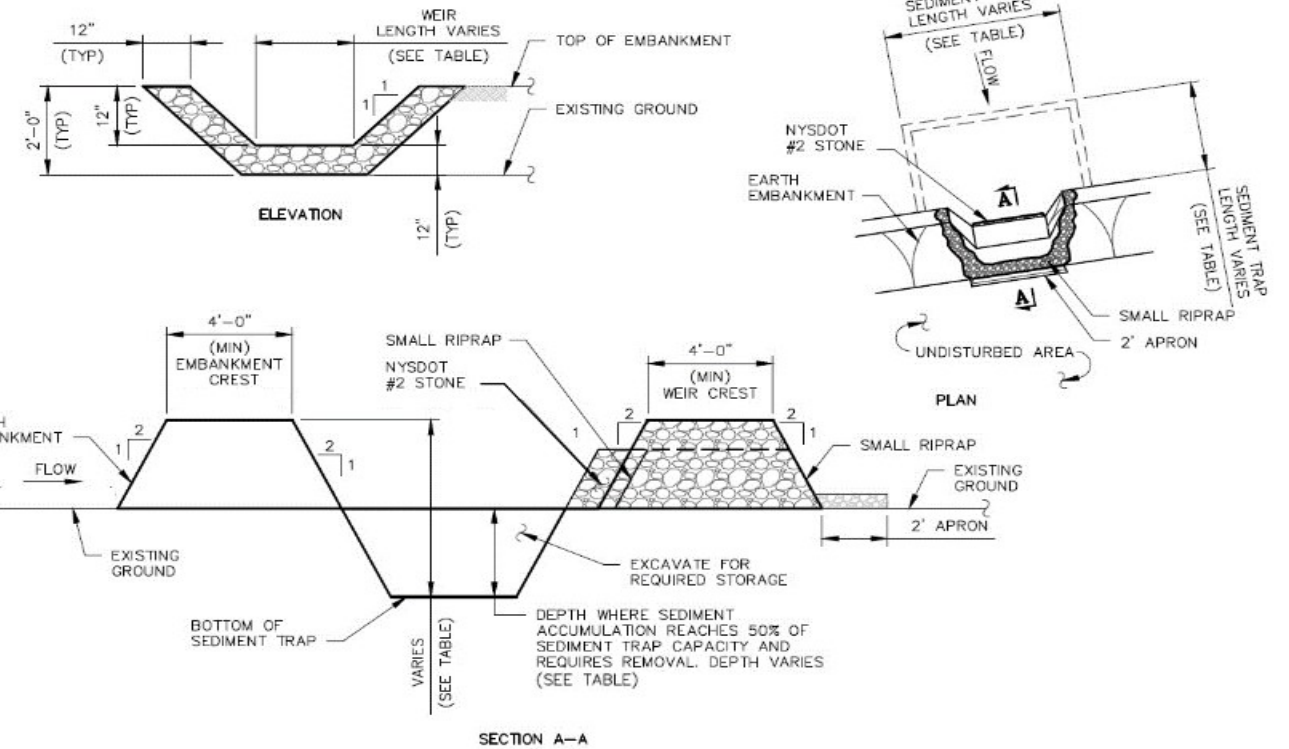
PROJECT TITLE Orangetown Town Hall Expansion	LOCATION Orangeburg, Rockland County, NY 10962	WO. NO. 10128.01	DATE 4/26/2021	SHEET 2 OF 4
ESTIMATED BY JM, RCC	APPROVED BY CO	REF DRAWING(S) C-105, C-205		

Sediment Trap A:

Overall Construction Footprint Dimensions			
Length (Outer Berm Toe)	=	82	FT
Width (Outer Berm Toe)	=	51	FT
Volumetric Dimensions			
Length (Inner Berm Crest)	=	67	FT
Width (Inner Berm Crest)	=	35	FT
Maximum Depth	=	8	FT
Depth at 50% Capacity***	=	5.7	FT
Emabankment Slope	=	2:1	H:V
Emabankment Crest	=	4	FT

Weir Dimensions

NYS DOT #2 Stone Thickness	=	12	IN
Weir Crest	=	4	FT
Weir Side Slope	=	1:1	H:V
Weir Length**	=	9	FT
Depth from Top of Weir to Stone	=	12	IN
Total Weir Height	=	2	FT



Sediment Trap B:

Overall Construction Footprint Dimensions			
Length (Outer Berm Toe)	=	122	FT
Width (Outer Berm Toe)	=	56	FT
Volumetric Dimensions			
Length (Inner Berm Crest)	=	106	FT
Width (Inner Berm Crest)	=	40	FT
Maximum Depth	=	4	FT
Depth at 50% Capacity***	=	2.3	FT
Emabankment Slope	=	2:1	H:V
Emabankment Crest	=	4	FT

Weir Dimensions

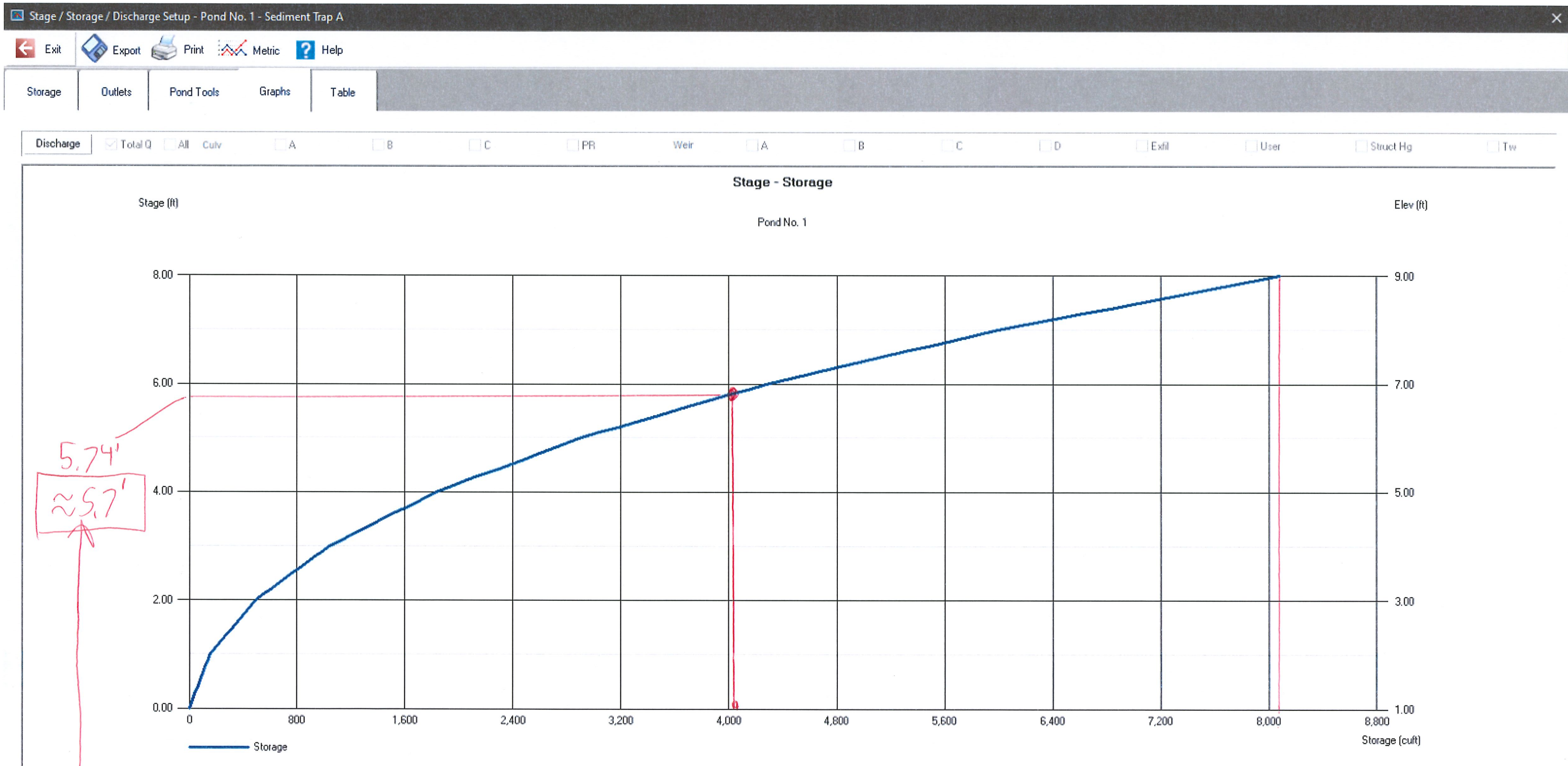
NYS DOT #2 Stone Thickness	=	12	IN
Weir Crest	=	4	FT
Weir Side Slope	=	1:1	H:V
Weir Length**	=	12	FT
Depth from Top of Weir to Stone	=	12	IN
Total Weir Height	=	2	FT

*Dimensions of Sediment Trap B are for the largest dimensions of the trap. See plan for footprint.

**Dimensions for Weir Length are calculated by multiplying the drainage area by 4, per the requirements stated in the New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016 for Sediment Trap Sizing.

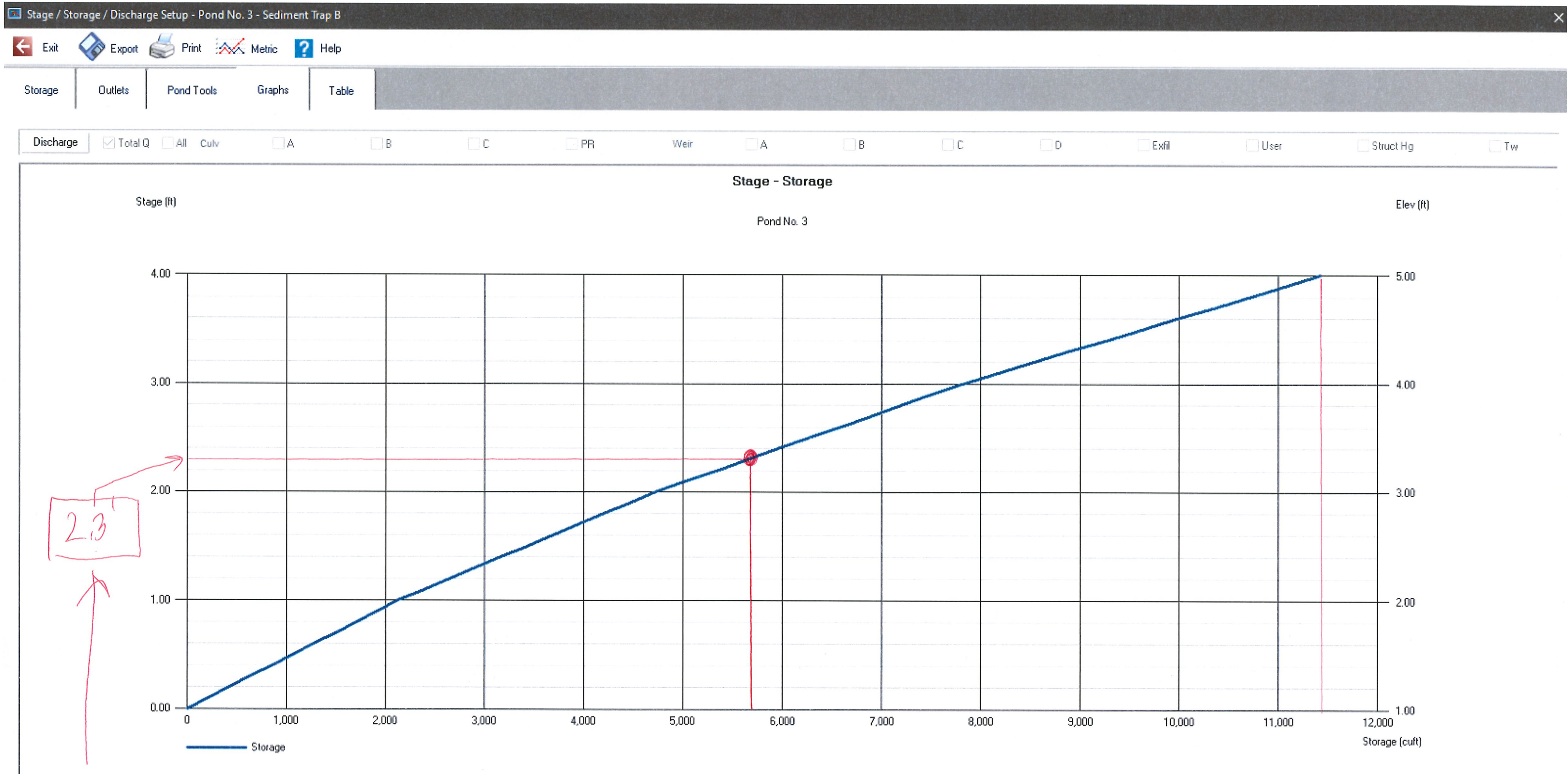
***Depth at 50% Capacity was determined by reviewing the stage storage chart for each sediment trap, see sheets 3-4 of Sediment Traps in this Appendix.

SEDIMENT TRAP A



Depth for 50% Capacity Maintenance

SEDIMENT TRAP B



Depth for 50% Capacity Maintenance



**New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION**

Division of Water

Deep-Ripping and Decompaction

April 2008

**New York State
Department of Environmental Conservation**

Document Prepared by:

John E. Lacey,
Land Resource Consultant and Environmental Compliance Monitor
(Formerly with the Division of Agricultural Protection and Development Services,
NYS Dept. of Agriculture & Markets)

Alternative Stormwater Management Deep-Ripping and Decompaction

Description

The two-phase practice of 1) “Deep Ripping;” and 2) “Decompaction” (deep subsoiling), of the soil material as a step in the cleanup and restoration/landscaping of a construction site, helps mitigate the physically induced impacts of soil compression; i.e.: soil compaction or the substantial increase in the bulk density of the soil material.

Deep Ripping and Decompaction are key factors which help in restoring soil pore space and permeability for water infiltration. Conversely, the physical actions of cut-and-fill work, land grading, the ongoing movement of construction equipment and the transport of building materials throughout a site alter the architecture and structure of the soil, resulting in: the mixing of layers (horizons) of soil materials, compression of those materials and diminished soil porosity which, if left unchecked, severely impairs the soil’s water holding capacity and vertical drainage (rainfall infiltration), from the surface downward.

In a humid climate region, compaction damage on a site is virtually guaranteed over the duration of a project. Soil in very moist to wet condition when compacted, will have severely reduced permeability. Figure 1 displays the early stage of the deep-ripping phase (Note that all topsoil was stripped prior to construction access, and it remains stockpiled until the next phase – decompaction – is complete). A heavy-duty tractor is pulling a three-shank ripper on the first of several series of incrementally deepening passes through the construction access corridor's densely compressed subsoil material. Figure 2 illustrates the approximate volumetric composition of a loam surface soil when conditions are good for plant growth, with adequate natural pore space for fluctuating moisture conditions.



Fig. 1. A typical deep ripping phase of this practice, during the first in a series of progressively deeper “rips” through severely compressed subsoil.

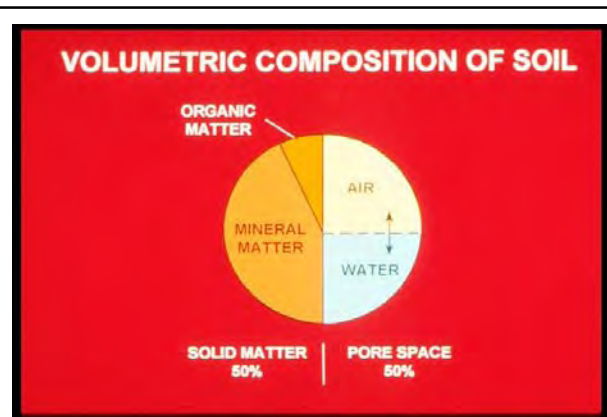


Fig. 2. About 50% of the volume of undisturbed loam surface soil is pore space, when soil is in good condition for plant growth. Brady, 2002.

Recommended Application of Practice

The objective of Deep Ripping and Decompaction is to effectively fracture (vertically and laterally) through the thickness of the physically compressed subsoil material (see Figure 3), restoring soil porosity and permeability and aiding infiltration to help reduce runoff. Together with topsoil stripping, the “two-phase” practice of Deep Ripping and Decompaction first became established as a “best management practice” through ongoing success on commercial farmlands affected by heavy utility construction right-of-way projects (transmission pipelines and large power lines).



Fig. 3. Construction site with significant compaction of the deep basal till subsoil extends 24 inches below this exposed cut-and-fill work surface.

Soil permeability, soil drainage and cropland productivity were restored. For broader construction application, the two-phase practice of Deep Ripping and Decompaction is best adapted to areas impacted with significant soil compaction, on contiguous open portions of large construction sites and inside long, open construction corridors used as temporary access over the duration of construction. Each mitigation area should have minimal above-and-below-ground obstructions for the easy avoidance and maneuvering of a large tractor and ripping/decompacting implements. Conversely, the complete two-phase practice is not recommended in congested or obstructed areas due to the limitations on tractor and implement movement.

Benefits

Aggressive “deep ripping” through the compressed thickness of exposed subsoil before the replacement/respreading of the topsoil layer, followed by “decompaction,” i.e.: “sub-soiling,” through the restored topsoil layer down into the subsoil, offers the following benefits:

- Increases the project (larger size) area’s direct surface infiltration of rainfall by providing the open site’s mitigated soil condition and lowers the demand on concentrated runoff control structures
- Enhances direct groundwater recharge through greater dispersion across and through a broader surface than afforded by some runoff-control structural measures
- Decreases runoff volume generated and provides hydrologic source control
- May be planned for application in feasible open locations either alone or in

conjunction with plans for structural practices (e.g., subsurface drain line or infiltration basin) serving the same or contiguous areas

- Promotes successful long-term revegetation by restoring soil permeability, drainage and water holding capacity for healthy (rather than restricted) root-system development of trees, shrubs and deep rooted ground cover, minimizing plant drowning during wet periods and burnout during dry periods.

Feasibility/Limitations

The effectiveness of Deep Ripping and Decompaction is governed mostly by site factors such as: the original (undisturbed) soil's hydrologic characteristics; the general slope; local weather/timing (soil moisture) for implementation; the space-related freedom of equipment/implement maneuverability (noted above in **Recommended Application of Practice**), and by the proper selection and operation of tractor and implements (explained below in **Design Guidance**). The more notable site-related factors include:

Soil

In the undisturbed condition, each identified soil type comprising a site is grouped into one of four categories of soil hydrology, Hydrologic Soil Group A, B, C or D, determined primarily by a range of characteristics including soil texture, drainage capability when thoroughly wet, and depth to water table. The natural rates of infiltration and transmission of soil-water through the undisturbed soil layers for Group A is "high" with a low runoff potential while soils in Group B are moderate in infiltration and the transmission of soil-water with a moderate runoff potential, depending somewhat on slope. Soils in Group C have slow rates of infiltration and transmission of soil-water and a moderately high runoff potential influenced by soil texture and slope; while soils in Group D have exceptionally slow rates of infiltration and transmission of soil-water, and high runoff potential.

In Figure 4, the profile displays the undisturbed horizons of a soil in Hydrologic Soil Group C and the naturally slow rate of infiltration through the subsoil. The slow rate of infiltration begins immediately below the topsoil horizon (30 cm), due to the limited amount of macro pores, e.g.: natural subsoil fractures, worm holes and root channels. Infiltration after the construction-induced mixing and compression of such subsoil material is virtually absent; but can be restored back to this natural level with the two-phase practice of deep ripping and decompaction, followed by the permanent establishment of an appropriate, deep taproot

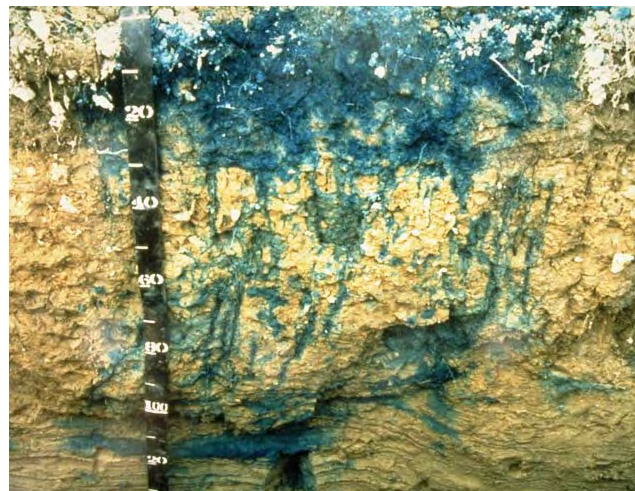


Fig. 4. Profile (in centimeters) displaying the infiltration test result of the natural undisturbed horizons of a soil in Hydrologic Soil Group C.

lawn/ground cover to help maintain the restored subsoil structure. Infiltration after construction-induced mixing and compression of such subsoil material can be notably rehabilitated with the Deep Ripping and Decompaction practice, which prepares the site for the appropriate long-term lawn/ground cover mix including deep taproot plants such as clover, fescue or trefoil, etc. needed for all rehabilitated soils.

Generally, soils in Hydrologic Soil Groups A and B, which respectively may include deep, well-drained, sandy-gravelly materials or deep, moderately well-drained basal till materials, are among the easier ones to restore permeability and infiltration, by deep ripping and decompaction. Among the many different soils in Hydrologic Soil Group C are those unique glacial tills having a natural fragipan zone, beginning about 12 to 18 inches (30 – 45cm), below surface. Although soils in Hydrologic Soil Group C do require a somewhat more carefully applied level of the Deep Ripping and Decompaction practice, it can greatly benefit such affected areas by reducing the runoff and fostering infiltration to a level equal to that of pre-disturbance.

Soils in Hydrologic Soil Group D typically have a permanent high water table close to the surface, influenced by a clay or other highly impervious layer of material. In many locations with clay subsoil material, the bulk density is so naturally high that heavy trafficking has little or no added impact on infiltration; and structural runoff control practices rather than Deep Ripping and Decompaction should be considered.

The information about Hydrologic Soil Groups is merely a general guideline. Site-specific data such as limited depths of cut-and-fill grading with minimal removal or translocation of the inherent subsoil materials (as analyzed in the county soil survey) or, conversely, the excavation and translocation of deeper, unconsolidated substratum or consolidated bedrock materials (unlike the analyzed subsoil horizons' materials referred to in the county soil survey) should always be taken into account.

Sites made up with significant quantities of large rocks, or having a very shallow depth to bedrock, are not conducive to deep ripping and decompaction (subsoiling); and other measures may be more practical.

Slope

The two-phase application of 1) deep ripping and 2) decompaction (deep subsoiling), is most practical on flat, gentle and moderate slopes. In some situations, such as but not limited to temporary construction access corridors, inclusion areas that are moderately steep along a project's otherwise gentle or moderate slope may also be deep ripped and decompacted. For limited instances of moderate steepness on other projects, however, the post-construction land use and the relative alignment of the potential ripping and decompaction work in relation to the lay of the slope should be reviewed for safety and practicality. In broad construction areas predominated by moderately steep or steep slopes, the practice is generally not used.

Local Weather/Timing/Soil Moisture

Effective fracturing of compressed subsoil material from the exposed work surface, laterally and vertically down through the affected zone is achieved only when the soil material is moderately dry to moderately moist. Neither one of the two-phases, deep ripping nor decompaction (deep

subsoiling), can be effectively conducted when the soil material (subsoil or replaced topsoil) is in either a “plastic” or “liquid” state of soil consistency. Pulling the respective implements legs through the soil when it is overly moist only results in the “slicing and smearing” of the material or added “squeezing and compression” instead of the necessary fracturing. Ample drying time is needed for a “rippable” soil condition not merely in the material close to the surface, but throughout the material located down to the bottom of the physically compressed zone of the subsoil.

The “poor man’s Atterberg field test” for soil plasticity is a simple “hand-roll” method used for quick, on-site determination of whether or not the moisture level of the affected soil material is low enough for: effective deep ripping of subsoil; respreading of topsoil in a friable state; and final decompaction (deep subsoiling). Using a sample of soil material obtained from the planned bottom depth of ripping, e.g.: 20 - 24 inches below exposed subsoil surface, the sample is hand rolled between the palms down to a 1/8-inch diameter thread. (Use the same test for stored topsoil material before respreading on the site.) If the respective soil sample crumbles apart in segments no greater than 3/8 of an inch long, by the time it is rolled down to 1/8 inch diameter, it is low enough in moisture for deep ripping (or topsoil replacement), and decompaction. Conversely, as shown in Figure 5, if the rolled sample stretches out in increments greater than 3/8 of an inch long before crumbling, it is in a “plastic” state of soil consistency and is too wet for subsoil ripping (as well as topsoil replacement) and final decompaction.



Fig. 5. Augered from a depth of 19 inches below the surface of the replaced topsoil, this subsoil sample was hand rolled to a 1/8-inch diameter. The test shows the soil at this site stretches out too far without crumbling; it indicates the material is in a plastic state of consistence, too wet for final decompaction (deep subsoiling) at this time.

Design Guidance

Beyond the above-noted site factors, a vital requirement for the effective Deep Ripping and Decompaction (deep subsoiling), is implementing the practice in its distinct, two-phase process:

- 1) Deep rip the affected thickness of exposed subsoil material (see Figure 10 and 11), aggressively fracturing it before the protected topsoil is reapplied on the site (see Figure 12); and
- 2) Decompact (deep subsoil), simultaneously through the restored topsoil layer and the upper half of the affected subsoil (Figure 13). The second phase, “decompaction,” mitigates the partial recompaction which occurs during the heavy process of topsoil spreading/grading. Prior to deep ripping and decompacting the site, all construction activity, including construction equipment and material storage, site cleanup and trafficking (Figure 14), should be finished; and the site closed off to further disturbance. Likewise, once the practice is underway and the area’s soil permeability and

rainfall infiltration are being restored, a policy limiting all further traffic to permanent travel lanes is maintained.

The other critical elements, outlined below, are: using the proper implements (deep, heavy-duty rippers and subsoilers), and ample pulling-power equipment (tractors); and conducting the practice at the appropriate speed, depth and pattern(s) of movement.

Note that an appropriate plan for the separate practice of establishing a healthy perennial ground cover, with deep rooting to help maintain the restored soil structure, should be developed in advance. This may require the assistance of an agronomist or landscape horticulturist.

Implements

Avoid the use of all undersize implements. The small-to-medium, light-duty tool will, at best, only “scarify” the uppermost surface portion of the mass of compacted subsoil material. The term “chisel plow” is commonly but incorrectly applied to a broad range of implements. While a few may be adapted for the moderate subsoiling of non-impacted soils, the majority are less durable and used for only lighter land-fitting (see Figure 6).



Fig. 6. A light duty chisel implement, not adequate for either the deep ripping or decompaction (deep subsoiling) phase.



Fig. 7. One of several variations of an agricultural ripper. This unit has long, rugged shanks mounted on a steel V-frame for deep, aggressive fracturing through Phase 1.

Use a “heavy duty” agricultural-grade, deep ripper (see Figures 7,9,10 and 11) for the first phase: the lateral and vertical fracturing of the mass of exposed and compressed subsoil, down and through, to the bottom of impact, prior to the replacement of the topsoil layer. (Any oversize rocks which are uplifted to the subsoil surface during the deep ripping phase are picked and removed.) Like the heavy-duty class of implement for the first phase, the decompaction (deep subsoiling) of Phase 2 is conducted with the heavy-duty version of the deep subsoiler. More preferable is the angled-leg variety of deep subsoiler (shown in Figures 8 and 13). It minimizes the inversion of the subsoil and topsoil layers while laterally and vertically fracturing the upper half of the previously ripped subsoil layer and all of the topsoil layer by delivering a momentary, wave-like “lifting and shattering” action up through the soil layers as it is pulled.

Pulling-Power of Equipment

Use the following rule of thumb for tractor horsepower (hp) whenever deep ripping and decompacting a significantly impacted site: For both types of implement, have at least 40 hp of tractor pull available for each mounted shank/ leg.

Using the examples of a 3-shank and a 5-shank implement, the respective tractors should have 120 and 200 hp available for fracturing down to the final depth of 20-to-24 inches per phase. Final depth for the deep ripping in Phase 1 is achieved incrementally by a progressive series of passes (see Depth and Patterns of Movement, below); while for Phase 2, the full operating depth of the deep subsoiler is applied from the beginning.

The operating speed for pulling both types of implement should not exceed 2 to 3 mph. At this slow and managed rate of operating speed, maximum functional performance is sustained by the tractor and the implement performing the soil fracturing. Referring to Figure 8, the implement is the 6-leg version of the deep angled-leg subsoiler. Its two outside legs are “chained up” so that only four legs will be engaged (at the maximum depth), requiring no less than 160 hp, (rather than 240 hp) of pull. The 4-wheel drive, articulated-frame tractor in Figure 8 is 174 hp. It will be decompacting this unobstructed, former construction access area simultaneously through 11 inches of replaced topsoil and the upper 12 inches of the previously deep-ripped subsoil. In constricted areas of Phase 1) Deep Ripping, a medium-size tractor with adequate hp, such as the one in Figure 9 pulling a 3-shank deep ripper, may be more maneuverable.

Some industrial-grade variations of ripping implements are attached to power graders and bulldozers. Although highly durable, they are generally not recommended. Typically, the shanks or “teeth” of these rippers are too short and stout; and they are mounted too far apart to achieve the well-distributed type of lateral and vertical fracturing of the soil materials necessary to restore soil permeability and infiltration. In addition, the power graders and bulldozers, as pullers, are far less maneuverable for turns and patterns than the tractor.



Fig. 8. A deep, angled-leg subsoiler, ideal for Phase 2 decompaction of after the topsoil layer is graded on top of the ripped subsoil.



Fig. 9. This medium tractor is pulling a 3-shank deep ripper. The severely compacted construction access corridor is narrow, and the 120 hp tractor is more maneuverable for Phase 1 deep ripping (subsoil fracturing), here.

Depth and Patterns of Movement

As previously noted both Phase 1 Deep Ripping through significantly compressed, exposed subsoil and Phase 2 Decomposition (deep subsoiling) through the replaced topsoil and upper subsoil need to be performed at maximum capable depth of each implement. With an implement's guide wheels attached, some have a "normal" maximum operating depth of 18 inches, while others may go deeper. In many situations, however, the tractor/implement operator must first remove the guide wheels and other non essential elements from the implement. This adapts the ripper or the deep subsoiler for skillful pulling with its frame only a few inches above surface, while the shanks or legs, fracture the soil material 20-to-24 inches deep.

There may be construction sites where the depth of the exposed subsoil's compression is moderate, e.g.: 12 inches, rather than deep. This can be verified by using a $\frac{3}{4}$ inch cone penetrometer and a shovel to test the subsoil for its level of compaction, incrementally, every three inches of increasing depth. Once the full thickness of the subsoil's compacted zone is finally "pieced" and there is a significant drop in the psi measurements of the soil penetrometer, the depth/thickness of compaction is determined. This is repeated at several representative locations of the construction site. If the thickness of the site's subsoil compaction is verified as, for example, ten inches, then the Phase 1 Deep Ripping can be correspondingly reduced to the implement's minimum operable depth of 12 inches. However, the Phase 2 simultaneous Decomposition (subsoiling) of an 11 inch thick layer of replaced topsoil and the upper subsoil should run at the subsoiling implements full operating depth.



Fig. 10. An early pass with a 3-shank deep ripper penetrating only 8 inches into this worksite's severely compressed subsoil.



Fig. 11. A repeat run of the 3-shank ripper along the same patterned pass area as Fig. 9; here, incrementally reaching 18 of the needed 22 inches of subsoil fracture.

Typically, three separate series (patterns) are used for both the Phase 1 Deep Ripping and the Phase 2 Decomposition on significantly compacted sites. For Phase 1, each series begins with a moderate depth of rip and, by repeat-pass, continues until full depth is reached. Phase 2 applies the full depth of Decomposition (subsoiling), from the beginning.

Every separate series (pattern) consists of parallel, forward-and-return runs, with each progressive

pass of the implement's legs or shanks evenly staggered between those from the previous pass. This compensates for the shank or leg-spacing on the implement, e.g., with 24-to-30 inches between each shank or leg. The staggered return pass ensures lateral and vertical fracturing actuated every 12 to 15 inches across the densely compressed soil mass.

Large, Unobstructed Areas

For larger easy areas, use the standard patterns of movement:

- The first series (pattern) of passes is applied lengthwise, parallel with the longest spread of the site; gradually progressing across the site's width, with each successive pass.
- The second series runs obliquely, crossing the first series at an angle of about 45 degrees.
- The third series runs at right angle (or 90 degrees), to the first series to complete the fracturing and shattering on severely compacted sites, and avoid leaving large unbroken blocks of compressed soil material. (In certain instances, the third series may be optional, depending on how thoroughly the first two series loosen the material and eliminate large chunks/blocks of material as verified by tests with a $\frac{3}{4}$ -inch cone penetrometer.)



Fig. 12. Moderately dry topsoil is being replaced on the affected site now that Phase 1 deep ripping of the compressed subsoil is complete.



Fig. 13. The same deep, angled-leg subsoiler shown in Fig. 7 is engaged at maximum depth for Phase 2, decompaction (deep soiling), of the replaced topsoil and the upper subsoil materials.

Corridors

In long corridors of limited width and less maneuverability than larger sites, e.g.: along compacted areas used as temporary construction access, a modified series of pattern passes are used.

- First, apply the same initial lengthwise, parallel series of passes described above.

- A second series of passes makes a broad “S” shaped pattern of rips, continually and gradually alternating the “S” curves between opposite edges inside the compacted corridor.
- The third and final series again uses the broad, alternating S pattern, but it is “flip-flopped” to continually cross the previous S pattern along the corridor’s centerline. This final series of the S pattern curves back along the edge areas skipped by the second series.

Maintenance and Cost

Once the two-phase practice of Deep Ripping and Decompan is completed, two items are essential for maintaining a site’s soil porosity and permeability for infiltration. They are: planting and maintaining the appropriate ground cover with deep roots to maintain the soil structure (see Figure 15); and keeping the site free of traffic or other weight loads.

Note that site-specific choice of an appropriate vegetative ground-cover seed mix, including the proper seeding ratio of one or more perennial species with a deep taproot system and the proper amount of lime and soil nutrients (fertilizer mix) adapted to the soil-needs, are basic to the final practice of landscaping, i.e: surface tillage, seeding/planting/fertilizing and culti-packing or mulching is applied. The "maintenance" of an effectively deep-ripped and decompacted area is generally limited to the successful perennial (long-term) landscape ground cover; as long as no weight-bearing force of soil compaction is applied.



Fig. 14. The severely compacted soil of a temporary construction yard used daily by heavy equipment for four months; shown before deep ripping, topsoil replacement, and decompaction.



Fig. 15. The same site as Fig. 14 after deep ripping of the exposed subsoil, topsoil replacement, decompaction through the topsoil and upper subsoil and final surface tillage and revegetation to maintain soil permeability and infiltration.

The Deep Ripping and Decompaction practice is, by necessity, more extensive than periodic subsoiling of farmland. The cost of deep ripping and decompacting (deep subsoiling), will vary according to the depth and severity of soil-material compression and the relative amount of tractor and implement time that is required. In some instances, depending on open maneuverability, two-to-three acres of compacted project area may be deep-ripped in one day. In other situations of more severe compaction and - or less maneuverability, as little as one acre may be fully ripped in a day. Generally, if the Phase 1) Deep Ripping is fully effective, the Phase 2) Decompaction should be completed in $\frac{2}{3}$ to $\frac{3}{4}$ of the time required for Phase 1.

Using the example of two acres of Phase 1) Deep Ripping in one day, at \$1800 per day, the net cost is \$900 per acre. If the Phase 2) Decompacting or deep subsoiling takes $\frac{3}{4}$ the time as Phase 1, it costs \$675 per acre for a combined total of \$1575 per acre to complete the practice (these figures do not include the cost of the separate practice of topsoil stripping and replacement). Due to the many variables, it must be recognized that cost will be determined by the specific conditions or constraints of the site and the availability of proper equipment.

Resources

Publications:

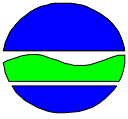
- American Society of Agricultural Engineers. 1971. *Compaction of Agricultural Soils*. ASAE.
- Brady, N.C., and R.R. Weil. 2002. *The Nature and Properties of Soils*. 13th ed. Pearson Education, Inc.
- Baver, L.D. 1948. *Soil Physics*. John Wiley & Sons.
- Carpachi, N. 1987 (1995 fifth printing). *Excavation and Grading Handbook, Revised*. 2nd ed. Craftsman Book Company
- Ellis, B. (Editor). 1997. *Safe & Easy Lawn Care: The Complete Guide to Organic Low Maintenance Lawn*. Houghton Mifflin.
- Harpstead, M.I., T.J. Sauer, and W.F. Bennett. 2001. *Soil Science Simplified*. 4th ed. Iowa State University Press.
- Magdoff, F., and H. van Es. 2000. *Building Soils for Better Crops*. 2nd ed. Sustainable Agricultural Networks
- McCarthy, D.F. 1993. *Essentials of Soil Mechanics and Foundations, Basic Geotechnics* 4th ed. Regents/Prentice Hall.
- Plaster, E.J. 1992. *Soil Science & Management*. 3rd ed. Delmar Publishers.
- Union Gas Limited, Ontario, Canada. 1984. *Rehabilitation of Agricultural Lands, Dawn-Kerwood Loop Pipeline; Technical Report*. Ecological Services for Planning, Ltd.; Robinson, Merritt & Devries, Ltd. and Smith, Hoffman Associates, Ltd.
- US Department of Agriculture in cooperation with Cornell University Agricultural Experiment Station. Various years. *Soil Survey of (various names) County, New York*. USDA.

Internet Access:

- Examples of implements:
V-Rippers. Access by internet search of *John Deere Ag -New Equipment for 915* (larger-frame model) *V-Ripper*; and, *for 913* (smaller-frame model) *V-Ripper*. Deep, angled-leg subsoiler. Access by internet search of: *Bigham Brothers Shear Bolt Paratill-Subsoiler*.
http://salesmanual.deere.com/sales/salesmanual/en_NA/primary_tillage/2008/feature/rippers/915v_pattern_frame.html?sbu=ag&link=prodcut Last visited March 08.
- Soils data of USDA Natural Resources Conservation Service. *NRCS Web Soil Survey*.
<http://websoilsurvey.nrcs.usda.gov/app/> and *USDA-NRCS Official Soil Series Descriptions; View by Name*. <http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi> . Last visited Jan. 08.
- Soil penetrometer information. Access by internet searches of: *Diagnosing Soil Compaction using a Penetrometer (soil compaction tester)*, PSU Extension; as well as *Dickey-john Soil Compaction Tester*.
<http://www.dickey-johnproducts.com/pdf/SoilCompactionTest.pdf> and <http://cropsoil.psu.edu/Extension/Facts/uc178pdf> Last visited Sept. 07

APPENDIX F

NOTICE OF INTENT



New York State Department of Environmental Conservation

Division of Water

625 Broadway, 4th Floor

Albany, New York 12233-3505

NYR

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(for DEC use only)

Stormwater Discharges Associated with Construction Activity Under State Pollutant Discharge Elimination System (SPDES) General Permit # GP-0-20-001

All sections must be completed unless otherwise noted. Failure to complete all items may result in this form being returned to you, thereby delaying your coverage under this General Permit. Applicants must read and understand the conditions of the permit and prepare a Stormwater Pollution Prevention Plan prior to submitting this NOI. Applicants are responsible for identifying and obtaining other DEC permits that may be required.

-IMPORTANT-

RETURN THIS FORM TO THE ADDRESS ABOVE

OWNER/OPERATOR MUST SIGN FORM

Owner/Operator Information

Owner/Operator (Company Name/Private Owner Name/Municipality Name)

T o w n o f O r a n g e t o w n

Owner/Operator Contact Person Last Name (NOT CONSULTANT)

K e n n y

Owner/Operator Contact Person First Name

T e r e s a

Owner/Operator Mailing Address

2 6 O r a n g e b u r g R d .

City

O r a n g e b u r g

State

N Y

Zip

1 0 9 6 2 -

Phone (Owner/Operator)

8 4 5 - 3 5 9 - 5 1 0 0

Fax (Owner/Operator)

- - -

Email (Owner/Operator)

s u p e r v i s o r @ o r a n g e t o w n . c o m

FED TAX ID

- (not required for individuals)

Project Site Information

Project/Site Name

O r a n g e t o w n T o w n H a l l E x p a n s i o n

Street Address (NOT P.O. BOX)

2 6 O r a n g e b u r g R d . , O r a n g e b u r g N Y , 1 0 9 6 2

Side of Street

☒ North ☐ South ☐ East ☐ West

City/Town/Village (THAT ISSUES BUILDING PERMIT)

T o w n o f O r a n g e t o w n

State Zip

N Y 1 0 9 6 2 -

County

R o c k l a n d

DEC Region

3

Name of Nearest Cross Street

D u t c h H i l l R d .

Distance to Nearest Cross Street (Feet)

0

Project In Relation to Cross Street

☐ North ☐ South ☐ East ☒ WestTax Map Numbers
Section-Block-Parcel

7 4 . 1 0 - 1 - 2 6

Tax Map Numbers

1. Provide the Geographic Coordinates for the project site. To do this, go to the NYSDEC Stormwater Interactive Map on the DEC website at:

<https://gisservices.dec.ny.gov/gis/stormwater/>

Zoom into your Project Location such that you can accurately click on the centroid of your site. Once you have located the centroid of your project site, go to the bottom right hand corner of the map for the X, Y coordinates. Enter the coordinates into the boxes below. For problems with the interactive map use the help function.

X Coordinates (Easting)

-7 3 9 5 6 0 0

Ex. -73.749

Y Coordinates (Northing)

4 1 0 4 6 7

Ex. 42.652

2. What is the nature of this construction project?

- ☐ New Construction
- ☒ Redevelopment with increase in impervious area
- ☐ Redevelopment with no increase in impervious area

3. Select the predominant land use for both pre and post development conditions.

SELECT ONLY ONE CHOICE FOR EACH

**Pre-Development
Existing Land Use**

- ☐ FOREST
☐ PASTURE/OPEN LAND
☐ CULTIVATED LAND
☐ SINGLE FAMILY HOME
☐ SINGLE FAMILY SUBDIVISION
☐ TOWN HOME RESIDENTIAL
☐ MULTIFAMILY RESIDENTIAL
☐ INSTITUTIONAL/SCHOOL
☐ INDUSTRIAL
☒ COMMERCIAL
☐ ROAD/HIGHWAY
☐ RECREATIONAL/SPORTS FIELD
☐ BIKE PATH/TRAIL
☐ LINEAR UTILITY
☐ PARKING LOT
☐ OTHER

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**Post-Development
Future Land Use**

- ☐ SINGLE FAMILY HOME
☐ SINGLE FAMILY SUBDIVISION
☐ TOWN HOME RESIDENTIAL
☐ MULTIFAMILY RESIDENTIAL
☐ INSTITUTIONAL/SCHOOL
☐ INDUSTRIAL
☒ COMMERCIAL
☐ MUNICIPAL
☐ ROAD/HIGHWAY
☐ RECREATIONAL/SPORTS FIELD
☐ BIKE PATH/TRAIL
☐ LINEAR UTILITY (water, sewer, gas, etc.)
☐ PARKING LOT
☐ CLEARING/GRADING ONLY
☐ DEMOLITION, NO REDEVELOPMENT
☐ WELL DRILLING ACTIVITY *(Oil, Gas, etc.)
☐ OTHER

Number of Lots

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***Note:** for gas well drilling, non-high volume hydraulic fractured wells only

4. In accordance with the larger common plan of development or sale, enter the total project site area; the total area to be disturbed; existing impervious area to be disturbed (for redevelopment activities); and the future impervious area constructed within the disturbed area. (Round to the nearest tenth of an acre.)

Total Site Area	Total Area To Be Disturbed	Existing Impervious Area To Be Disturbed	Future Impervious Area Within Disturbed Area																								
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			5	.	1																						
			2	.	9																						
			1	.	3																						
			1	.	9																						

5. Do you plan to disturb more than 5 acres of soil at any one time? ☐ Yes ☐ No

6. Indicate the percentage of each Hydrologic Soil Group(HSG) at the site.

A	B	C	D												
<table border="1"><tr><td></td><td></td><td>0</td></tr></table> %			0	<table border="1"><tr><td></td><td></td><td>0</td></tr></table> %			0	<table border="1"><tr><td>1</td><td>0</td><td>0</td></tr></table> %	1	0	0	<table border="1"><tr><td></td><td></td><td>0</td></tr></table> %			0
		0													
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1	0	0													
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7. Is this a phased project? ☐ Yes ☐ No

8. Enter the planned start and end dates of the disturbance activities.

Start Date	End Date																				
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			/			/															

[illegible]

☐ Wetland / State Jurisdiction On Site (Answer 9b)
☐ Wetland / State Jurisdiction Off Site
☐ Wetland / Federal Jurisdiction On Site (Answer 9b)
☐ Wetland / Federal Jurisdiction Off Site
☐ Stream / Creek On Site
☐ Stream / Creek Off Site
☐ River On Site
☐ River Off Site
☐ Lake On Site
☐ Lake Off Site
☐ Other Type On Site
☐ Other Type Off Site

- ☐ Regulatory Map
- ☐ Delineated by Consultant
- ☐ Delineated by Army Corps of Engineers
- ☐ Other (identify)

[illegible][illegible]

11. Is this project located in one of the Watersheds identified in Appendix C of GP-0-20-001? ☐ Yes ☒ No

13. Does this construction activity disturb land with no existing impervious cover and where the Soil Slope Phase is identified as an E or F on the USDA Soil Survey? ☐ Yes ☒ No

If Yes, what is the acreage to be disturbed?

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Page 4 of 14

15. Does the site runoff enter a separate storm sewer system (including roadside drains, swales, ditches, culverts, etc)? ☒ Yes ☐ No ☐ Unknown

16. What is the name of the municipality/entity that owns the separate storm sewer system?

[illegible]

17. Does any runoff from the site enter a sewer classified as a Combined Sewer? ☐ Yes ☒ No ☐ Unknown

18. Will future use of this site be an agricultural property as defined by the NYS Agriculture and Markets Law? ☐ Yes ☒ No

19. Is this property owned by a state authority, state agency, federal government or local government? ☒ Yes ☐ No

20. Is this a remediation project being done under a Department approved work plan? (i.e. CERCLA, RCRA, Voluntary Cleanup Agreement, etc.) ☐ Yes ☒ No

21. Has the required Erosion and Sediment Control component of the SWPPP been developed in conformance with the current NYS Standards and Specifications for Erosion and Sediment Control (aka Blue Book)? ☒ Yes ☐ No

22. Does this construction activity require the development of a SWPPP that includes the post-construction stormwater management practice component (i.e. Runoff Reduction, Water Quality and Quantity Control practices/techniques)? ☒ Yes ☐ No
- If No, skip questions 23 and 27-39.**

23. Has the post-construction stormwater management practice component of the SWPPP been developed in conformance with the current NYS Stormwater Management Design Manual? ☒ Yes ☐ No

24. The Stormwater Pollution Prevention Plan (SWPPP) was prepared by:

- ☒ Professional Engineer (P.E.)
☐ Soil and Water Conservation District (SWCD)
☐ Registered Landscape Architect (R.L.A.)
☐ Certified Professional in Erosion and Sediment Control (CPESC)
☐ Owner/Operator
☐ Other

[illegible]

SWPPP Preparer

[illegible]

Contact Name (Last, Space, First)

[illegible]

Mailing Address

[illegible]

City

[illegible]

State Zip

N	Y		1	0	9	5	3	-				
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Phone

8	4	5	-	5	3	5	-	5	9	5	9
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Fax

8	4	5	-	5	3	4	-	5	9	9	9
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Email

C	O	M	a	r	a	@	t	e	c	t	o	n	i	c	e	n	g	i	n	e	e	r	i	n	g	.	c	o	m
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[illegible]

SWPPP Preparer Certification

I hereby certify that the Stormwater Pollution Prevention Plan (SWPPP) for this project has been prepared in accordance with the terms and conditions of the GP-0-20-001. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of this permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

First Name

[illegible]

MI

7

Last Name

[illegible]

Signature

--

Date

--	--	--	--

25. Has a construction sequence schedule for the planned management practices been prepared? ☒ Yes ☐ No

26. Select **all** of the erosion and sediment control practices that will be employed on the project site:

Temporary Structural

- ☐ Check Dams
- ☐ Construction Road Stabilization
- ☒ Dust Control
- ☐ Earth Dike
- ☐ Level Spreader
- ☒ Perimeter Dike/Swale
- ☐ Pipe Slope Drain
- ☐ Portable Sediment Tank
- ☐ Rock Dam
- ☐ Sediment Basin
- ☒ Sediment Traps
- ☒ Silt Fence
- ☒ Stabilized Construction Entrance
- ☒ Storm Drain Inlet Protection
- ☒ Straw/Hay Bale Dike
- ☐ Temporary Access Waterway Crossing
- ☐ Temporary Stormdrain Diversion
- ☐ Temporary Swale
- ☐ Turbidity Curtain
- ☐ Water bars

Biotechnical

- Brush Matting
- Wattling

Other

[illegible]

Vegetative Measures

- ☐ Brush Matting
- ☐ Dune Stabilization
- ☐ Grassed Waterway
- ☐ Mulching
- ☐ Protecting Vegetation
- ☐ Recreation Area Improvement
- ☒ Seeding
- ☐ Sodding
- ☒ Straw/Hay Bale Dike
- ☐ Streambank Protection
- ☐ Temporary Swale
- ☐ Topsoiling
- ☐ Vegetating Waterways

Permanent Structural

- ☐ Debris Basin
- ☒ Diversion
- ☐ Grade Stabilization Structure
- ☒ Land Grading
- ☐ Lined Waterway (Rock)
- ☐ Paved Channel (Concrete)
- ☐ Paved Flume
- ☒ Retaining Wall
- ☐ Riprap Slope Protection
- ☐ Rock Outlet Protection
- ☐ Streambank Protection

Post-construction Stormwater Management Practice (SMP) Requirements

Important: Completion of Questions 27-39 is not required if response to Question 22 is No.

27. Identify all site planning practices that were used to prepare the final site plan/layout for the project.

- ☒ **Preservation of Undisturbed Areas**
- ☐ **Preservation of Buffers**
- ☐ **Reduction of Clearing and Grading**
- ☐ **Locating Development in Less Sensitive Areas**
- ☐ **Roadway Reduction**
- ☐ **Sidewalk Reduction**
- ☐ **Driveway Reduction**
- ☐ **Cul-de-sac Reduction**
- ☐ **Building Footprint Reduction**
- ☐ **Parking Reduction**

27a. Indicate which of the following soil restoration criteria was used to address the requirements in Section 5.1.6("Soil Restoration") of the Design Manual (2010 version).

- ☒ All disturbed areas will be restored in accordance with the Soil Restoration requirements in Table 5.3 of the Design Manual (see page 5-22).
- ☐ Compacted areas were considered as impervious cover when calculating the **WQv Required**, and the compacted areas were assigned a post-construction Hydrologic Soil Group (HSG) designation that is one level less permeable than existing conditions for the hydrology analysis.

28. Provide the total Water Quality Volume (WQv) required for this project (based on final site plan/layout).

Total WQv Required

. acre-feet

29. Identify the RR techniques (Area Reduction), RR techniques(Volume Reduction) and Standard SMPs with RRv Capacity in Table 1 (See Page 9) that were used to reduce the Total WQv Required(#28).

Also, provide in Table 1 the total impervious area that contributes runoff to each technique/practice selected. For the Area Reduction Techniques, provide the total contributing area (includes pervious area) and, if applicable, the total impervious area that contributes runoff to the technique/practice.

Note: Redevelopment projects shall use Tables 1 and 2 to identify the SMPs used to treat and/or reduce the WQv required. If runoff reduction techniques will not be used to reduce the required WQv, skip to question 33a after identifying the SMPs.

Table 1 - Runoff Reduction (RR) Techniques
and Standard Stormwater Management
Practices (SMPs)

RR Techniques (Area Reduction)	Total Contributing Area (acres)	Total Contributing Impervious Area(acres)
○ Conservation of Natural Areas (RR-1) ...	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	and/or <input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Sheetflow to Riparian Buffers/Filters Strips (RR-2)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	and/or <input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Tree Planting/Tree Pit (RR-3)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	and/or <input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Disconnection of Rooftop Runoff (RR-4) ..	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	and/or <input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
RR Techniques (Volume Reduction)		
○ Vegetated Swale (RR-5)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Rain Garden (RR-6)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Stormwater Planter (RR-7)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
● Rain Barrel/Cistern (RR-8)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Porous Pavement (RR-9)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Green Roof (RR-10)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
Standard SMPs with RRv Capacity		
○ Infiltration Trench (I-1)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Infiltration Basin (I-2)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Dry Well (I-3)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Underground Infiltration System (I-4)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Bioretention (F-5)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Dry Swale (O-1)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
Standard SMPs		
○ Micropool Extended Detention (P-1)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Wet Pond (P-2)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Wet Extended Detention (P-3)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Multiple Pond System (P-4)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Pocket Pond (P-5)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Surface Sand Filter (F-1)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Underground Sand Filter (F-2)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Perimeter Sand Filter (F-3)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Organic Filter (F-4)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Shallow Wetland (W-1)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Extended Detention Wetland (W-2)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Pond/Wetland System (W-3)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Pocket Wetland (W-4)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>
○ Wet Swale (O-2)	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> . <input type="text"/> <input type="text"/> <input type="text"/>

Table 2 - Alternative SMPs (DO NOT INCLUDE PRACTICES BEING USED FOR PRETREATMENT ONLY)		Total Contributing Impervious Area(acres)																		
Alternative SMP																				
<input checked="" type="radio"/> Hydrodynamic			0	.	0 6															
<input type="radio"/> Wet Vault																
<input type="radio"/> Media Filter																
<input type="radio"/> Other <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	

Provide the name and manufacturer of the Alternative SMPs (i.e. proprietary practice(s)) being used for WQv treatment.

Name

C	a	s	c	a	d	e		S	e	p	a	r	a	t	o	r												
---	---	---	---	---	---	---	--	---	---	---	---	---	---	---	---	---	--	--	--	--	--	--	--	--	--	--	--	--

Manufacturer

C	o	n	t	e	c	h		E	n	g	i	n	e	e	r	e	d		S	o	l	u	t	i	o	n	s		
---	---	---	---	---	---	---	--	---	---	---	---	---	---	---	---	---	---	--	---	---	---	---	---	---	---	---	---	--	--

Note: Redevelopment projects which do not use RR techniques, shall use questions 28, 29, 33 and 33a to provide SMPs used, total WQv required and total WQv provided for the project.

[illegible]

Manufacturer	C o n t e c h	E n g i n e e r e d	S o l u t i o n s
--------------	---------------	---------------------	-------------------

30. Indicate the Total RRv provided by the RR techniques (Area/Volume Reduction) and Standard SMPs with RRv capacity identified in question 29.

		0	.	0	8	5
--	--	---	---	---	---	---

 acre-feet

If Yes, go to question 36.
If No, go to question 32.

		0
--	--	---

 .

0	2	2
---	---	---

acre-feet

If No, sizing criteria has not been met, so NOI can not be processed. SWPPP preparer must modify design to meet sizing criteria.

33. Identify the Standard SMPs in Table 1 and, if applicable, the Alternative SMPs in Table 2 that were used to treat the remaining total WQv(=Total WQv Required in 28 - Total RRv Provided in 30).

Also, provide in Table 1 and 2 the total impervious area that contributes runoff to each practice selected.

Note: Use Tables 1 and 2 to identify the SMPs used on Redevelopment projects.

- 33a. Indicate the Total WQv provided (i.e. WQv treated) by the SMPs identified in question #33 and Standard SMPs with RRv Capacity identified in question 29.

WQv Provided

0 0 8 4 **acre-feet**

Note: For the standard SMPs with RRv capacity, the WQv provided by each practice = the WQv calculated using the contributing drainage area to the practice - RRv provided by the practice. (See Table 3.5 in Design Manual)

34. Provide the sum of the Total RRv provided (#30) and the WQv provided (#33a).

0 1 6 9

35. Is the sum of the RRv provided (#30) and the WQv provided (#33a) greater than or equal to the total WQv required (#28)? ☒ **Yes** ☐ **No**

If Yes, go to question 36.

If No, sizing criteria has not been met, so NOI can not be processed. SWPPP preparer must modify design to meet sizing criteria.

36. Provide the total Channel Protection Storage Volume (CPv) required and provided or select waiver (36a), if applicable.

CPv Required

acre-feet

CPv Provided

acre-feet

- 36a. The need to provide channel protection has been waived because:

- ☐ Site discharges directly to tidal waters or a fifth order or larger stream.
- ☒ Reduction of the total CPv is achieved on site through runoff reduction techniques or infiltration systems.

37. Provide the Overbank Flood (Qp) and Extreme Flood (Qf) control criteria or select waiver (37a), if applicable.

Total Overbank Flood Control Criteria (Qp)

Pre-Development

CFS

Post-development

CFS

Total Extreme Flood Control Criteria (Qf)

Pre-Development

CFS

Post-development

CFS

37a. The need to meet the Qp and Qf criteria has been waived because:

- ☐ Site discharges directly to tidal waters or a fifth order or larger stream.
- ☒ Downstream analysis reveals that the Qp and Qf controls are not required

- ☒ Yes ☐ No

[illegible]

39. Use this space to summarize the specific site limitations and justification for not reducing 100% of WQv required(#28). (See question 32a)
This space can also be used for other pertinent project information.

40. Identify other DEC permits, existing and new, that are required for this project/facility.

- [illegible]

41. Does this project require a US Army Corps of Engineers Wetland Permit? ☐ ☐ ☐ ☐ ☐ ☐

☐ Yes ☒ No

If Yes, Indicate Size of Impact.

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42. Is this project subject to the requirements of a regulated, traditional land use control MS4?
(If No, skip question 43)

☒ Yes ☐ No

43. Has the "MS4 SWPPP Acceptance" form been signed by the principal executive officer or ranking elected official and submitted along with this NOI?

☒ Yes ☐ No

44. If this NOI is being submitted for the purpose of continuing or transferring coverage under a general permit for stormwater runoff from construction activities, please indicate the former SPDES number assigned.

N	Y	P				
---	---	---	--	--	--	--

N	Y	R						
---	---	---	--	--	--	--	--	--

Owner/Operator Certification	
<p>I have read or been advised of the permit conditions and believe that I understand them. I also understand that, under the terms of the permit, there may be reporting requirements. I hereby certify that this document and the corresponding documents were prepared under my direction or supervision. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. I further understand that coverage under the general permit will be identified in the acknowledgment that I will receive as a result of submitting this NOI and can be as long as sixty (60) business days as provided in the general permit. I also understand that, by submitting this NOI, I am acknowledging that the SWPPP has been developed and will be implemented as the first element of construction, and agreeing to comply with all the terms and conditions of the general permit for which this NOI is being submitted.</p>	
Print First Name <div style="border: 1px solid black; height: 30px; width: 100%; position: relative;"> <div style="position: absolute; top: 0; left: 0; right: 0; bottom: 0; border: 1px solid black; display: flex; flex-wrap: wrap;"> <!-- 20 empty boxes for first name --> <!-- This is a simplified representation of the grid --> </div> </div>	MI <div style="border: 1px solid black; height: 30px; width: 100%; position: relative;"> <div style="position: absolute; top: 0; left: 0; right: 0; bottom: 0; border: 1px solid black; display: flex; flex-wrap: wrap;"> <!-- 2 empty boxes for MI --> </div> </div>
Print Last Name <div style="border: 1px solid black; height: 30px; width: 100%; position: relative;"> <div style="position: absolute; top: 0; left: 0; right: 0; bottom: 0; border: 1px solid black; display: flex; flex-wrap: wrap;"> <!-- 20 empty boxes for last name --> </div> </div>	
Owner/Operator Signature <div style="border: 1px solid black; height: 60px; width: 100%;"></div>	
<div style="display: flex; justify-content: flex-end; align-items: center;"> <div style="text-align: center; margin-right: 20px;"> Date <div style="border: 1px solid black; display: inline-block; width: 30px; height: 30px; line-height: 30px;"></div> <div style="border: 1px solid black; display: inline-block; width: 30px; height: 30px; line-height: 30px;"></div> <div style="font-size: 24px; margin: 0 5px;">/</div> <div style="border: 1px solid black; display: inline-block; width: 30px; height: 30px; line-height: 30px;"></div> <div style="border: 1px solid black; display: inline-block; width: 30px; height: 30px; line-height: 30px;"></div> <div style="border: 1px solid black; display: inline-block; width: 30px; height: 30px; line-height: 30px;"></div> </div> </div>	

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Department of
Environmental
Conservation

SWPPP Preparer Certification Form

*SPDES General Permit for Stormwater
Discharges From Construction Activity
(GP-0-20-001)*

Project Site Information

Project/Site Name

Orangetown Town Hall Expansion

Owner/Operator Information

Owner/Operator (Company Name/Private Owner/Municipality Name)

Town of Orangetown

Certification Statement – SWPPP Preparer

I hereby certify that the Stormwater Pollution Prevention Plan (SWPPP) for this project has been prepared in accordance with the terms and conditions of the GP-0-20-001. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of this permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Casey

First name

C

MI

O'Mara

Last Name

Signature 

10/15/21

Date



**Department of
Environmental
Conservation**

**NYS Department of Environmental Conservation
Division of Water
625 Broadway, 4th Floor
Albany, New York 12233-3505**

**MS4 Stormwater Pollution Prevention Plan (SWPPP) Acceptance
Form**
for

Construction Activities Seeking Authorization Under SPDES General Permit

*(NOTE: Attach Completed Form to Notice Of Intent and Submit to Address Above)

I. Project Owner/Operator Information

- | | |
|-------------------------|-----------------------------|
| 1. Owner/Operator Name: | Town of Orangetown |
| 2. Contact Person: | Teresa M. Kenny, Supervisor |
| 3. Street Address: | 26 Orangeburg Road |
| 4. City/State/Zip: | Orangeburg, NY 10962 |

II. Project Site Information

- | | |
|-----------------------|---|
| 5. Project/Site Name: | Orangetown Town Hall Addition and Alterations |
| 6. Street Address: | 26 Orangeburg Road |
| 7. City/State/Zip: | orangeburg, NY 10962 |

III. Stormwater Pollution Prevention Plan (SWPPP) Review and Acceptance Information

- | | |
|---|-----------------------|
| 8. SWPPP Reviewed by: | Bruce W. Peters, P.E. |
| 9. Title/Position: | Engineer IV |
| 10. Date Final SWPPP Reviewed and Accepted: | 10/15/2021 |

IV. Regulated MS4 Information

- | | |
|---|----------------------------|
| 11. Name of MS4: | Town of Orangetown |
| 12. MS4 SPDES Permit Identification Number: | NYR20A 471 |
| 13. Contact Person: | Bruce W. Peters, P.E. |
| 14. Street Address: | 127 Route 303 |
| 15. City/State/Zip: | Orangeburg, New York 10962 |
| 16. Telephone Number: | 1-845-359-6502 ext. 4206 |

MS4 SWPPP Acceptance Form - continued

V. Certification Statement - MS4 Official (principal executive officer or ranking elected official) or Duly Authorized Representative

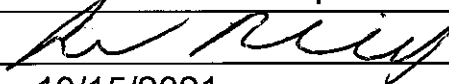
I hereby certify that the final Stormwater Pollution Prevention Plan (SWPPP) for the construction project identified in question 5 has been reviewed and meets the substantive requirements in the SPDES General Permit For Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s).

Note: The MS4, through the acceptance of the SWPPP, assumes no responsibility for the accuracy and adequacy of the design included in the SWPPP. In addition, review and acceptance of the SWPPP by the MS4 does not relieve the owner/operator or their SWPPP preparer of responsibility or liability for errors or omissions in the plan.

Printed Name: Eamon Reilly, P.E.

Title/Position: Commissioner - Dept. of Environmental Management & Engineering

Signature:



Date: 10/15/2021

VI. Additional Information

1. Please be advised that NO construction what-so-ever (including pre-construction SESC installation, demolition, etc.) can begin on the project until the signed Qualified Inspector and site Contractor's Certifications with Contractor's 4-hour - NYSDEC required and approved training certificate(s) have been provided to this Department and made part of all official SWPPPs (Town Copy, field copy, etc.)

2. Please also be advised that once a copy of the SPDES Permit for Construction is received from the NYS DEC, a copy shall be sent to this Department for inclusion in the SWPPP (as well as keeping a copy in all other required SWPPPs/ SWPPP locations).

APPENDIX G

**New York State Department of Environmental Conservation
Division of Water
625 Broadway, 4th Floor
Albany, New York 12233-3505**

(NOTE: Submit completed form to address above)

NOTICE OF TERMINATION for Storm Water Discharges Authorized
under the SPDES General Permit for Construction Activity

Please indicate your permit identification number: NYR ____ _

I. Owner or Operator Information

1. Owner/Operator Name:

2. Street Address:

3. City/State/Zip:

4. Contact Person:

4a. Telephone:

4b. Contact Person E-Mail:

II. Project Site Information

5. Project/Site Name:

6. Street Address:

7. City/Zip:

8. County:

III. Reason for Termination

9a. ☐ All disturbed areas have achieved final stabilization in accordance with the general permit and SWPPP. ***Date final stabilization completed** (month/year): _____

9b. ☐ Permit coverage has been transferred to new owner/operator. Indicate new owner/operator's permit identification number: NYR ____ _

(Note: Permit coverage can not be terminated by owner identified in I.1. above until new owner/operator obtains coverage under the general permit)

9c. ☐ Other (Explain on Page 2)

IV. Final Site Information:

10a. Did this construction activity require the development of a SWPPP that includes post-construction stormwater management practices? ☐ yes ☐ no (If no, go to question 10f.)

10b. Have all post-construction stormwater management practices included in the final SWPPP been constructed? ☐ yes ☐ no (If no, explain on Page 2)

10c. Identify the entity responsible for long-term operation and maintenance of practice(s)?

**NOTICE OF TERMINATION for Storm Water Discharges Authorized under the
SPDES General Permit for Construction Activity - continued**

10d. Has the entity responsible for long-term operation and maintenance been given a copy of the operation and maintenance plan required by the general permit? ☐ yes ☐ no

10e. Indicate the method used to ensure long-term operation and maintenance of the post-construction stormwater management practice(s):

- ☐ Post-construction stormwater management practice(s) and any right-of-way(s) needed to maintain practice(s) have been deeded to the municipality.
- ☐ Executed maintenance agreement is in place with the municipality that will maintain the post-construction stormwater management practice(s).
- ☐ For post-construction stormwater management practices that are privately owned, a mechanism is in place that requires operation and maintenance of the practice(s) in accordance with the operation and maintenance plan, such as a deed covenant in the owner or operator's deed of record.
- ☐ For post-construction stormwater management practices that are owned by a public or private institution (e.g. school, university or hospital), government agency or authority, or public utility; policy and procedures are in place that ensures operation and maintenance of the practice(s) in accordance with the operation and maintenance plan.

10f. Provide the total area of impervious surface (i.e. roof, pavement, concrete, gravel, etc.) constructed within the disturbance area? _____
(acres)

11. Is this project subject to the requirements of a regulated, traditional land use control MS4? ☐ yes
☐ no
(If Yes, complete section VI - "MS4 Acceptance" statement)

V. Additional Information/Explanation:
(Use this section to answer questions 9c. and 10b., if applicable)

VI. MS4 Acceptance - MS4 Official (principal executive officer or ranking elected official) or Duly Authorized Representative (Note: Not required when 9b. is checked -transfer of coverage)

I have determined that it is acceptable for the owner or operator of the construction project identified in question 5 to submit the Notice of Termination at this time.

Printed Name:

Title/Position:

Signature:

Date:

NOTICE OF TERMINATION for Storm Water Discharges Authorized under the
SPDES General Permit for Construction Activity - continued

VII. Qualified Inspector Certification - Final Stabilization:

I hereby certify that all disturbed areas have achieved final stabilization as defined in the current version of the general permit, and that all temporary, structural erosion and sediment control measures have been removed. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:

Title/Position:

Signature:

Date:

VIII. Qualified Inspector Certification - Post-construction Stormwater Management Practice(s):

I hereby certify that all post-construction stormwater management practices have been constructed in conformance with the SWPPP. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:

Title/Position:

Signature:

Date:

IX. Owner or Operator Certification

I hereby certify that this document was prepared by me or under my direction or supervision. My determination, based upon my inquiry of the person(s) who managed the construction activity, or those persons directly responsible for gathering the information, is that the information provided in this document is true, accurate and complete. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:

Title/Position:

Signature:

Date:

(NYS DEC Notice of Termination - January 2015)

APPENDIX H

CONTRACTOR'S CERTIFICATION

SPDES GENERAL PERMIT FOR STORMWATER DISCHARGES

To be completed by Contractor and filed with Owner's on-site copy of the SWPPP

CONTRACTOR IDENTIFICATION:

Contractor responsible for installing, constructing, repairing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and responsible for construction of all post-construction stormwater management practices included in the SWPPP:

Company:

Address:

Phone Number:

SPECIFIC ELEMENTS OF THE SWPPP THAT THE CONTRACTOR IS RESPONSIBLE FOR:

CERTIFICATION:

I hereby certify that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the qualified inspector during a site inspection. I also understand that the *owner or operator* must comply with the terms and conditions of the New York State Pollutant Discharge Elimination System ("SPDES") general permit for stormwater discharges from construction activities and that it is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Signature:

Name:

Title:

Company:

Date:

TRAINED INDIVIDUAL IDENTIFICATION:

The following trained individual will be on site on a daily basis when soil disturbance activities are being performed:

Name:

Title:

Company:

Individual's training and
expiration date:

SUBCONTRACTOR'S CERTIFICATION
SPDES GENERAL PERMIT FOR STORMWATER DISCHARGES

To be completed by each Subcontractor and filed with Owner's on-site copy of the SWPPP

CONTRACTOR IDENTIFICATION:

Company:

Address:

SUBCONTRACTOR IDENTIFICATION:

Subcontractor responsible for some/all of the following: installing, constructing, repairing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and responsible for construction of all post-construction stormwater management practices included in the SWPPP:

Company:

Address:

Phone Number:

SPECIFIC ELEMENTS OF THE SWPPP THAT THE SUBCONTRACTOR IS RESPONSIBLE FOR:

CERTIFICATION:

I hereby certify that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the qualified inspector during a site inspection. I also understand that the *owner or operator* must comply with the terms and conditions of the New York State Pollutant Discharge Elimination System ("SPDES") general permit for stormwater discharges from construction activities and that it is unlawful for any person to cause or contribute to a violation of water quality standards. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Signature:

Name:

Title:

Company:

Date:

TRAINED INDIVIDUAL IDENTIFICATION:

The following trained individual will be on site on a daily basis when soil disturbance activities are being performed:

Name:

Title:

Company:

Individual's training and
expiration date:

APPENDIX I



Parks, Recreation, and Historic Preservation

ANDREW M. CUOMO
Governor

ERIK KULLESEID
Commissioner

March 12, 2020

Kristofer Mierisch
Senior Environmental Analyst/CRM Specialist
Tectonic Engineering and Surveying Consultants P. C.
70 Pleasant Hill Road
Mountainville, NY 10953

Re: DEC
Orangetown Town Hall Expansion
26 W Orangeburg Rd, Orangeburg, NY 10962
20PR01491

Dear Kristofer Mierisch:

Thank you for requesting the comments of the Office of Parks, Recreation and Historic Preservation (OPRHP). We have reviewed the project in accordance with the New York State Historic Preservation Act of 1980 (Section 14.09 of the New York Parks, Recreation and Historic Preservation Law). These comments are those of the OPRHP and relate only to Historic/Cultural resources. They do not include potential environmental impacts to New York State Parkland that may be involved in or near your project. Such impacts must be considered as part of the environmental review of the project pursuant to the State Environmental Quality Review Act (New York Environmental Conservation Law Article 8) and its implementing regulations (6 NYCRR Part 617).

Based upon this review, it is the opinion of OPRHP that no properties, including archaeological and/or historic resources, listed in or eligible for the New York State and National Registers of Historic Places will be impacted by this project.

If further correspondence is required regarding this project, please be sure to refer to the OPRHP Project Review (PR) number noted above.

Sincerely,

A handwritten signature in black ink, reading "R. Daniel Mackay".

R. Daniel Mackay

Deputy Commissioner for Historic Preservation
Division for Historic Preservation

APPENDIX J

APPENDIX F
CONSTRUCTION SITE INSPECTION
AND MAINTENANCE LOG BOOK

**STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM FOR CONSTRUCTION
ACTIVITIES**

SAMPLE CONSTRUCTION SITE LOG BOOK

Table of Contents

- I. Pre-Construction Meeting Documents
 - a. Preamble to Site Assessment and Inspections
 - b. Pre-Construction Site Assessment Checklist

- II. Construction Duration Inspections
 - a. Directions
 - b. Modification to the SWPPP

I. PRE-CONSTRUCTION MEETING DOCUMENTS

Project Name _____
Permit No. _____ **Date of Authorization** _____
Name of Operator _____
Prime Contractor _____

a. Preamble to Site Assessment and Inspections

The Following Information To Be Read By All Person's Involved in The Construction of Stormwater Related Activities:

The Operator agrees to have a qualified inspector¹ conduct an assessment of the site prior to the commencement of construction² and certify in this inspection report that the appropriate erosion and sediment controls described in the SWPPP have been adequately installed or implemented to ensure overall preparedness of the site for the commencement of construction.

Prior to the commencement of construction, the Operator shall certify in this site logbook that the SWPPP has been prepared in accordance with the State's standards and meets all Federal, State and local erosion and sediment control requirements. A preconstruction meeting should be held to review all of the SWPPP requirements with construction personnel.

When construction starts, site inspections shall be conducted by the qualified inspector at least every 7 calendar days. The Operator shall maintain a record of all inspection reports in this site logbook. The site logbook shall be maintained on site and be made available to the permitting authorities upon request.

Prior to filing the Notice of Termination or the end of permit term, the Operator shall have a qualified inspector perform a final site inspection. The qualified inspector shall certify that the site has undergone final stabilization³ using either vegetative or structural stabilization methods and that all temporary erosion and sediment controls (such as silt fencing) not needed for long-term erosion control have been removed. In addition, the Operator must identify and certify that all permanent structures described in the SWPPP have been constructed and provide the owner(s) with an operation and maintenance plan that ensures the structure(s) continuously functions as designed.

1 Refer to "Qualified Inspector" inspection requirements in the current SPDES General Permit for Stormwater Discharges from Construction Activity for complete list of inspection requirements.

2 "Commencement of construction" means the initial removal of vegetation and disturbance of soils associated with clearing, grading or excavating activities or other construction activities.

3 "Final stabilization" means that all soil-disturbing activities at the site have been completed and a uniform, perennial vegetative cover with a density of eighty (80) percent has been established or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

b. Pre-construction Site Assessment Checklist

(NOTE: Provide comments below as necessary)

1. Notice of Intent, SWPPP, and Contractors Certification:

Yes No NA

- ☐ ☐ ☐ Has a Notice of Intent been filed with the NYS Department of Conservation?
- ☐ ☐ ☐ Is the SWPPP on-site? Where? _____
- ☐ ☐ ☐ Is the Plan current? What is the latest revision date? _____
- ☐ ☐ ☐ Is a copy of the NOI (with brief description) onsite? Where? _____
- ☐ ☐ ☐ Have all contractors involved with stormwater related activities signed a contractor's certification?

2. Resource Protection

Yes No NA

- ☐ ☐ ☐ Are construction limits clearly flagged or fenced?
- ☐ ☐ ☐ Important trees and associated rooting zones, on-site septic system absorption fields, existing vegetated areas suitable for filter strips, especially in perimeter areas, have been flagged for protection.
- ☐ ☐ ☐ Creek crossings installed prior to land-disturbing activity, including clearing and blasting.

3. Surface Water Protection

Yes No NA

- ☐ ☐ ☐ Clean stormwater runoff has been diverted from areas to be disturbed.
- ☐ ☐ ☐ Bodies of water located either on site or in the vicinity of the site have been identified and protected.
- ☐ ☐ ☐ Appropriate practices to protect on-site or downstream surface water are installed.
- ☐ ☐ ☐ Are clearing and grading operations divided into areas <5 acres?

4. Stabilized Construction Access

Yes No NA

- ☐ ☐ ☐ A temporary construction entrance to capture mud and debris from construction vehicles before they enter the public highway has been installed.
- ☐ ☐ ☐ Other access areas (entrances, construction routes, equipment parking areas) are stabilized immediately as work takes place with gravel or other cover.
- ☐ ☐ ☐ Sediment tracked onto public streets is removed or cleaned on a regular basis.

5. Sediment Controls

Yes No NA

- ☐ ☐ ☐ Silt fence material and installation comply with the standard drawing and specifications.
- ☐ ☐ ☐ Silt fences are installed at appropriate spacing intervals
- ☐ ☐ ☐ Sediment/detention basin was installed as first land disturbing activity.
- ☐ ☐ ☐ Sediment traps and barriers are installed.

6. Pollution Prevention for Waste and Hazardous Materials

Yes No NA

- ☐ ☐ ☐ The Operator or designated representative has been assigned to implement the spill prevention avoidance and response plan.
- ☐ ☐ ☐ The plan is contained in the SWPPP on page _____
- ☐ ☐ ☐ Appropriate materials to control spills are onsite. Where? _____

II. CONSTRUCTION DURATION INSPECTIONS

a. Directions:

Inspection Forms will be filled out during the entire construction phase of the project.

Required Elements:

- 1) On a site map, indicate the extent of all disturbed site areas and drainage pathways. Indicate site areas that are expected to undergo initial disturbance or significant site work within the next 14-day period;
- 2) Indicate on a site map all areas of the site that have undergone temporary or permanent stabilization;
- 3) Indicate all disturbed site areas that have not undergone active site work during the previous 14-day period;
- 4) Inspect all sediment control practices and record the approximate degree of sediment accumulation as a percentage of sediment storage volume (for example, 10 percent, 20 percent, 50 percent);
- 5) Inspect all erosion and sediment control practices and record all maintenance requirements such as verifying the integrity of barrier or diversion systems (earthen berms or silt fencing) and containment systems (sediment basins and sediment traps). Identify any evidence of rill or gully erosion occurring on slopes and any loss of stabilizing vegetation or seeding/mulching. Document any excessive deposition of sediment or ponding water along barrier or diversion systems. Record the depth of sediment within containment structures, any erosion near outlet and overflow structures, and verify the ability of rock filters around perforated riser pipes to pass water; and
- 6) Immediately report to the Operator any deficiencies that are identified with the implementation of the SWPPP.

SITE PLAN/SKETCH

Inspector (print name)

Date of Inspection

Qualified Inspector (print name)

Qualified Inspector Signature

The above signed acknowledges that, to the best of his/her knowledge, all information provided on the forms is accurate and complete.

Maintaining Water Quality**Yes No NA**

- ☐ ☐ ☐ Is there an increase in turbidity causing a substantial visible contrast to natural conditions at the outfalls?
- ☐ ☐ ☐ Is there residue from oil and floating substances, visible oil film, or globules or grease at the outfalls?
- ☐ ☐ ☐ All disturbance is within the limits of the approved plans.
- ☐ ☐ ☐ Have receiving lake/bay, stream, and/or wetland been impacted by silt from project?

Housekeeping

1. General Site Conditions

Yes No NA

- ☐ ☐ ☐ Is construction site litter, debris and spoils appropriately managed?
- ☐ ☐ ☐ Are facilities and equipment necessary for implementation of erosion and sediment control in working order and/or properly maintained?
- ☐ ☐ ☐ Is construction impacting the adjacent property?
- ☐ ☐ ☐ Is dust adequately controlled?

2. Temporary Stream Crossing

Yes No NA

- ☐ ☐ ☐ Maximum diameter pipes necessary to span creek without dredging are installed.
- ☐ ☐ ☐ Installed non-woven geotextile fabric beneath approaches.
- ☐ ☐ ☐ Is fill composed of aggregate (no earth or soil)?
- ☐ ☐ ☐ Rock on approaches is clean enough to remove mud from vehicles & prevent sediment from entering stream during high flow.

3. Stabilized Construction Access

Yes No NA

- ☐ ☐ ☐ Stone is clean enough to effectively remove mud from vehicles.
- ☐ ☐ ☐ Installed per standards and specifications?
- ☐ ☐ ☐ Does all traffic use the stabilized entrance to enter and leave site?
- ☐ ☐ ☐ Is adequate drainage provided to prevent ponding at entrance?

Runoff Control Practices

1. Excavation Dewatering

Yes No NA

- ☐ ☐ ☐ Upstream and downstream berms (sandbags, inflatable dams, etc.) are installed per plan.
- ☐ ☐ ☐ Clean water from upstream pool is being pumped to the downstream pool.
- ☐ ☐ ☐ Sediment laden water from work area is being discharged to a silt-trapping device.
- ☐ ☐ ☐ Constructed upstream berm with one-foot minimum freeboard.

Runoff Control Practices (continued)

2. Flow Spreader

Yes No NA

- ☐ ☐ ☐ Installed per plan.
- ☐ ☐ ☐ Constructed on undisturbed soil, not on fill, receiving only clear, non-sediment laden flow.
- ☐ ☐ ☐ Flow sheets out of level spreader without erosion on downstream edge.

3. Interceptor Dikes and Swales

Yes No NA

- ☐ ☐ ☐ Installed per plan with minimum side slopes 2H:1V or flatter.
- ☐ ☐ ☐ Stabilized by geotextile fabric, seed, or mulch with no erosion occurring.
- ☐ ☐ ☐ Sediment-laden runoff directed to sediment trapping structure

4. Stone Check Dam

Yes No NA

- ☐ ☐ ☐ Is channel stable? (flow is not eroding soil underneath or around the structure).
- ☐ ☐ ☐ Check is in good condition (rocks in place and no permanent pools behind the structure).
- ☐ ☐ ☐ Has accumulated sediment been removed?.

5. Rock Outlet Protection

Yes No NA

- ☐ ☐ ☐ Installed per plan.
- ☐ ☐ ☐ Installed concurrently with pipe installation.

Soil Stabilization

1. Topsoil and Spoil Stockpiles

Yes No NA

- ☐ ☐ ☐ Stockpiles are stabilized with vegetation and/or mulch.
- ☐ ☐ ☐ Sediment control is installed at the toe of the slope.

2. Revegetation

Yes No NA

- ☐ ☐ ☐ Temporary seedings and mulch have been applied to idle areas.
- ☐ ☐ ☐ 4 inches minimum of topsoil has been applied under permanent seedings

Sediment Control Practices

1. Silt Fence and Linear Barriers

Yes No NA

- ☐ ☐ ☐ Installed on Contour, 10 feet from toe of slope (not across conveyance channels).
- ☐ ☐ ☐ Joints constructed by wrapping the two ends together for continuous support.
- ☐ ☐ ☐ Fabric buried 6 inches minimum.
- ☐ ☐ ☐ Posts are stable, fabric is tight and without rips or frayed areas.

Sediment accumulation is ____% of design capacity.

Sediment Control Practices (continued)

2. Storm Drain Inlet Protection (Use for Stone & Block; Filter Fabric; Curb; or, Excavated; Filter Sock or Manufactured practices)

Yes No NA

- ☐ ☐ ☐ Installed concrete blocks lengthwise so open ends face outward, not upward.
- ☐ ☐ ☐ Placed wire screen between No. 3 crushed stone and concrete blocks.
- ☐ ☐ ☐ Drainage area is 1 acre or less.
- ☐ ☐ ☐ Excavated area is 900 cubic feet.
- ☐ ☐ ☐ Excavated side slopes should be 2:1.
- ☐ ☐ ☐ 2" x 4" frame is constructed and structurally sound.
- ☐ ☐ ☐ Posts 3-foot maximum spacing between posts.
- ☐ ☐ ☐ Fabric is embedded 1 to 1.5 feet below ground and secured to frame/posts with staples at max 8-inch spacing.
- ☐ ☐ ☐ Posts are stable, fabric is tight and without rips or frayed areas.
- ☐ ☐ ☐ Manufactured insert fabric is free of tears and punctures.
- ☐ ☐ ☐ Filter Sock is not torn or flattened and fill material is contained within the mesh sock.

Sediment accumulation ____% of design capacity.

3. Temporary Sediment Trap

Yes No NA

- ☐ ☐ ☐ Outlet structure is constructed per the approved plan or drawing.
- ☐ ☐ ☐ Geotextile fabric has been placed beneath rock fill.
- ☐ ☐ ☐ Sediment trap slopes and disturbed areas are stabilized.

Sediment accumulation is ____% of design capacity.

4. Temporary Sediment Basin

Yes No NA

- ☐ ☐ ☐ Basin and outlet structure constructed per the approved plan.
- ☐ ☐ ☐ Basin side slopes are stabilized with seed/mulch.
- ☐ ☐ ☐ Drainage structure flushed and basin surface restored upon removal of sediment basin facility.
- ☐ ☐ ☐ Sediment basin dewatering pool is dewatering at appropriate rate.

Sediment accumulation is ____% of design capacity.

Note: Not all erosion and sediment control practices are included in this listing. Add additional pages to this list as required by site specific design. All practices shall be maintained in accordance with their respective standards.

Construction inspection checklists for post-development stormwater management practices can be found in Appendix F of the New York Stormwater Management Design Manual.

CONSTRUCTION DURATION INSPECTIONS

b. Modifications to the SWPPP (To be completed as described below)

The Operator shall amend the SWPPP whenever:

1. There is a significant change in design, construction, operation, or maintenance which may have a significant effect on the potential for the discharge of pollutants to the waters of the United States and which has not otherwise been addressed in the SWPPP; or
2. The SWPPP proves to be ineffective in:
 - a. Eliminating or significantly minimizing pollutants from sources identified in the SWPPP and as required by this permit; or
 - b. Achieving the general objectives of controlling pollutants in stormwater discharges from permitted construction activity; and
3. Additionally, the SWPPP shall be amended to identify any new contractor or subcontractor that will implement any measure of the SWPPP.

Modification & Reason:This image shows a full page of blank, lined paper. It features approximately 20 evenly spaced horizontal black lines across its entire width, providing a guide for handwriting or typing. The paper is otherwise completely empty, with no margins, text, or other markings.

Orangetown Town Hall	CONSTRUCTION INSPECTION STRUCTURE CHECKLIST		INSPECTOR:	PAGE OF
			REPORT NO.	DATE
Cascade- HDS	Y	N	Notes	
1. Unit protected from sediment laden runoff?				
2. Sediment Present?				
3.Oil Sheen Observed?				
4. Outlet/Inlet Plugged?				
5. Vacuuming Required?				
6. Backwash Required?				
7. Additional Protection Required?				
Cistern- Duromaxx	Y	N	Notes	
1. Unit protected from sediment laden runoff?				
2. Sediment Present?				
3.Oil Sheen Observed?				
4. Outlet/Inlet Plugged?				
5. Vacuuming Required?				
6. Backwash Required?				
7. Additional Protection Required?				
ACF R-Tank Storage	Y	N	Notes	
1. Unit protected from sediment laden runoff?				
2. Sediment Present?				
3.Oil Sheen Observed?				
4. Outlet/Inlet Plugged?				
5. Vacuuming Required?				
6. Backwash Required?				
7. Additional Protection Required?				
Additional Comments:				

Orangetown Town Hall Construction Inspection List

Part a - Site Inspection	Y	N	Notes	
1. Are there signs of pollution leaving site?				
2. Are discharge points and receiving waters free of sediment deposits?				
3. Are all structural Stormwater Management Practices (SMPs) working properly?				
4. Are all slopes and disturbed areas not actively being worked properly stabilized?				
5. Are all structural SMPs in good condition?				
6. Is there sediment in SMP structures?				
7. Are additional SMPs needed?				
8. Is the construction permit notice posted?				
9. Changes necessary to the SWPPP?				
10. Has site plan been completed as per SPDES permit requirements?				
Part b - Hazardous Materials	Y	N	N/A	Notes
1. Are there any signs of hazardous materials being exposed to stormwater runoff?				
2. Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?				
3. Are equipment fueling, cleaning & maintenance areas free of spills, leaks, or any other deleterious material?				
4. Are materials that are potential stormwater contaminants stored inside or under cover?				
5. Have there been any reportable quantities releases of hazardous materials?				
6. Was the NYSDEC Spills Hotline notified?				
7. Was the SWPPP modified to include:				
a. Date of Release				
b. Circumstances leading to release				
c. Steps taken to prevent reoccurrence				
Part c - Rain Effects	Y	N	N/A	Notes
1. Are there any signs of significant amounts of mud in the street or outfalls from the rain event?				
2. Are there any erosion control structures (BMPs) damaged or overwhelmed by the rain event?				
3. Are there signs of new ruts, gullies, rills or other damage from the rain event?				
4. Are there any conditions that need immediate attention?				

APPENDIX K



PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.

Rare, Threatened, and Endangered Species Report

Orangetown
Town Hall Expansion
Tax ID: 74.10 - 1 - 26
Town of Orangetown, NY

Submitted To:

Lothrop Associates LLP

333 Westchester Avenue
White Plains, New York 10604

Submitted By:

**Tectonic Engineering &
Surveying Consultants**

70 Pleasant Hill Road, PO Box 37
Mountainville, NY 10953
tectonicengineering.com

RARE, THREATENED, ENDANGERED SPECIES REPORT
TECTONIC WO #9983
ORANGETOWN TOWN HALL EXPANSION – TAX ID: 74.10 – 1 – 26
26 ORANGEBURG ROAD, HAMLET OF ORANGEBURG, TOWN OF ORANGETOWN,
ROCKLAND COUNTY, NEW YORK

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APPENDIX II	USGS TOPOGRAPHIC MAP
APPENDIX III	NRCS CUSTOM SOIL RESOURCE REPORT
APPENDIX IV	USFWS OFFICIAL SPECIES LISTS AND IPAC RESOURCE LIST
APPENDIX V	NYSDEC ERM MAP AND EAF SUMMARY REPORT
APPENDIX VI	SITE PHOTOGRAPHS

CONTACTS:

Project Manager:

Lori Bart
Tectonic Engineering & Surveying Consultants, P.C.
70 Pleasant Hill Road
Mountainville, NY 10953
LBart@tectonicengineering.com
Ph. (845) 534-5959

Environmental Scientist:

Christopher Camacho
Tectonic Engineering & Surveying Consultants, P.C.
70 Pleasant Hill Road
Mountainville, NY 10953
CCamacho@tectonicengineering.com
Ph. (845) 534-5959

1.0 INTRODUCTION

Tectonic Engineering & Surveying Consultants P.C. ("Tectonic") was retained by Lothrop Associates LLP to perform a Rare, Threatened, and Endangered (RTE) Species Assessment for the Orangetown Town Hall Expansion, which is located on a parcel of land designated as Tax ID: 74.10 – 1 – 26 and is located at 26 Orangeburg Road, hamlet of Orangeburg, Town of Orangetown, Rockland County, New York (the "Survey Area"). Maps of the Survey Area are included in **Appendix I**.

The RTE species report aids in the identification and subsequent documentation of potential adverse impacts to flora, fauna, and overall habitat characteristics in the Survey Area. The results of this study will supply general baseline data on the ecological characteristics and observed communities in the Survey Area in accordance with the following:

- Endangered Species Act of 1973 (ESA)
- Bald and Golden Eagle Protection Act (BGEPA)
- Migratory Bird Act (MBA)
- Magnuson-Stevens Act (MSA)
- Environmental Conservation Law Article 11 and 6 NYCRR Part 182

This formal habitat assessment and RTE species report was performed in order to determine what, if any, state and/or federally listed threatened and endangered species and/or other protected species or associated suitable and/or critical habitat may occur or potentially be impacted by construction activity in the Survey Area.

2.0 SITE CHARACTERIZATION

2.1 SITE DESCRIPTION

The Survey Area is located in the Glaciated Triassic Lowlands ecoregion, which is comprised of undulating plains underlain by erodible Triassic sandstones and shales and covered by glacial drift. Much of the native vegetation in much of this ecoregion has been replaced by urban development. Elevation within the Survey Area ranges from approximately 210 feet Above Mean Sea Level (AMSL) to 220 AMSL. According to the aerial map (**Appendix I**) and topographic map (**Appendix II**), the Survey Area appears to be comprised of a paved parking area and driveway, existing buildings, and mowed lawn with trees. The abutting land north of the Survey Area is comprised of residential development, the abutting land west of the Survey Area is the Palisades Interstate Parkway and associated highway on and off ramps; the abutting land east of the Survey Area is comprised of a municipal fire district building; and the abutting land south of the Survey Area is comprised of commercial properties.

Corporate Office

70 Pleasant Hill Road, PO Box 37 | Mountainville, NY 10953
845.534.5959 Tel | 845.534.5999 Fax

tectonicengineering.com

2.2 SOILS

According to the Natural Resource Conservation Services (NRCS) online websoil survey, assessed February 25, 2020, a total of three (3) soil types occurs within the Survey Area (**Appendix III**). Each soil type identified within the Survey Area has a hydric soil rating of not hydric. A summary of the on-site soils is provided in Table 1.

Table 1: Soil Characterization

Soil Symbol	Soil Name	Approximate Percentage of Survey Area	Hydric Soil Rating
WeB	Wethersfield gravelly silt loam, 3 to 8 percent slopes	93.9	Not Hydric
Ux	Urban land	5.0	Not Hydric
WuC	Wethersfield-Urban land complex, 8 to 15 percent slopes	1.1	Not Hydric

3.0 METHODOLOGY

3.1 AGENCY CONSULTATION

An online review of information from federal and state agencies was performed to determine what, if any, critical habitats and/or state or federally protected species exist within the Survey Area. The desktop analysis was used to develop a habitat assessment plan.

3.1.1 UNITED STATES FISH AND WILDLIFE SERVICE

The United States Fish and Wildlife Service (USFWS) Environmental Conservation Online System (ECOS) Information for Planning and Conservation (IPaC) webpage was searched to determine which federally protected species and critical habitats, if any, are potentially present within the Survey Area.

3.1.2 NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

The New York State Department of Environmental Conservation (NYSDEC) Environmental Resource Mapper (ERM) and Environmental Assessment Form (EAF) Summary Report were searched to determine which state protected species and significant natural communities, if any, are potentially present within the Survey Area.

3.2 HABITAT ASSESSMENT

A habitat assessment was performed to determine whether the Survey Area contains habitat for any RTE species. The goal of the habitat assessment was to provide a characterization of the quality and quantity of habitat available to support RTE species. A desktop review of the Survey Area and information obtained from agency consultations was utilized to provide a preliminary characterization of site conditions. Information from the USFWS and NYSDEC was analyzed to identify RTE species that may be found in the vicinity of the Survey Area. Information about the type of habitat preferred by the respective RTE species was compared to the habitats observed in the Survey Area.

4.0 RESULTS

4.1 AGENCY CONSULTATION

4.1.1 UNITED STATES FISH AND WILDLIFE SERVICE

On January 24, 2020, Tectonic generated a USFWS Official Species List and IPaC Resource List for the Survey Area (**Appendix IV**). The results of the report are summarized below:

Proposed, Candidate, Threatened, and Endangered Species

The USFWS Official Species Lists from the New York and Long Island Field Offices indicate that there are no proposed, candidate, threatened, or endangered species that may occur at the proposed project location, and/or may be affected by the proposed project.

Critical Habitats

According to the USFWS Official Species List, the Survey Area does not contain any critical habitat areas.

Migratory Birds

According to the USFWS IPaC Resource List (**Appendix IV**), a total of thirteen (13) migratory bird species of concern may inhabit the Survey Area, including the bald eagle (*Haliaeetus leucocephalus*), black-billed cuckoo (*Coccyzus erythrophthalmus*), bobolink (*Dolichonyx oryzivorus*), Canada warbler (*Cardellina canadensis*), dunlin (*Calidris alpina arctica*), lesser yellowlegs (*Tringa flavipes*), long-eared owl (*Asio otus*), prairie warbler (*Dendroica discolor*), red-headed woodpecker (*Melanerpes erythrocephalus*), red-throated loon (*Gavia stellata*), rusty blackbird (*Euphagus carolinus*), semipalmated sandpiper (*Calidris pusilla*), and wood thrush (*Hylocichla mustelina*).

4.1.2 NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

According to the NYSDEC ERM, the NYSDEC has no records of rare plants and animals in the vicinity of the Survey Area. The NYSDEC ERM and NYSDEC EAF Mapper are included in **Appendix V**.

4.2 HABITAT ASSESSMENT

Tectonic conducted a field assessment on February 18, 2020. Representative photographs of conditions observed during the field assessment are included in **Appendix VI**.

The land in the Survey Area was classified into ecological communities based on *Ecological Communities of New York State, Second Edition, March 2014*. The existing municipal buildings were classified as an urban structure exterior ecological community, which include the exterior surfaces of metal, wood, or concrete structures (such as commercial buildings, apartment buildings, houses, bridges). The unpaved mowed lawn with sporadic tree cover in the Survey Area was classified as a mowed lawn with trees ecological community, which includes residential, recreational, or commercial land in which the groundcover is dominated by clipped grasses and forbs, and it is shaded by at least 30% cover of trees. The paved driveway and parking lot was classified as a paved road / path ecological community, which includes a road or pathway that is paved with asphalt, concrete, brick, or stone. These ecological communities can be found throughout New York State and do not provide suitable habitat for any state or federally designated rare, threatened, or endangered species.

5.0 DISCUSSION AND RECOMMENDATIONS

Based on the preliminary review of the Survey Area and the field habitat assessment, the project is not anticipated to impact state or federally designated RTE species. According to the NYSDEC ERM and EAF Summary Report, the NYSDEC has no records of rare plants and animals in the vicinity of the Survey Area. According to USFWS Official Species Lists from the New York and Long Island Field Offices; there are no proposed, candidate, threatened, or endangered species that may occur at the proposed project location, and/or may be affected by the proposed project. Additionally, during a field habitat assessment, no suitable habitat for any state or federally designated rare, threatened, or endangered species was identified in the Survey Area. Therefore, Tectonic anticipates that the proposed project will have no effect on federal or state regulated rare, threatened or endangered species.

Should you have any questions, comments, concerns, or require any additional information, please do not hesitate to contact the undersigned by phone at (845) 534-5959, or by e-mail at ccamacho@tectonicengineering.com or lbart@tectonicengineering.com.



Christopher Camacho
Environmental Scientist



Lori Bart
Project Manager

6.0 REFERENCES

New York Natural Heritage Program - Ecological Communities of New York State, Second Edition, March 2014.

USFWS 2019 Range-wide Indiana Bat Summer Survey Guidelines, April 2019.

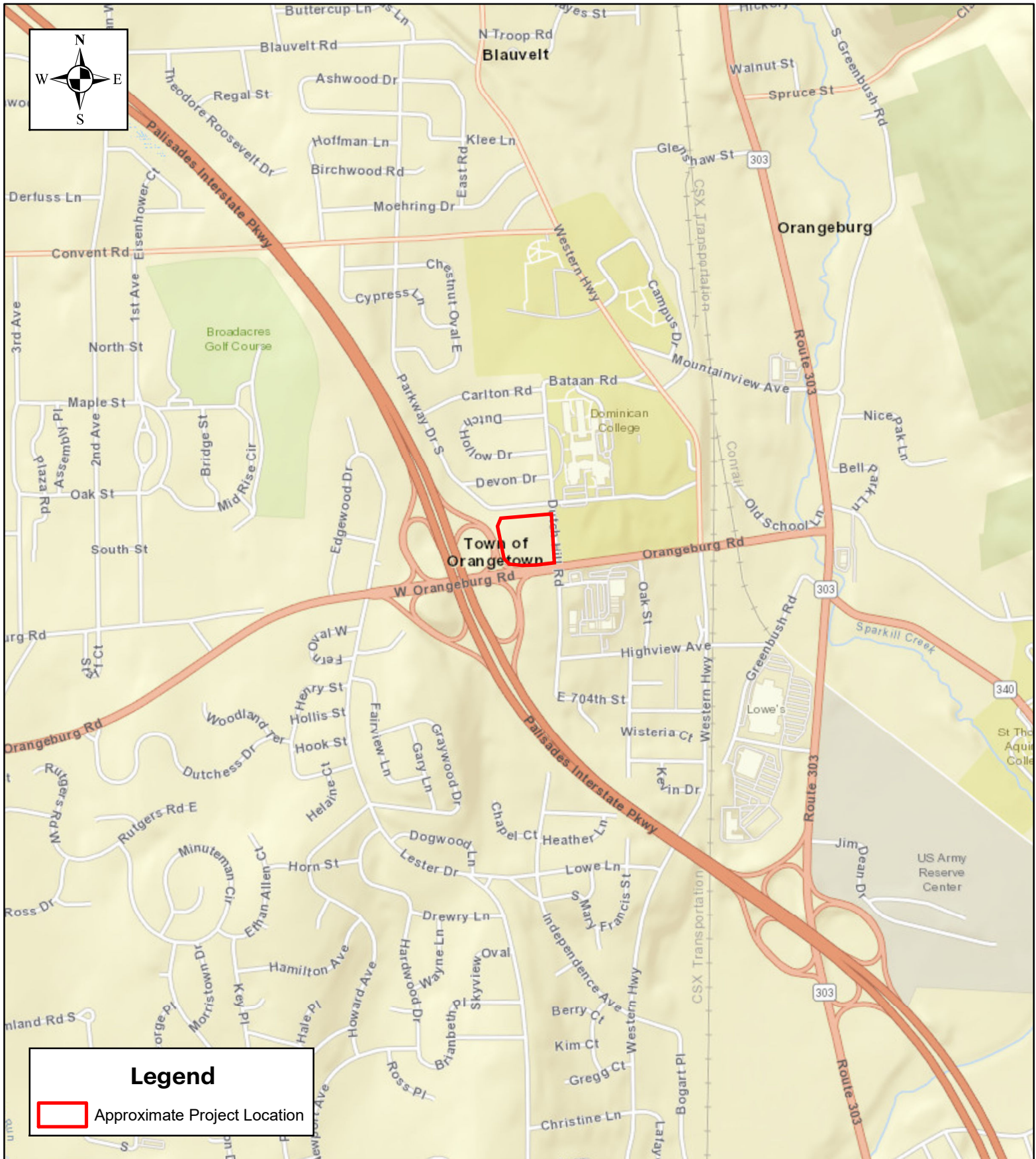
United States Fish and Wildlife Service (USFWS)
<https://ecos.fws.gov/ipac/>

New York Natural Heritage Program (NHP)
<http://www.acris.nynhp.org/>

Natural Resources Conservation Service (NRCS) Web Soil Survey
<https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>

Appendix I


Street Map



Aerial Map



Legend

 Approximate Project Location

Tectonic

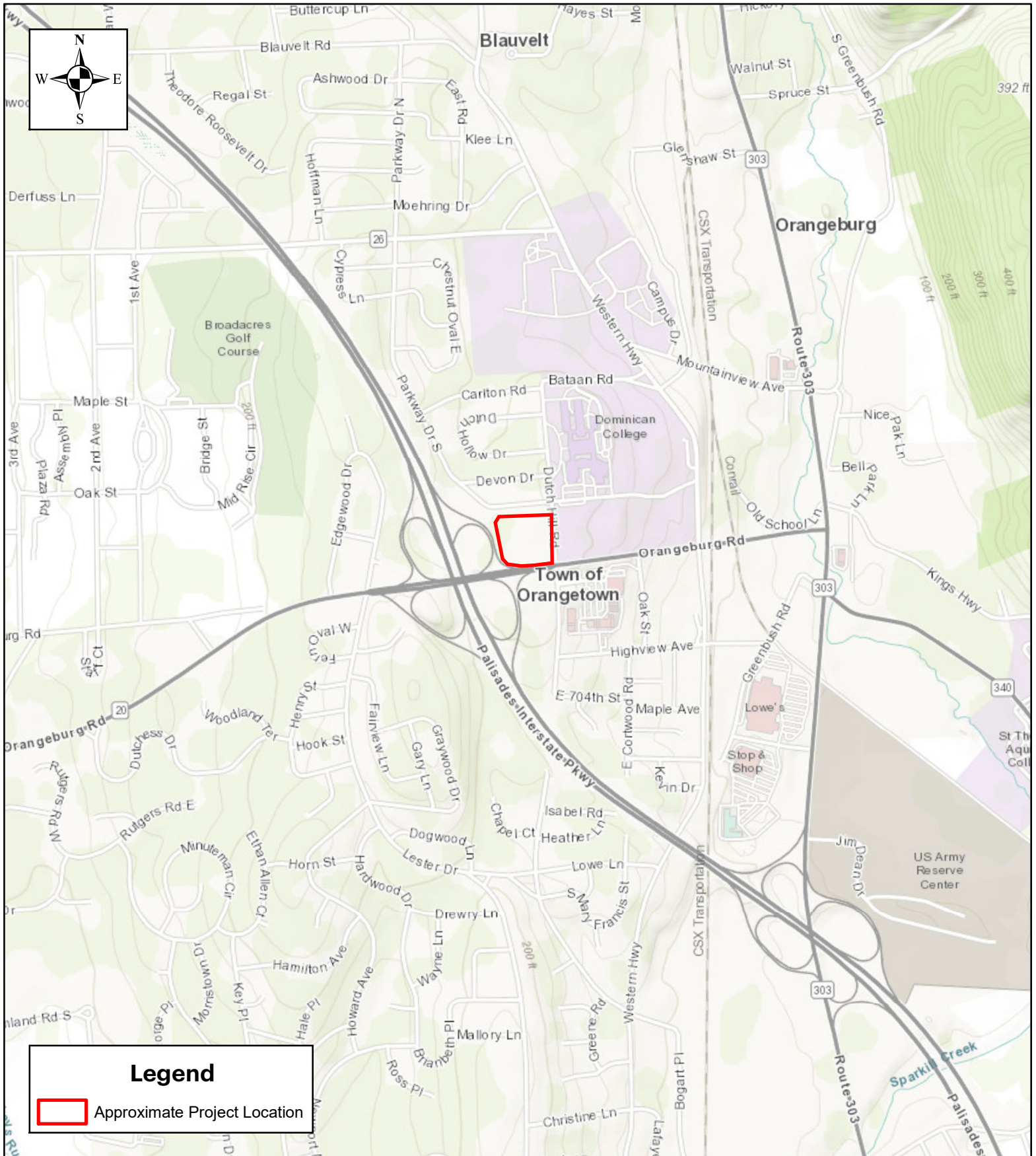
1:5,000

0 250 500 1,000 Feet

Orangetown Town Hall Project
26 Orangeburg Road
Town of Orangetown
Rockland County, New York

Appendix II

Topographic Map



Appendix III



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Rockland County, New York**



February 25, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot


 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rockland County, New York
Survey Area Data: Version 17, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 7, 2013—Feb 26, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ux	Urban land	0.3	5.0%
WeB	Wethersfield gravelly silt loam, 3 to 8 percent slopes	4.8	93.9%
WuC	Wethersfield-Urban land complex, 8 to 15 percent slopes	0.1	1.1%
Totals for Area of Interest		5.1	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or

landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Rockland County, New York

Ux—Urban land

Map Unit Setting

National map unit symbol: 9v5g
Mean annual precipitation: 47 to 50 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Udorthents

Percent of map unit: 5 percent
Hydric soil rating: No

Holyoke

Percent of map unit: 5 percent
Hydric soil rating: No

Yalesville

Percent of map unit: 5 percent
Hydric soil rating: No

Riverhead

Percent of map unit: 5 percent
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Hydric soil rating: No

WeB—Wethersfield gravelly silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9v5l
Mean annual precipitation: 47 to 50 inches
Mean annual air temperature: 48 to 52 degrees F

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Frost-free period: 135 to 215 days

Farmland classification: All areas are prime farmland

Map Unit Composition

Wethersfield and similar soils: 80 percent

Minor components: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wethersfield

Setting

Landform: Hills, till plains

Landform position (two-dimensional): Summit

Landform position (three-dimensional): Crest

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Loamy acid till derived mainly from reddish sandstone, shale, and conglomerate, with some basalt

Typical profile

H1 - 0 to 13 inches: gravelly silt loam

H2 - 13 to 22 inches: gravelly loam

H3 - 22 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: 20 to 38 inches to densic material

Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 18 to 30 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2e

Hydrologic Soil Group: C

Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 5 percent

Hydric soil rating: No

Wallington

Percent of map unit: 5 percent

Hydric soil rating: No

Cheshire

Percent of map unit: 5 percent

Hydric soil rating: No

Riverhead

Percent of map unit: 5 percent

Hydric soil rating: No

WuC—Wethersfield-Urban land complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9v5q
Mean annual precipitation: 47 to 50 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Wethersfield and similar soils: 60 percent
Urban land: 20 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wethersfield

Setting

Landform: Hills, till plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy acid till derived mainly from reddish sandstone, shale, and conglomerate, with some basalt

Typical profile

H1 - 0 to 13 inches: gravelly silt loam
H2 - 13 to 22 inches: gravelly loam
H3 - 22 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 38 inches to densic material
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s

Hydric soil rating: Unranked

Minor Components

Riverhead

Percent of map unit: 5 percent

Hydric soil rating: No

Charlton

Percent of map unit: 5 percent

Hydric soil rating: No

Cheshire

Percent of map unit: 5 percent

Hydric soil rating: No

Udorthents

Percent of map unit: 3 percent

Hydric soil rating: No

Wallington

Percent of map unit: 2 percent

Hydric soil rating: No

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Land Classifications

Land Classifications are specified land use and management groupings that are assigned to soil areas because combinations of soil have similar behavior for specified practices. Most are based on soil properties and other factors that directly influence the specific use of the soil. Example classifications include ecological site classification, farmland classification, irrigated and nonirrigated land capability classification, and hydric rating.

Hydric Rating by Map Unit

This rating indicates the percentage of map units that meets the criteria for hydric soils. Map units are composed of one or more map unit components or soil types, each of which is rated as hydric soil or not hydric. Map units that are made up dominantly of hydric soils may have small areas of minor nonhydric components in the higher positions on the landform, and map units that are made up dominantly of nonhydric soils may have small areas of minor hydric components in the lower positions on the landform. Each map unit is rated based on its respective components and the percentage of each component within the map unit.

The thematic map is color coded based on the composition of hydric components. The five color classes are separated as 100 percent hydric components, 66 to 99 percent hydric components, 33 to 65 percent hydric components, 1 to 32 percent hydric components, and less than one percent hydric components.

In Web Soil Survey, the Summary by Map Unit table that is displayed below the map pane contains a column named 'Rating'. In this column the percentage of each map unit that is classified as hydric is displayed.

Custom Soil Resource Report

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register, 1994). Under natural conditions, these soils are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation.

The NTCHS definition identifies general soil properties that are associated with wetness. In order to determine whether a specific soil is a hydric soil or nonhydric soil, however, more specific information, such as information about the depth and duration of the water table, is needed. Thus, criteria that identify those estimated soil properties unique to hydric soils have been established (Federal Register, 2002). These criteria are used to identify map unit components that normally are associated with wetlands. The criteria used are selected estimated soil properties that are described in "Soil Taxonomy" (Soil Survey Staff, 1999) and "Keys to Soil Taxonomy" (Soil Survey Staff, 2006) and in the "Soil Survey Manual" (Soil Survey Division Staff, 1993).

If soils are wet enough for a long enough period of time to be considered hydric, they should exhibit certain properties that can be easily observed in the field. These visible properties are indicators of hydric soils. The indicators used to make onsite determinations of hydric soils are specified in "Field Indicators of Hydric Soils in the United States" (Hurt and Vasilas, 2006).

References:

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

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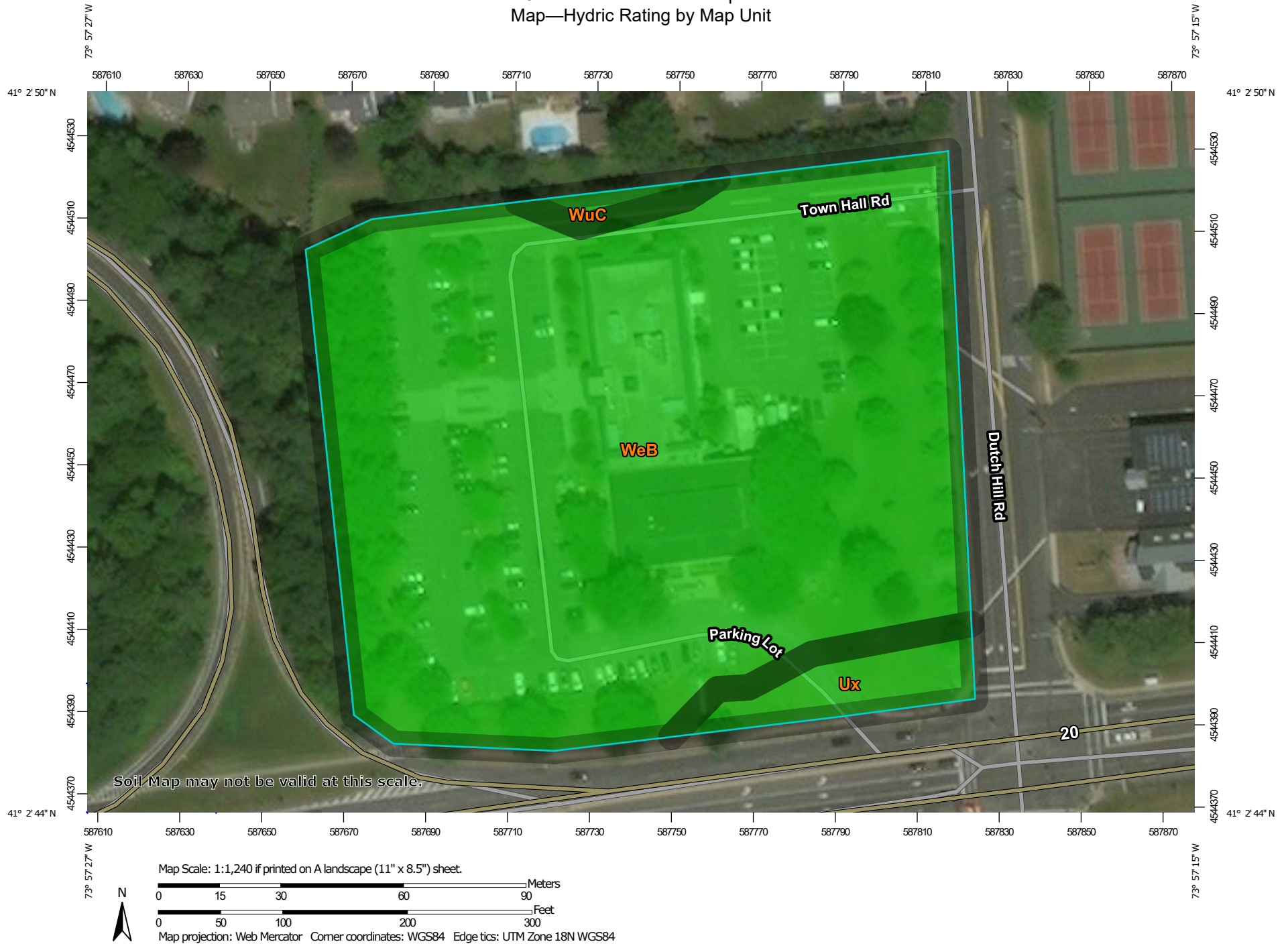
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Custom Soil Resource Report Map—Hydric Rating by Map Unit









MAP LEGEND

Area of Interest (AOI)







 Area of Interest (AOI)

Soils







Soil Rating Polygons

 Hydric (100%)
 Hydric (66 to 99%)
 Hydric (33 to 65%)
 Hydric (1 to 32%)
 Not Hydric (0%)
 Not rated or not available


Soil Rating Lines

 Hydric (100%)
 Hydric (66 to 99%)
 Hydric (33 to 65%)
 Hydric (1 to 32%)
 Not Hydric (0%)
 Not rated or not available






Soil Rating Points

 Hydric (100%)
 Hydric (66 to 99%)
 Hydric (33 to 65%)
 Hydric (1 to 32%)
 Not Hydric (0%)
 Not rated or not available


Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Rockland County, New York
 Survey Area Data: Version 17, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 7, 2013—Feb 26, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydric Rating by Map Unit

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ux	Urban land	0	0.3	5.0%
WeB	Wethersfield gravelly silt loam, 3 to 8 percent slopes	0	4.8	93.9%
WuC	Wethersfield-Urban land complex, 8 to 15 percent slopes	0	0.1	1.1%
Totals for Area of Interest			5.1	100.0%

Rating Options—Hydric Rating by Map Unit

Aggregation Method: Percent Present

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

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- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelpdb1043084>

Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Appendix IV



United States Department of the Interior



FISH AND WILDLIFE SERVICE
New York Ecological Services Field Office
3817 Luker Road

Cortland, NY 13045-9385

Phone: (607) 753-9334 Fax: (607) 753-9699

<http://www.fws.gov/northeast/nyfo/es/section7.htm>

In Reply Refer To:

January 24, 2020

Consultation Code: 05E1NY00-2020-SLI-1394

Event Code: 05E1NY00-2020-E-04308

Project Name: Orangeburg Town Hall Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). This list can also be used to determine whether listed species may be present for projects without federal agency involvement. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list.

Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the ESA, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC site at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list. If listed, proposed, or candidate species were identified as potentially occurring in the project area, coordination with our office is encouraged. Information on the steps involved with assessing potential impacts from projects can be found at: <http://www.fws.gov/northeast/nyfo/es/section7.htm>

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (<http://www.fws.gov/windenergy/>

[eagle_guidance.html](#)). Additionally, wind energy projects should follow the Services wind energy guidelines (<http://www.fws.gov/windenergy/>) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm>; <http://www.towerkill.com>; and <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html>.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the ESA. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New York Ecological Services Field Office

3817 Luker Road

Cortland, NY 13045-9385

(607) 753-9334

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

Long Island Ecological Services Field Office

340 Smith Road

Shirley, NY 11967-2258

(631) 286-0485

Project Summary

Consultation Code: 05E1NY00-2020-SLI-1394

Event Code: 05E1NY00-2020-E-04308

Project Name: Orangeburg Town Hall Project

Project Type: Federal Grant / Loan Related

Project Description: The proposed Project involves the installation of a two-story building with basement, demolition of the existing town hall building, and construction of a pedestrian plaza and parking area on a parcel of land located on 26 Orangetown Road, Town of Orangetown, Rockland County, New York

Project Location:

Approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/place/41.046560698006004N73.95591050592895W>



Counties: Rockland, NY

Endangered Species Act Species

There is a total of 0 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries¹, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

-
1. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Long Island Ecological Services Field Office
340 Smith Road
Shirley, NY 11967-2258
Phone: (631) 286-0485 Fax: (631) 286-4003



In Reply Refer To:

January 24, 2020

Consultation Code: 05E1LI00-2020-SLI-0243

Event Code: 05E1LI00-2020-E-00558

Project Name: Orangeburg Town Hall Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

<http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF>

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (<http://www.fws.gov/windenergy/>) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm>; <http://www.towerkill.com>; and <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html>.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
-

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Long Island Ecological Services Field Office

340 Smith Road

Shirley, NY 11967-2258

(631) 286-0485

This project's location is within the jurisdiction of multiple offices. Expect additional species list documents from the following office, and expect that the species and critical habitats in each document reflect only those that fall in the office's jurisdiction:

New York Ecological Services Field Office

3817 Luker Road

Cortland, NY 13045-9385

(607) 753-9334

Project Summary

Consultation Code: 05E1LI00-2020-SLI-0243

Event Code: 05E1LI00-2020-E-00558

Project Name: Orangeburg Town Hall Project

Project Type: Federal Grant / Loan Related

Project Description: The proposed Project involves the installation of a two-story building with basement, demolition of the existing town hall building, and construction of a pedestrian plaza and parking area on a parcel of land located on 26 Orangetown Road, Town of Orangetown, Rockland County, New York

Project Location:

Approximate location of the project can be viewed in Google Maps: <https://www.google.com/maps/place/41.046560698006004N73.95591050592895W>



Counties: Rockland, NY

Endangered Species Act Species

There is a total of 0 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries¹, as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

-
1. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Location

Rockland County, New York



Local offices

Long Island Ecological Services Field Office

☎ (631) 286-0485

📠 (631) 286-4003

340 Smith Road

Shirley, NY 11967-2258

New York Ecological Services Field Office

☎ (607) 753-9334

📠 (607) 753-9699

3817 Luker Road
Cortland, NY 13045-9385

<http://www.fws.gov/northeast/nyfo/es/section7.htm>

NOT FOR CONSULTATION

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population, even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species

¹ and their critical habitats are managed by the [Ecological Services Program](#) of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries²).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact [NOAA Fisheries](#) for [species under their jurisdiction](#).

-
1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the [listing status page](#) for more information.
 2. [NOAA Fisheries](#), also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

THERE ARE NO ENDANGERED SPECIES EXPECTED TO OCCUR AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act

¹ and the Bald and Golden Eagle Protection Act².

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described [below](#).

1. The [Migratory Birds Treaty Act](#) of 1918.
2. The [Bald and Golden Eagle Protection Act](#) of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern <http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php>
- Measures for avoiding and minimizing impacts to birds <http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php>
- Nationwide conservation measures for birds

The birds listed below are birds of particular concern either because they occur on the [USFWS Birds of Conservation Concern](#) (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ [below](#). This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the [E-bird data mapping tool](#) (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found [below](#).

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME

BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE")

INDICATES THAT THE BIRD DOES
NOT LIKELY BREED IN YOUR
PROJECT AREA.)

Bald Eagle *Haliaeetus leucocephalus*

This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.

<https://ecos.fws.gov/ecp/species/1626>

Breeds Oct 15 to Aug 31

Black-billed Cuckoo *Coccyzus erythrophthalmus*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/9399>

Breeds May 15 to Oct 10

Bobolink *Dolichonyx oryzivorus*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Breeds May 20 to Jul 31

Canada Warbler *Cardellina canadensis*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Breeds May 20 to Aug 10

Dunlin *Calidris alpina arctica*

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Breeds elsewhere

Lesser Yellowlegs *Tringa flavipes*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/9679>

Breeds elsewhere

Long-eared Owl *asio otus*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

<https://ecos.fws.gov/ecp/species/3631>

Breeds elsewhere

Prairie Warbler *Dendroica discolor*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Breeds May 1 to Jul 31

Red-headed Woodpecker *Melanerpes erythrocephalus*

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Breeds May 10 to Sep 10

Red-throated Loon *Gavia stellata*

Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Rusty Blackbird *Euphagus carolinus*

Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Semipalmated Sandpiper *Calidris pusilla*

Breeds elsewhere

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Wood Thrush *Hylocichla mustelina*

Breeds May 10 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

[Nationwide Conservation Measures](#) describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. [Additional measures](#) and/or [permits](#) may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS [Birds of Conservation Concern \(BCC\)](#) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the [Avian Knowledge Network \(AKN\)](#). The AKN data is based on a growing collection of [survey, banding, and citizen science datasets](#) and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle ([Eagle Act](#) requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the [AKN Phenology Tool](#).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the [Avian Knowledge Network \(AKN\)](#). This data is derived from a growing collection of [survey, banding, and citizen science datasets](#).

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: [The Cornell Lab of Ornithology All About Birds Bird Guide](#), or (if you are unsuccessful in locating the bird of interest there), the [Cornell Lab of Ornithology Neotropical Birds guide](#). If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are [Birds of Conservation Concern](#) (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the [Eagle Act](#) requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the [Northeast Ocean Data Portal](#). The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the [NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf](#) project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the [Diving Bird Study](#) and the [nanotag studies](#) or contact [Caleb Spiegel](#) or [Pam Loring](#).

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to [obtain a permit](#) to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which

means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the [National Wildlife Refuge](#) system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to [NWI wetlands](#) and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local [U.S. Army Corps of Engineers District](#).

THERE ARE NO KNOWN WETLANDS AT THIS LOCATION.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tubercid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION

Appendix V



Environmental Resource Mapper

Base Map: Topographical Using this map

Search

Tools

Layers and Legend

☐ All Layers

☐ ★ Unique Geological Features

☐ Waterbody Classifications for Rivers/Streams i

☐ Waterbody Classifications for Lakes

☐ State Regulated Freshwater Wetlands (Outside of the Adirondack Park)

☐ State Regulated Wetland Checkzone i

☐ Significant Natural Communities

☐ Natural Communities Near This Location i

☒ Rare Plants or Animals

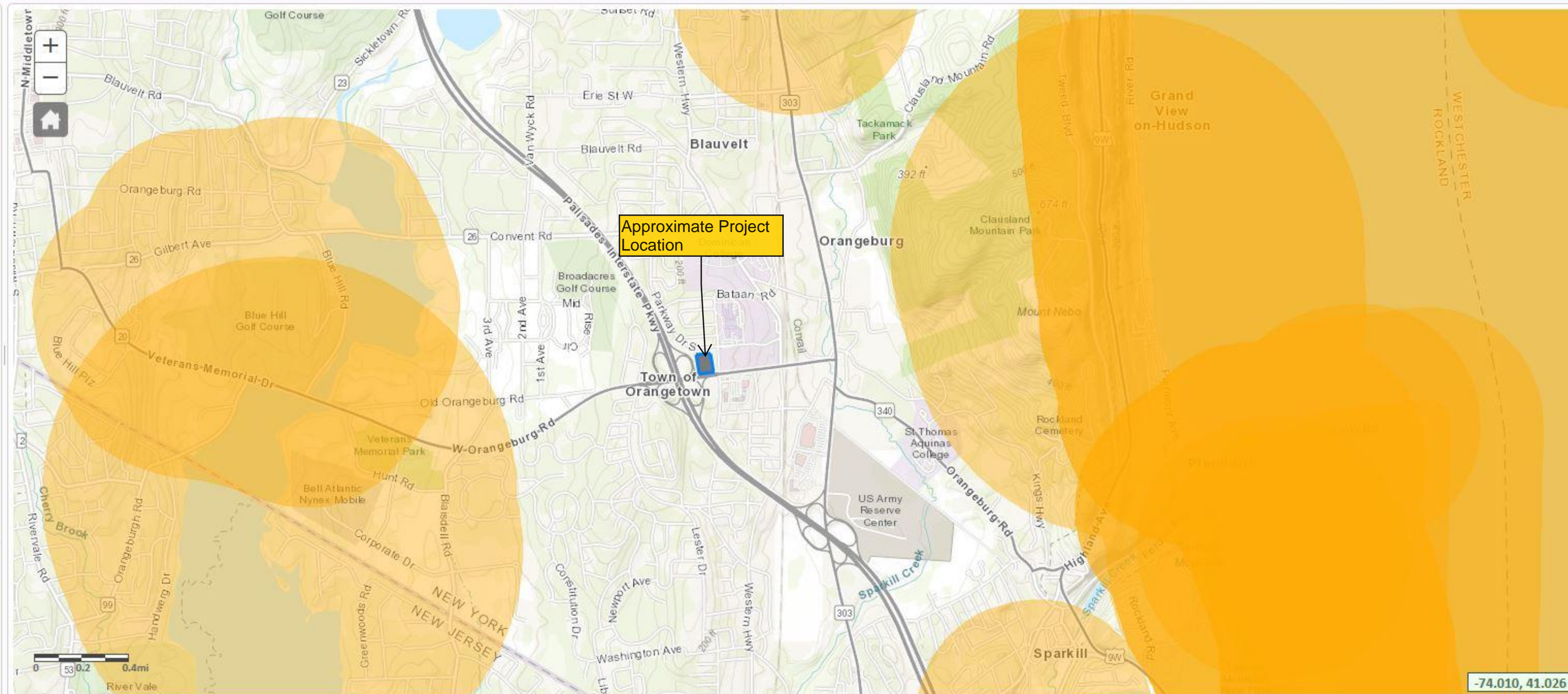
Other Wetland Layers

Reference Layers

Tell Me More...

Need A Permit?

Contacts



Environmental Resource Mapper



The coordinates of the point you clicked on are:

UTM 18	Easting:	587745.1520637264	Northing:	4544447.562191401
Longitude/Latitude	Longitude:	-73.9559508415922	Latitude:	41.04654012202368

The approximate address of the point you clicked on is:

Orangetown Police Department

County: Rockland

Town: Orangetown

USGS Quad: NYACK

DEC Region

Region 3:

(Lower Hudson Valley) Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster and Westchester counties. For more information visit <http://www.dec.ny.gov/about/607.html>.

If your project or action is within or near an area with a rare animal, a permit may be required if the species is listed as endangered or threatened and the department determines the action may be harmful to the species or its habitat.

If your project or action is within or near an area with rare plants and/or significant natural communities, the environmental impacts may need to be addressed.

The presence of a unique geological feature or landform near a project, unto itself, does not trigger a requirement for a NYS DEC permit. Readers are advised, however, that there is the chance that a unique feature may also show in another data layer (ie. a wetland) and thus be subject to permit jurisdiction.

Please refer to the "Need a Permit?" tab for permit information or other authorizations regarding these natural resources.

Disclaimer: If you are considering a project or action in, or near, a wetland or a stream, a NYS DEC permit may be required. The Environmental Resources Mapper does not show all natural resources which are regulated by NYS DEC, and for which permits from NYS DEC are required. For example, Regulated Tidal Wetlands, and Wild, Scenic, and Recreational Rivers, are currently not included on the maps.



Disclaimer: The EAF Mapper is a screening tool intended to assist project sponsors and reviewing agencies in preparing an environmental assessment form (EAF). Not all questions asked in the EAF are answered by the EAF Mapper. Additional information on any EAF question can be obtained by consulting the EAF Workbooks. Although the EAF Mapper provides the most up-to-date digital data available to DEC, you may also need to contact local or other data sources in order to obtain data not provided by the Mapper. Digital data is not a substitute for agency determinations.



B.i.i [Coastal or Waterfront Area]	No
B.i.ii [Local Waterfront Revitalization Area]	No
C.2.b. [Special Planning District]	Digital mapping data are not available or are incomplete. Refer to EAF Workbook.
E.1.h [DEC Spills or Remediation Site - Potential Contamination History]	Digital mapping data are not available or are incomplete. Refer to EAF Workbook.
E.1.h.i [DEC Spills or Remediation Site - Listed]	Digital mapping data are not available or are incomplete. Refer to EAF Workbook.
E.1.h.i [DEC Spills or Remediation Site - Environmental Site Remediation Database]	Digital mapping data are not available or are incomplete. Refer to EAF Workbook.
E.1.h.iii [Within 2,000' of DEC Remediation Site]	Yes
E.1.h.iii [Within 2,000' of DEC Remediation Site - DEC ID]	V00343, C344078, C344066
E.2.g [Unique Geologic Features]	No
E.2.h.i [Surface Water Features]	No
E.2.h.ii [Surface Water Features]	No
E.2.h.iii [Surface Water Features]	No
E.2.h.v [Impaired Water Bodies]	No
E.2.i. [Floodway]	No
E.2.j. [100 Year Floodplain]	No
E.2.k. [500 Year Floodplain]	No
E.2.l. [Aquifers]	No
E.2.n. [Natural Communities]	No
E.2.o. [Endangered or Threatened Species]	No

E.2.p. [Rare Plants or Animals]	No
E.3.a. [Agricultural District]	No
E.3.c. [National Natural Landmark]	No
E.3.d [Critical Environmental Area]	No
E.3.e. [National or State Register of Historic Places or State Eligible Sites]	Yes - Digital mapping data for archaeological site boundaries are not available. Refer to EAF Workbook.
E.3.e.ii [National or State Register of Historic Places or State Eligible Sites - Name]	Palisades Interstate Parkway
E.3.f. [Archeological Sites]	Yes
E.3.i. [Designated River Corridor]	No

Appendix VI

SITE PHOTOS



PHOTO 1: VIEW, LOOKING SOUTH, OF PARKING LOT WEST OF EXISTING TOWN HALL.

Corporate Office

70 Pleasant Hill Road, PO Box 37 | Mountainville, NY 10953
845.534.5959 Tel | 845.534.5999 Fax

tectonicengineering.com



PHOTO 2: VIEW, LOOKING NORTH, OF PARKING LOT WEST OF EXISTING TOWN HALL.



PHOTO 3: VIEW, LOOKING EAST, OF EXISTING TOWN HALL BUILDING.



PHOTO 4: VIEW, LOOKING SOUTH, OF PARKING LOT WEST OF EXISTING TOWN HALL.



PHOTO 5: VIEW, LOOKING NORTH, OF PARKING LOT WEST OF EXISTING TOWN HALL.



PHOTO 6: VIEW, LOOKING EAST, OF PARKING LOT SOUTH OF EXISTING TOWN HALL BUILDING.



PHOTO 7: VIEW, LOOKING NORTH, OF LAWN LOCATED EAST OF EXISTING TOWN HALL (ADJACENT TO DUTCH HILL ROAD).



PHOTO 8: VIEW, LOOKING EAST, OF LAWN LOCATED SOUTHEAST OF EXISTING TOWN HALL, TOWARDS DUTCH HILL ROAD.

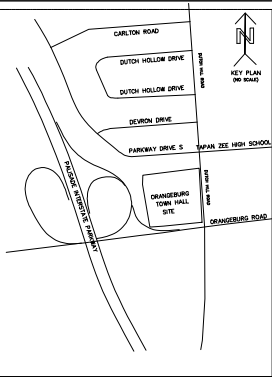
Our Story

For the past 30 years, Tectonic has delivered quality professional services in a timely and cost effective manner by pooling its talented staff into project teams that think, act, and perform as one integral unit. By carefully listening and collaborating with its clients, the firm is able to identify the key issues and assure stakeholder objectives are met in the final deliverables. Through innovating and adopting technological advances, the firm is able to generate unique solutions to improve our nation's deteriorating infrastructure and build safe sustainable communities.

As the world evolves, and its challenges grow more complex, Tectonic continues to innovate and provide the practical solutions and exceptional customer service its clients have trusted since its founding.

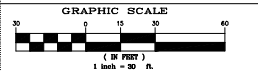
APPENDIX L

Comment: This drawing was prepared by the firm of Lothrop Associates LLP Architects, 333 Westchester Avenue, White Plains, New York 10604, 914-741-1116.



LEGEND & ABBREVIATIONS:

- 47.35 ELEVATION
- ★ LIGHT
- LIGHT POLE
- SIGN
- TREE(14" SIZE)
- UTILITY POLE
- HYDRANT
- WATER VALVE
- GAS VALVE
- DRAINAGE INLET
- CATCH BASIN
- SEWER MANHOLE
- ELECTRIC MANHOLE
- WATER MANHOLE
- W- WATER MAIN
- S- SEWER LINE
- E- ELECTRIC LINE
- G- GAS LINE
- OVER HEAD WIRES
- CHAIN LINK FENCE
- TC TOP OF CURB
- BC BOTTOM OF CURB
- TW TOP OF WALL
- BW BOTTOM OF WALL
- LEGAL GRADE
- C- CABLE LINE
- LIGHT POLE
- CONCRETE CURB
- BUILDING
- DRAIN LINE
- DOUBLE YELLOW LINE
- STORM DRAIN LINE
- OR STORM SANITARY LINE
- AC AIR CONDITIONER
- CONC. CONCRETE PLAT
- PAD
- EXTERIOR ELEVATION
- 300R 30. ELEVATION
- MAN HOLE
- WATER LINE

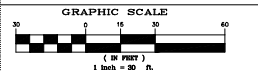


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 3. SEWER MANHOLE, RM AND INVERT ELEVATIONS SHOWN HEREON WERE OBTAINED FROM FIELD MEASUREMENTS.
 4. WATER, ELECTRIC AND GAS LINES SHOWN HEREON ARE TAKEN FROM FIELD MARKING AND MUST BE VERIFIED BEFORE ANY DESIGN.
 5. CONSULT THE APPROPRIATE UTILITY COMPANY PRIOR TO DESIGNING IMPROVEMENTS.
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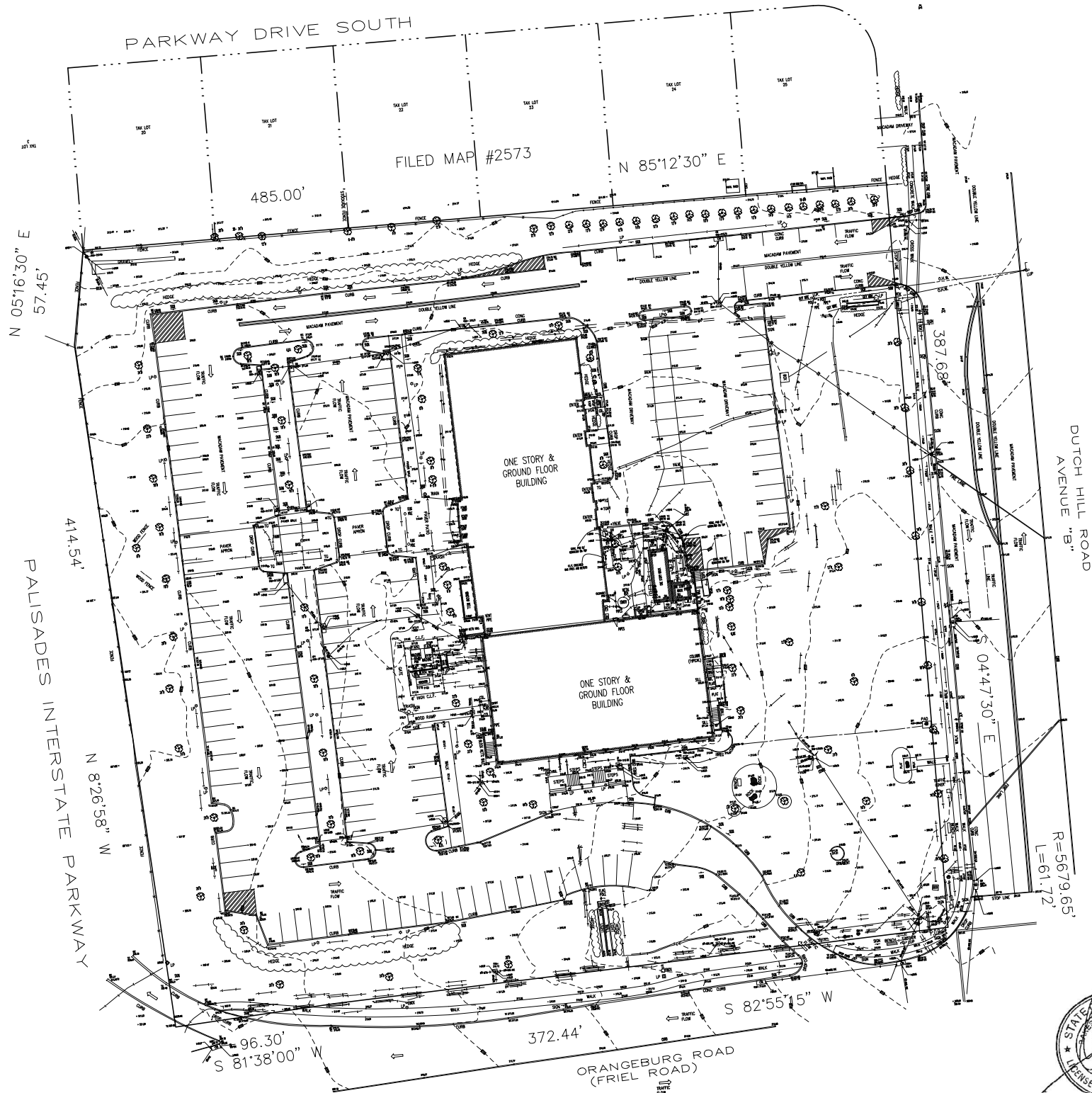
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REVISIONS

NO.	DATE	DESC.	BY
1.	8-5-20	Added conduit pipes near the tower area	RB
2.	8-14-20	Added GAS & ELECTRIC GENERATOR near tower area	RB
3.	8-14-20	ADDED NEW GENERATOR	RB

N/F
ROBBINS CONTRACTING CO. OF N.Y. INC.



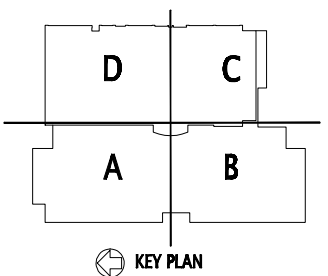
SHEET-1 OF 1
TOPOGRAPHICAL SURVEY OF
ORANGETOWN TOWN HALL
LOCATED AT
TOWN OF ORANGETOWN
ROCKLAND COUNTY STATE OF NEW YORK.
ADDRESS: 26 ORANGETOWN ROAD, ORANGETOWN, N.Y. 10962.
COPYRIGHT © 2019 SUMMIT LAND SURVEYING P.C.

SCALE: 1"=30'-0"
DATE: 12-14-2019
JOB NUMBER:
SC0014-10-33-36(TOP)

Lothrop

Lothrop Associates LLP Architects
333 Westchester Avenue
White Plains, New York 10604
914-741-1116

White Plains Roseton Red Bank Hartford



0	10/13/2021	RELEASED FOR BID
ISSUE NO.	ISSUE DATE	DESCRIPTION



ORANGETOWN
TOWN HALL
ADDITION AND ALTERATIONS
26 ORANGETOWN RD
ORANGETOWN, NEW YORK 10962

EXISTING SITE SURVEY

PROJECT NO.: 2219-05 SCALE: 1" = 30'-0"

DRAWING NO.:

C-001



DEMOLITION NOTES

1. SAW CUTTING OF ASPHALT AND SUBSEQUENT UTILITY INSTALLATIONS SHALL NOT OBSTRUCT THE POLICE DEPARTMENT'S ABILITY TO ENTER AND EXIT THE PARKING LOT. A MINIMUM OF 12 FEET OF ACCESS ON PARKING SPACES DESIGNATED FOR POLICE VEHICLES CONTINUOUSLY DURING AND THROUGHOUT CONSTRUCTION. SEE SITE PLAN FOR POLICE VEHICLE PARKING SPACES.
2. PEDESTRIAN ACCESS TO TOWN HALL BUILDING SHALL BE MAINTAINED THROUGHOUT DURATION OF CONSTRUCTION. PEDESTRIAN ACCESS THROUGH EAST SIDE OF EXISTING BUILDING THAT WILL REMAIN, IS NOT PERMITTED DUE TO THIS BEING THE POLICE OFFICE'S ENTRANCE. SEQUENCING PROVIDED BELOW SHALL BE USED TO MAINTAIN PEDESTRIAN ACCESS.
- A. INSTALL PROPOSED ADDITION AND PEDESTRIAN ACCESS. MAINTAIN EXISTING PEDESTRIAN ACCESS AT SOUTHERN ENTRANCE AND INSTALL TEMPORARY RAMP ON SOUTHERN SIDE OF EXISTING BUILDING WITH ACCESS AT WESTERN ENTRANCE.
- B. DISCONTINUE ACCESS TO EXISTING SOUTH BUILDING. DEMOLISH EXISTING SOUTH BUILDING (NOT IN CONTRACT). PEDESTRIAN ACCESS SHALL BE MAINTAINED THROUGH PROPOSED BUILDING WITH ACCESS AT WESTERN ENTRANCE.
- C. INSTALL SOUTH ACCESS TO EXISTING BUILDING THAT WILL REMAIN AFTER COMPLETE DEMOLITION AND REMOVAL OF DEBRIS OF EXISTING BUILDING TO BE REMOVED. PEDESTRIAN ACCESS THROUGH PROPOSED BUILDING SHALL BE ONLY ACCESS ALLOWED FOR PEDESTRIAN ACCESS UNTIL DEVOLUTION OF EXISTING BUILDING TO BE REMOVED IS COMPLETE.
- D. CONSTRUCTION FENCE SHALL BE USED TO DEMARCAT CURRENT PEDESTRIAN PATHS AT CURRENT SEQUENCE OF CONSTRUCTION. PEDESTRIAN PATHS SHALL BE KEPT CLEAR OF CONSTRUCTION DEBRIS. OBSTACLES SHALL BE DISCONTINUED AND CHANGED OUTSIDE OF TOWN OF ORANGETOWN BUSINESS HOURS OF 9AM TO 5PM. CONTRACTOR SHALL NOTIFY TOWN OF ORANGETOWN WHEN CHANGES SHALL BE OCCURRING.
- E. EXISTING POLICE PEDESTRIAN ACCESS AT EASTERN SIDE OF EXISTING BUILDING THAT WILL REMAIN SHALL BE MAINTAINED THROUGH DURATION OF CONSTRUCTION.
3. SEE SHEET C-102, SITE PLAN, FOR PROPOSED LOCATION OF RELOCATED ITEMS. ITEMS SHALL BE PRESERVED ON-SITE. ANY DAMAGE TO THESE ITEMS SHALL BE THE SOLE RESPONSIBILITY OF THE CONTRACTOR. IF DAMAGED, THESE ITEMS SHALL BE REPLACED TO THE SATISFACTION OF THE TOWN OF ORANGETOWN AT THE SOLE COST TO THE CONTRACTOR.
4. ALL EXISTING SURFACE AND SUBSURFACE IMPROVEMENTS WITHIN THE AREAS DEPICTED AS "TO BE REMOVED" SHALL BE REMOVED OR ABANDONED IN PLACE WHERE ACCEPTABLE. UNLESS OTHERWISE STATED AS "TO REMAIN" OR "TO BE RELOCATED" UNLESS OTHERWISE STATED, ALL WORK SHALL BE PERFORMED BY THE GENERAL CONTRACTOR.
5. FOR CUTTING/TRENCHING OF ADDITIONAL UTILITY CONDUITS, SEE ELECTRICAL PLANS.
6. CONTRACTOR SHALL RESTORE ALL TRENCH WITHIN THE PARCEL LIMITS WITH BRIDGE TO RESTORE TRAFFIC. MILL AND OVERLAY CURB TO CURB AND OVERLAY AT THE END TO PROVIDE A CONTINUOUS TOP SURFACE.
7. AT THE COMPLETION OF DEMOLITION OF PAVEMENT AND BUILDINGS AND PRIOR TO NEW CONSTRUCTION IN VICINITY, CONTRACTOR CAN USE AREA FOR MATERIALS, BORROW, EQUIPMENT, STORAGE, AND STAGING. AREAS SHALL BE COORDINATED WITH OWNER'S REPRESENTATIVE. CONSTRUCTION FENCE SHALL BE INSTALLED AT LIMITS OF STAGING TO VEHICLES, AND PEDESTRIAN TRAFFIC. SEE C-101 FOR SEQUENCING PLAN AND PROPOSED AREAS FOR CONTRACTOR USE.

LEGEND

---	PROPERTY LINE
- - - -	ADJOINING PROPERTY LINE
---	EXISTING CONTOUR LINE
- - - -	EXISTING INDEX CONTOUR LINE
---	DROP CURB
---	EXISTING ELEVATION
---	LIGHT
---	LIGHT POLE
---	SIGN
---	TREE (14" SIZE)
---	UTILITY POLE
---	HYDRANT
---	WATER VALVE
---	GAS VALVE
---	DRAINAGE INLET
---	CATCH BASIN
---	SEWER MANHOLE
---	ELECTRIC MANHOLE
---	WATER MANHOLE
---	WATER MAIN
---	SEWER LINE
---	ELECTRIC LINE
---	GAS LINE
---	DRAIN LINE
---	OVER-HEAD WIRES
---	STORM SEWER/RECONSTRUCT SANITARY LINE
---	TOP OF CURB
---	BOTTOM OF CURB
---	TOP OF WALL
---	BOTTOM OF WALL
---	LEGAL GRADE
---	CABLE LINE
---	LIGHT POLE
---	CONCRETE CURB
---	BUILDING
---	DOUBLE YELLOW LINE
---	AIR CONDITIONER
---	CONCRETE PAD
---	ENTRANCE ELEVATION
---	DOOR SILL ELEVATION
---	MANHOLE
---	BORING
---	TO BE REMOVED
---	MILL AND OVERLAY
---	REMOVAL OF THIS BUILDING NOT IN CONTRACT
---	INDIVIDUAL ITEM TO BE REMOVED
---	TREE PROTECTION
---	SAWCUT PAVEMENT
---	LIMITS OF DISTURBANCE

1 DEMOLITION PLAN
SCALE: 1" = 30'

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White Plains, New York 10604
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ISSUE NO.	ISSUE DATE	DESCRIPTION



ORANGETOWN
TOWN HALL
ADDITION AND
ALTERATIONS

26 ORANGEBURG RD
ORANGETOWN, NY 10962

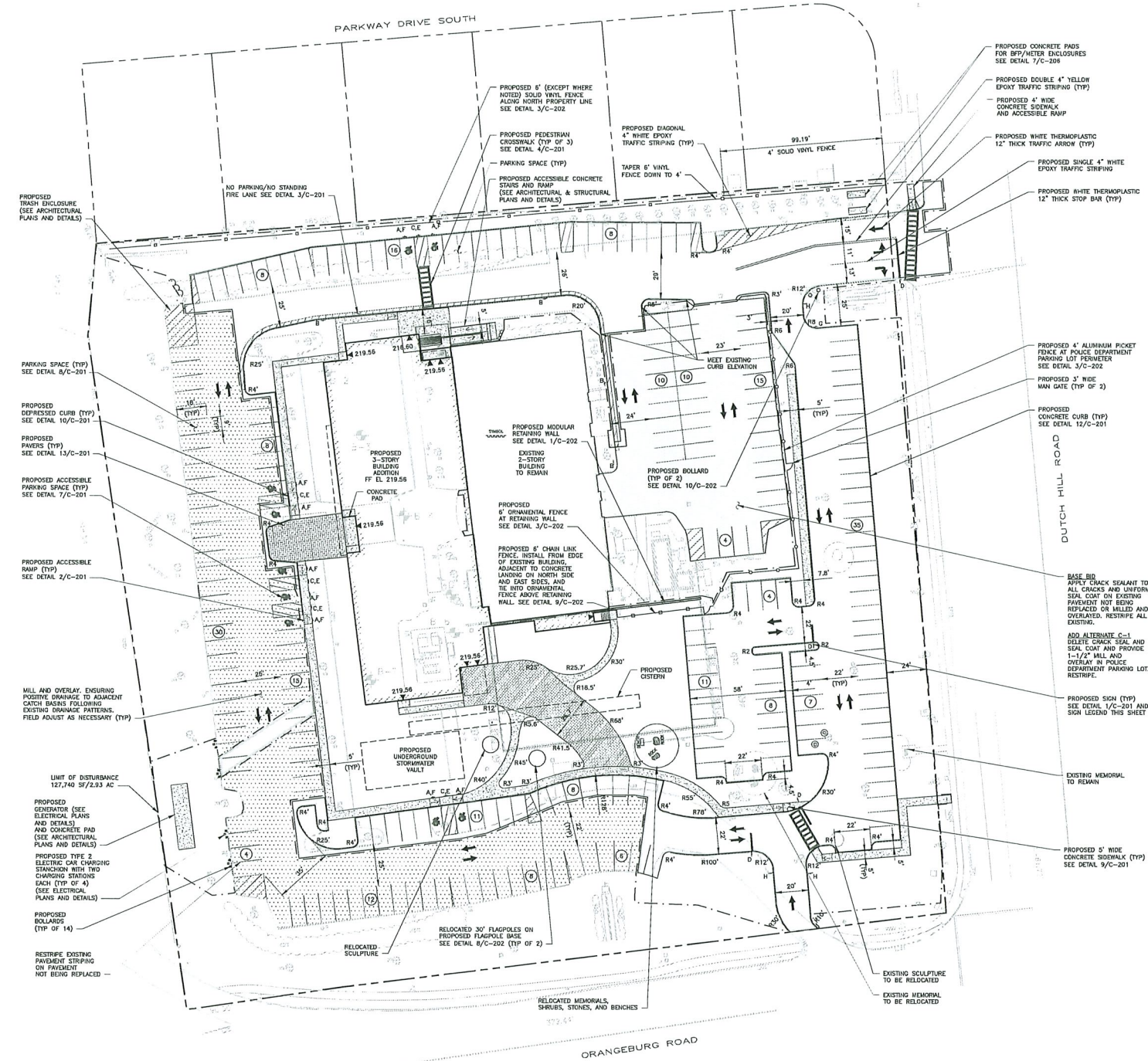
DEMOLITION PLAN

PROJECT NO.: 2219-05 SCALE: 1" = 30'

DRAWING NO.:

C-101

one eighth inch = one foot
one quarter inch = one foot
one half inch = one foot
one inch = one foot
three eighths inch = one foot
three quarters inch = one foot

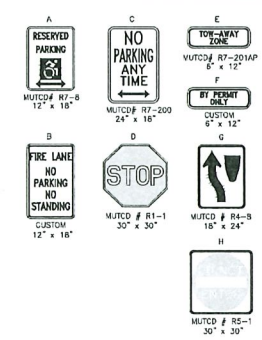


1 SITE PLAN
SCALE: 1" = 30'

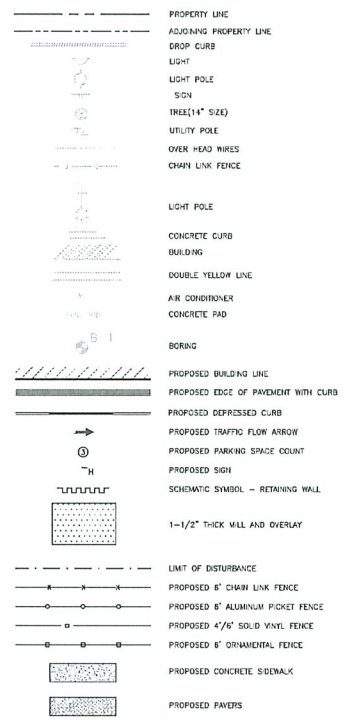
PARKING ALLOCATION

TOTAL SPACES RECOMMENDED:	300 SPACES
LEED REDUCTION (20%) =	60 SPACES
TOTAL SPACES REQUIRED =	240 SPACES
ACCESSIBLE SPACES:	REQUIRED: 7 SPACES PROVIDED: 7 SPACES
TOTAL SPACES RECOMMENDED:	240 SPACES
TOTAL SPACES PROVIDED:	239 SPACES

SIGN LEGEND



LEGEND



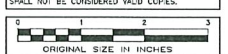
THE MAXIMUM SOIL EXPOSURE
LIMIT IS 14 DAYS

TECTONIC WORK ORDER NO.: 10128.01

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Tectonic Engineering Consultants, Geologists & Land Surveyors, P.C.
70 Pleasant Hill Road
P.O. Box 37
Mountaintop, NY 10953
Phone: (845) 534-5959
(800) 829-6531
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0	10/13/2021	RELEASED FOR BID
ISSUE NO.	ISSUE DATE	DISCUSSION



ORANGETOWN
TOWN HALL
ADDITION AND
ALTERATIONS

26 ORANGEBURG RD
ORANGEBURG, NY 10962

SITE PLAN

PROJECT NO.: 2219-05 SCALE: 1" = 30'

DRAWING NO.:

C-102



ORANGETOWN
TOWN HALL
ADDITION AND
ALTERATIONS

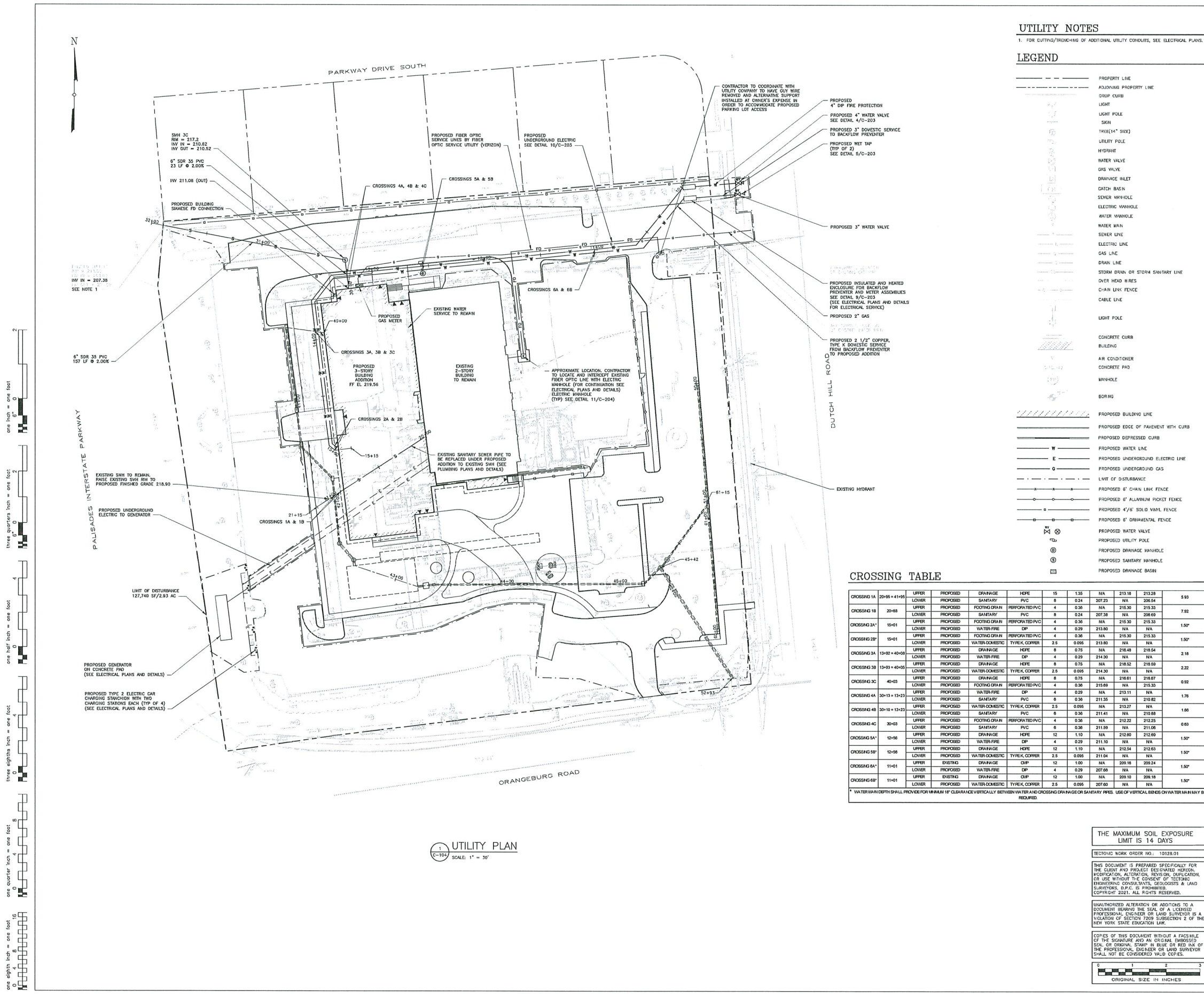
26 ORANGEBURG RD
ORANGEBURG, NY 10962

GRADING & DRAINAGE PLAN

PROJECT NO.: 2219-05 | SCALE: 1" = 30'

DRAWING NO.:

C-103



UTILITY NOTES

1. FOR CUTTING/TRENCHING OF ADDITIONAL UTILITY CONDUITS, SEE ELECTRICAL PLANS.

LEGEND

---	PROPERTY LINE
---	ADJOINING PROPERTY LINE
---	DROP CURB
---	LIGHT
---	LIGHT POLE
---	SIGN
---	TREE(14" SIZE)
---	UTILITY POLE
---	HYDRANT
---	WATER VALVE
---	GAS VALVE
---	DRAINAGE INLET
---	CATCH BASIN
---	SEWER MANHOLE
---	ELECTRIC MANHOLE
---	WATER MANHOLE
---	WATER MAN
---	SEWER LINE
---	ELECTRIC LINE
---	GAS LINE
---	DRAIN LINE
---	STORM DRAIN OR STORM SANITARY LINE
---	OVER HEAD WIRES
---	CHAIN LINK FENCE
---	CABLE LINE
---	LIGHT POLE
---	CONCRETE CURB
---	BUILDING
---	AIR CONDITIONER
---	CONCRETE PAD
---	MANHOLE
---	BORING
---	PROPOSED BUILDING LINE
---	PROPOSED EDGE OF PAVEMENT WITH CURB
---	PROPOSED DEPRESSED CURB
---	PROPOSED WATER LINE
---	PROPOSED UNDERGROUND ELECTRIC LINE
---	PROPOSED UNDERGROUND GAS
---	LIMIT OF DISTURBANCE
---	PROPOSED 6" CHAIN LINK FENCE
---	PROPOSED 6" ALUMINUM PICKET FENCE
---	PROPOSED 4"/6" SOLID VINYL FENCE
---	PROPOSED 6" ORNAMENTAL FENCE
---	PROPOSED WATER VALVE
---	PROPOSED UTILITY POLE
---	PROPOSED DRAINAGE MANHOLE
---	PROPOSED SANITARY MANHOLE
---	PROPOSED DRAINAGE BASIN

CROSSING TABLE

CROSSING 1A	20+46 + 41+99	UPPER	PROPOSED	DRAINAGE	HOPE	15	1.35	NA	213.19	213.28	5.93
		LOWER	PROPOSED	SANITARY	PVC	8	0.24	207.23	NA	206.54	
CROSSING 1B	20+48	UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	215.30	215.33	7.92
		LOWER	PROPOSED	SANITARY	PVC	8	0.24	207.38	NA	206.69	
CROSSING 2A	15+01	UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	215.30	215.33	1.50"
		LOWER	PROPOSED	WATER FIRE	DP	4	0.29	213.80	NA	NA	
CROSSING 2B	15+01	UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	215.30	215.33	1.50"
		LOWER	PROPOSED	WATER DOMESTIC	TYVEK COPPER	2.5	0.095	213.80	NA	NA	
CROSSING 3A	13+82 + 40+08	UPPER	PROPOSED	DRAINAGE	HOPE	8	0.75	NA	216.49	216.54	2.18
		LOWER	PROPOSED	WATER FIRE	DP	4	0.29	214.30	NA	NA	
CROSSING 3B	13+83 + 40+09	UPPER	PROPOSED	DRAINAGE	HOPE	8	0.75	NA	216.52	216.59	2.22
		LOWER	PROPOSED	WATER DOMESTIC	TYVEK COPPER	2.5	0.095	214.30	NA	NA	
CROSSING 3C	40+03	UPPER	PROPOSED	DRAINAGE	HOPE	8	0.75	NA	216.61	216.67	0.92
		LOWER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	215.69	NA	215.33	
CROSSING 4A	30+13 + 13+23	UPPER	PROPOSED	WATER FIRE	DP	4	0.29	NA	213.11	NA	1.76
		LOWER	PROPOSED	SANITARY	PVC	8	0.36	211.35	NA	210.82	
CROSSING 4B	30+10 + 13+23	UPPER	PROPOSED	WATER DOMESTIC	TYVEK COPPER	2.5	0.095	NA	213.27	NA	1.88
		LOWER	PROPOSED	SANITARY	PVC	8	0.36	211.41	NA	210.88	
CROSSING 4C	30+03	UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	212.22	212.25	0.83
		LOWER	PROPOSED	SANITARY	PVC	8	0.36	211.59	NA	211.05	
CROSSING 5A	12+56	UPPER	PROPOSED	DRAINAGE	HOPE	12	1.10	NA	212.60	212.69	1.50"
		LOWER	PROPOSED	WATER FIRE	DP	4	0.29	211.10	NA	NA	
CROSSING 5B	12+56	UPPER	PROPOSED	DRAINAGE	HOPE	12	1.10	NA	212.54	212.63	1.50"
		LOWER	PROPOSED	WATER DOMESTIC	TYVEK COPPER	2.5	0.095	211.04	NA	NA	
CROSSING 6A	11+01	UPPER	EXISTING	DRAINAGE	OMP	12	1.00	NA	209.18	209.24	1.50"
		LOWER	PROPOSED	WATER FIRE	DP	4	0.29	207.68	NA	NA	
CROSSING 6B	11+01	UPPER	EXISTING	DRAINAGE	OMP	12	1.00	NA	209.10	209.16	1.50"
		LOWER	PROPOSED	WATER DOMESTIC	TYVEK COPPER	2.5	0.095	207.60	NA	NA	

* WATER MAIN DEPTH SHALL PROVIDE FOR MINIMUM 18" CLEARANCE VERTICALLY BETWEEN WATER AND CROSSING DRAINAGE OR SANITARY PIPES. USE OF VERTICAL BENDS ON WATER MAIN MAY BE REQUIRED.

THE MAXIMUM SOIL EXPOSURE
LIMIT IS 14 DAYS

TECTONIC WORK ORDER NO. 10128.01

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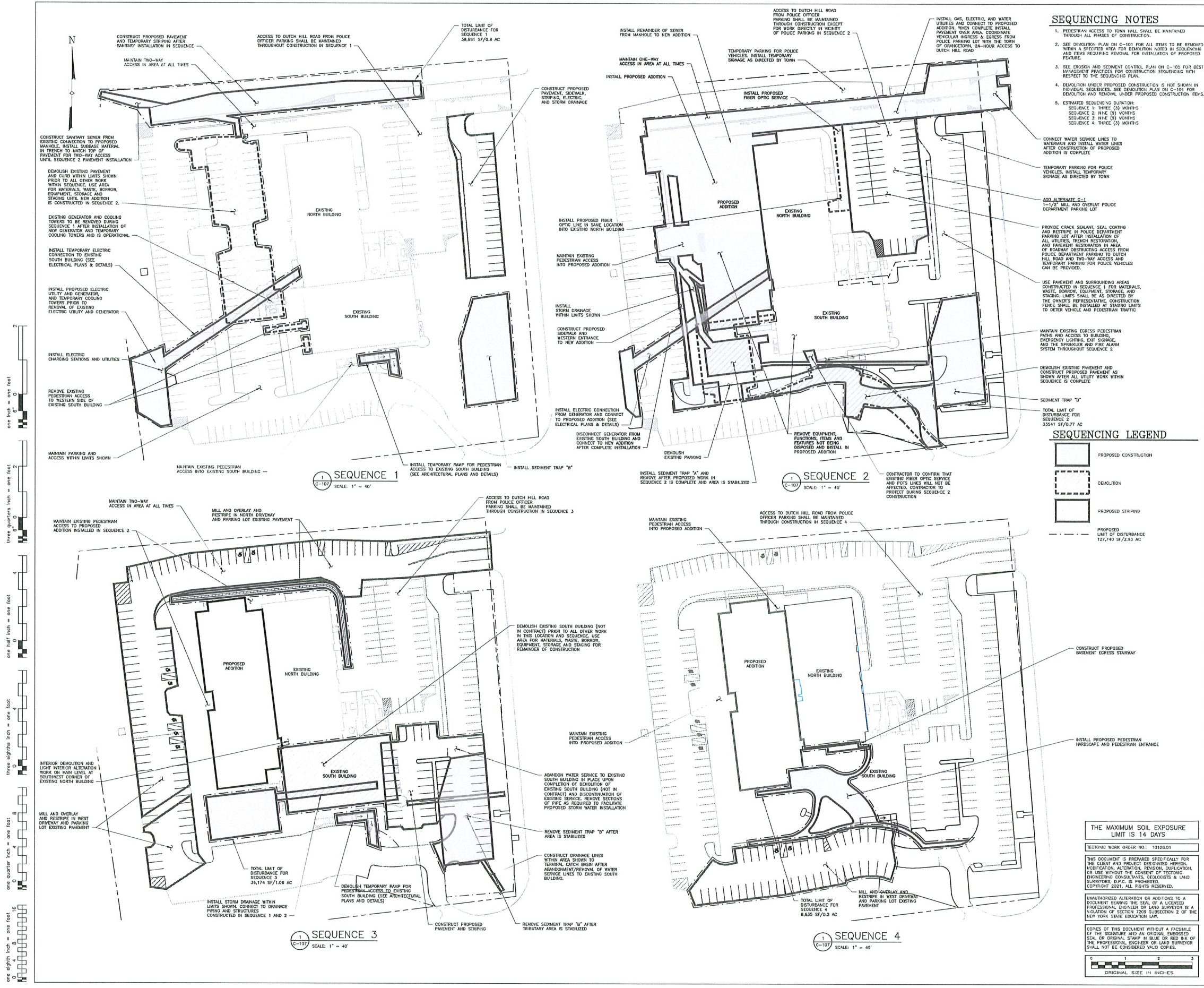
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UTILITY PLAN

PROJECT NO.: 2219-05 SCALE: 1" = 30'

DRAWING NO.:

C-104



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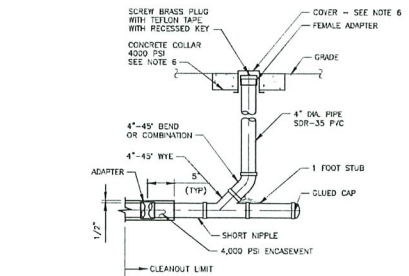
SEQUENCING PLAN

PROJECT NO.: 2219-05
DRAWING NO.: C-107

SCALE: 1" = 40'

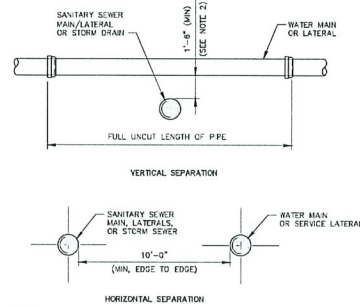


one inch = one foot
one quarter inch = one foot
one half inch = one foot
three eighths inch = one foot
one eighth inch = one foot



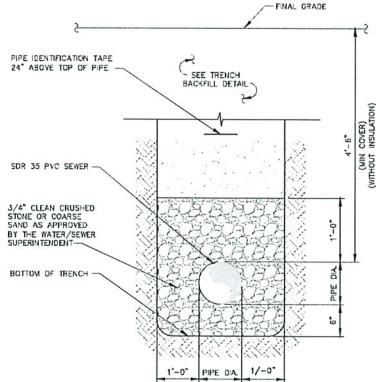
- NOTES:
1. TOP OF CLEANOUT STACK/PLUG/CHP ASSEMBLY SHALL BE RECESSED 1/8" BELOW FINISHED GRADE.
 2. ADAPTORS FOR TRANSITION BETWEEN DIFFERENT PIPE MATERIALS SHALL BE SUBJECT TO APPROVAL BY THE OWNER'S REPRESENTATIVE.
 3. ALL CONCRETE SHALL HAVE THE MINIMUM ULTIMATE COMPRESSION STRENGTH AS INDICATED WITHIN 28 DAYS.
 4. BEDDING BENEATH BASE OF DEEP CONNECTION SHALL BE EQUAL TO THAT PROVIDED FOR REMAINDER OF SEWER MAIN.
 5. ADAPTORS FOR DISSIMILAR MATERIALS AND/OR SIZES SHALL BE PROVIDED AS REQUIRED.
 6. ALL CLEANOUTS SHALL BE PROVIDED WITH A 18 1/2"x18"x13" DEEP CAST IN PLACE CLEANOUT COLLAR WITH CAMPBELL CASTING #130 CLEANOUT BOX.
 7. THE USE OF FLEXIBLE ADAPTORS (FENHO) IS ABSOLUTELY PROHIBITED.
 8. CLEANOUTS SHALL BE PROVIDED AT ALL BENDS, ENDS, BUILDING LINE CONNECTIONS, AND AT 100' INTERVALS ON LINEAR RUNS EXCEEDING 200' IN LENGTH.

1 CLEANOUT ASSEMBLIES
C-204 SCALE: NTS

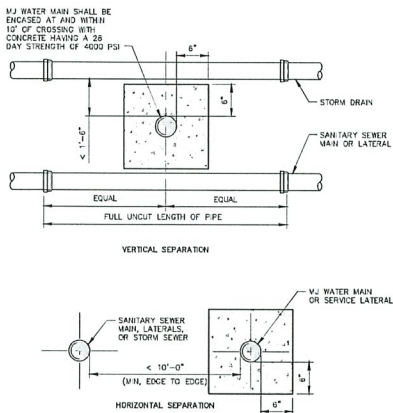


- NOTES:
1. NO DEVIATION (EXCEPT AS SPECIFICALLY INDICATED ON THE PLANS) IN THE SEPARATION REQUIREMENTS WILL BE PERMITTED WITHOUT APPROVAL OF THE JURISDICTIONAL AUTHORITY.
 2. WHERE WATER AND SANITARY OR STORM SEWER MAINS ARE LESS THAN 10' APART HORIZONTAL OR PROVIDE LESS THAN 18" SEPARATION BETWEEN PIPES, CONCRETE ENCASE WATER MAIN PER ENCASEMENT DETAIL.

2 WATER/SEWER SEPARATION REQUIREMENTS
C-204 SCALE: NTS

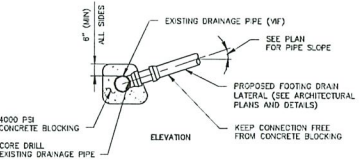
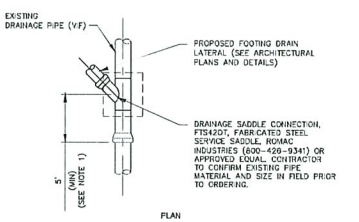


3 SEWER PIPE BEDDING
C-204 SCALE: 1" = 1'-0"

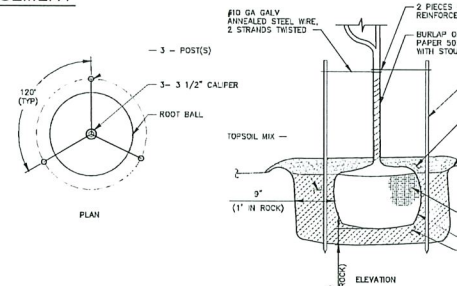


- NOTE:
- NO DEVIATION IN THE SEPARATION REQUIREMENTS WILL BE PERMITTED WITHOUT JURISDICTIONAL AUTHORITY APPROVAL.

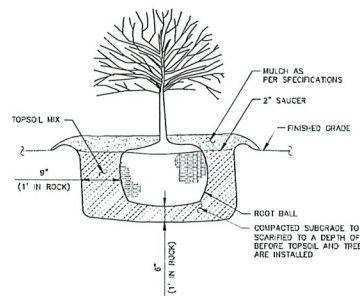
4 ENCASEMENT
C-204 SCALE: NTS



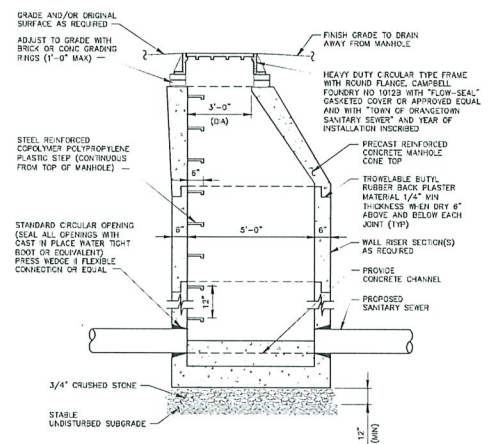
5 DRAINAGE SADDLE CONNECTION
C-204 SCALE: NTS



6 TYPICAL TREE PLANTING
C-204 SCALE: NTS

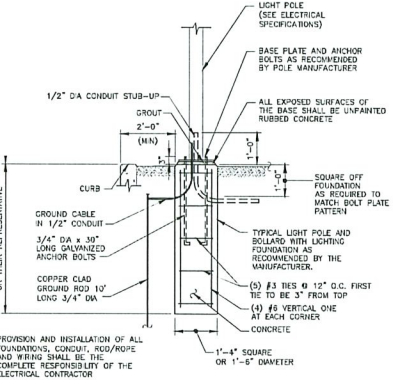


7 TYPICAL SHRUB PLANTING
C-204 SCALE: NTS

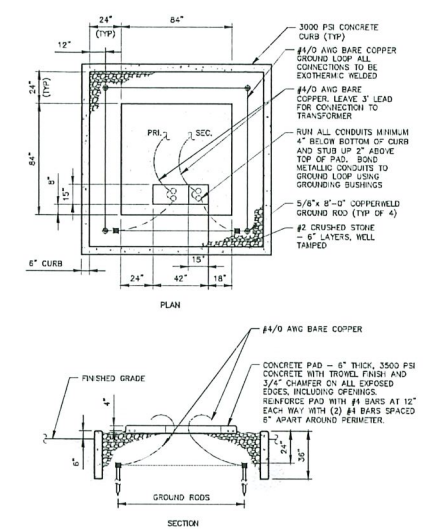


- NOTES:
1. CONCRETE TO HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI @ 28 DAYS.
 2. REINFORCEMENT TO BE IN CONFORMANCE WITH ASTM A615 GRADE 60 AND #40 AS REQUIRED.
 3. CONTRACTOR TO ORDER MANHOLE SECTIONS FROM MANUFACTURER TO MATCH REQUIRED ELEVATIONS AND INVERTS PER PLAN.
 4. THE OUTSIDE FACES OF BUILT-IN-PLACE MANHOLES SHALL BE COATED WITH A BITUMINOUS WATERPROOFING MATERIAL.

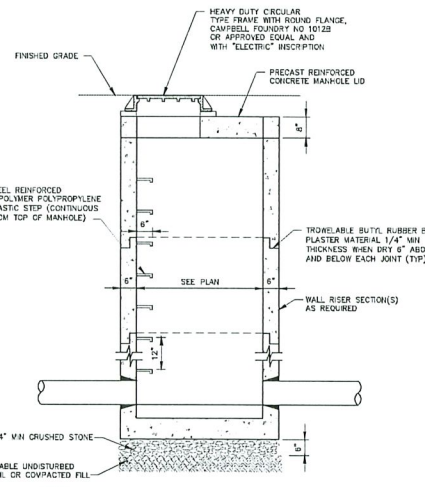
8 SANITARY MANHOLE
C-204 SCALE: 1/2" = 1'-0"



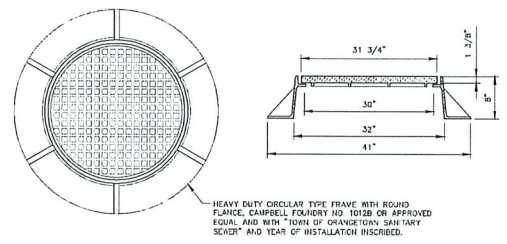
9 SITE LIGHT FOUNDATION
C-204 SCALE: 1/2" = 1'-0"



10 TRANSFORMER PAD
C-204 SCALE: 1/4" = 1'-0"



11 ELECTRIC MANHOLE
C-204 SCALE: 1/2" = 1'-0"



12 SANITARY FRAME & COVER
C-204 SCALE: 1" = 1'-0"

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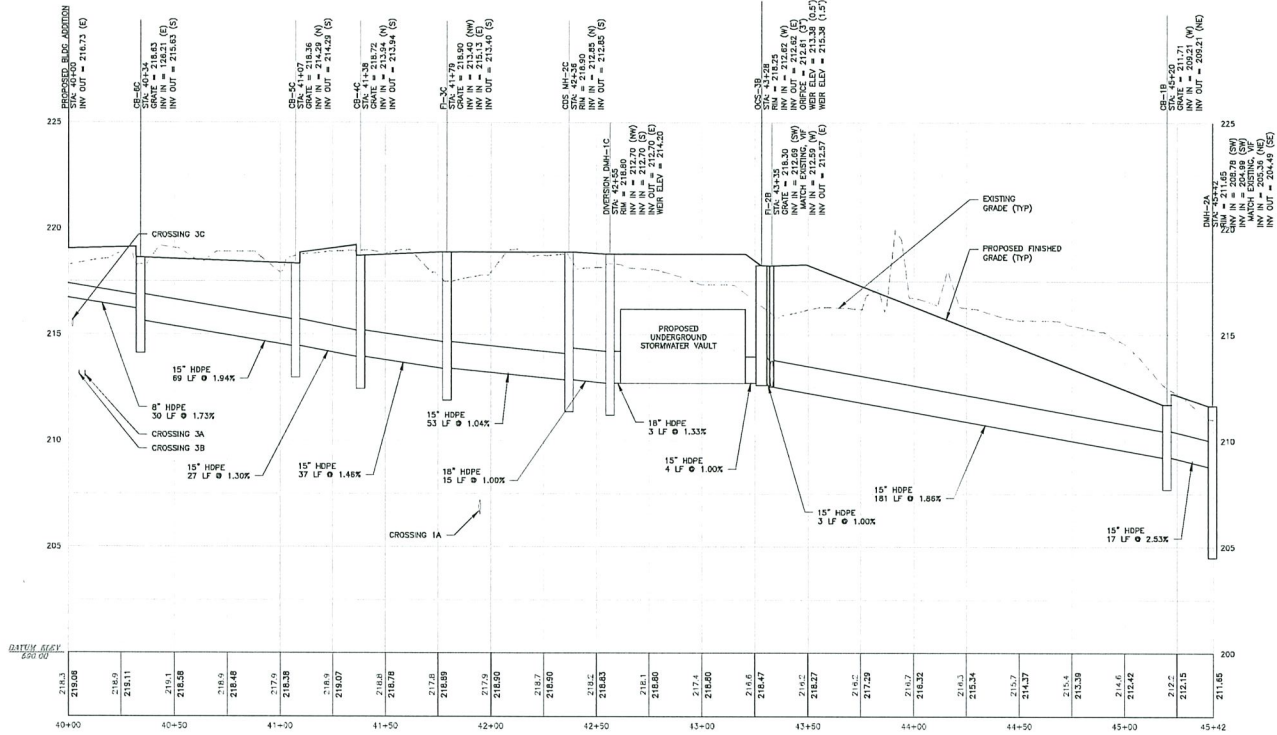
SITE DETAILS

PROJECT NO.: 2219-05 SCALE: AS NOTED

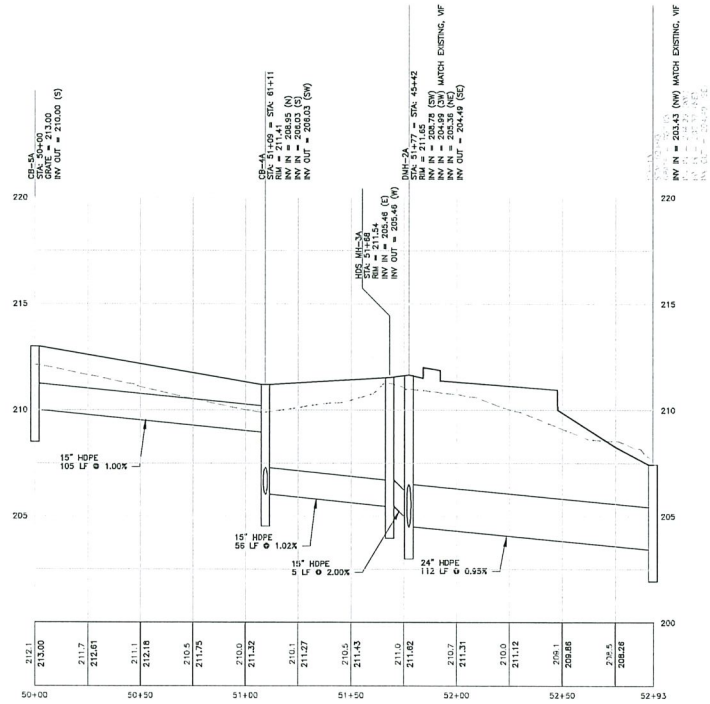
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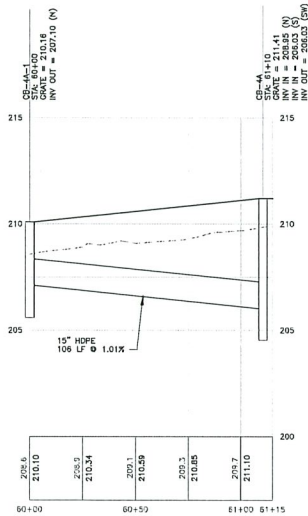
one eighth inch = one foot
one quarter inch = one foot
one half inch = one foot
three eighths inch = one foot
three quarters inch = one foot
one inch = one foot



DRAINAGE PROFILE A
SCALE: HORIZONTAL: 1" = 30'
VERTICAL: 1" = 5'



DRAINAGE PROFILE B
SCALE: HORIZONTAL: 1" = 30'
VERTICAL: 1" = 5'



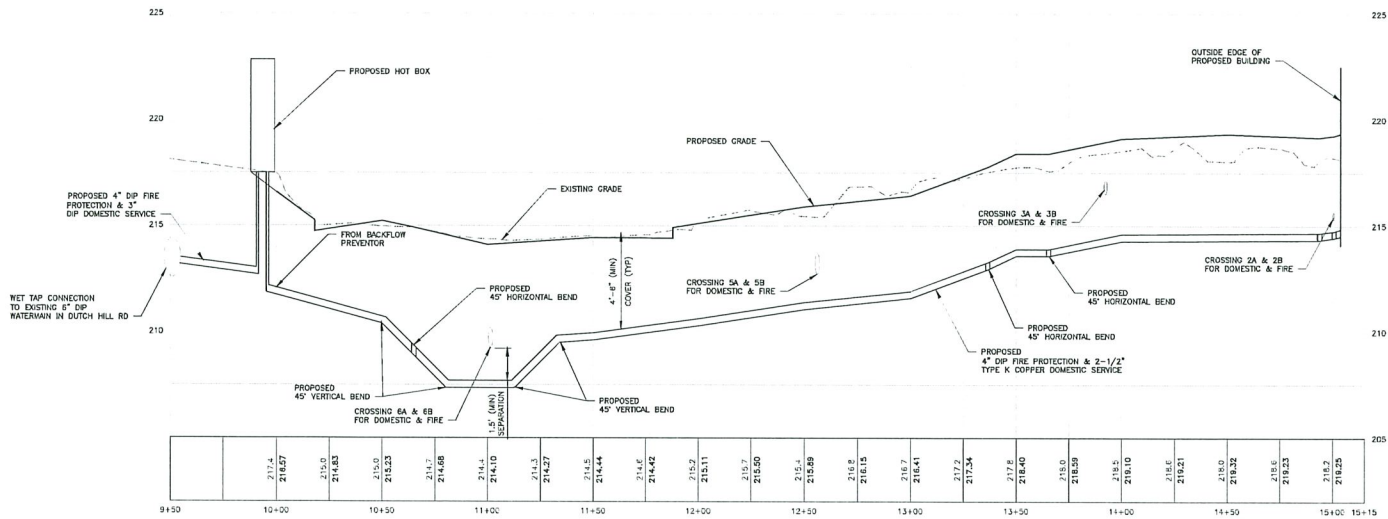
DRAINAGE PROFILE C
SCALE: HORIZONTAL: 1" = 30'
VERTICAL: 1" = 5'

CROSSING TABLE

CROSSING 1A	20-66 + 419-5	UPPER	PROPOSED	DRAINAGE	HOPE	15	1.35	NA	213.16	213.28	5.93
		LOWER	PROPOSED	SANITARY	PVC	8	0.24	207.23	NA	206.54	
CROSSING 1B	20-68	UPPER	PROPOSED	FOOTING DRAIN	REFORCED PVC	4	0.36	NA	215.30	215.33	7.92
		LOWER	PROPOSED	SANITARY	PVC	8	0.24	207.28	NA	206.54	
CROSSING 2A	15-01	UPPER	PROPOSED	FOOTING DRAIN	REFORCED PVC	4	0.36	NA	215.30	215.33	1.50
		LOWER	PROPOSED	WATER-FIRE	DP	4	0.29	215.60	NA	NA	
CROSSING 2B	15-01	UPPER	PROPOSED	FOOTING DRAIN	REFORCED PVC	4	0.36	NA	215.30	215.33	1.50
		LOWER	PROPOSED	WATER-DESTRUCTIVE	TYPICAL COPPER	2.5	0.065	215.80	NA	NA	
CROSSING 3A	11-62 + 60-0	UPPER	PROPOSED	DRAINAGE	HOPE	8	0.36	216.48	216.48	216.54	2.18
		LOWER	PROPOSED	WATER-FIRE	DP	4	0.29	213.40	NA	NA	
CROSSING 3B	11-63 + 60-0	UPPER	PROPOSED	DRAINAGE	HOPE	8	0.75	NA	216.52	216.59	2.22
		LOWER	PROPOSED	WATER-DESTRUCTIVE	TYPICAL COPPER	2.5	0.066	214.30	NA	NA	
CROSSING 3C	40-03	UPPER	PROPOSED	DRAINAGE	HOPE	8	0.75	NA	216.61	216.67	0.92
		LOWER	PROPOSED	FOOTING DRAIN	REFORCED PVC	4	0.36	215.69	NA	215.33	
CROSSING 4A	40-13 + 13-2	UPPER	PROPOSED	WATER-FIRE	DP	4	0.29	NA	213.61	NA	1.78
		LOWER	PROPOSED	SANITARY	PVC	8	0.38	211.35	NA	210.62	
CROSSING 4B	40-13 + 13-2	UPPER	PROPOSED	WATER-FIRE	TYPICAL COPPER	2.5	0.065	NA	213.27	NA	1.80
		LOWER	PROPOSED	SANITARY	PVC	8	0.36	211.41	NA	210.65	
CROSSING 4C	30-03	UPPER	PROPOSED	FOOTING DRAIN	REFORCED PVC	4	0.36	NA	213.22	213.25	0.63
		LOWER	PROPOSED	SANITARY	PVC	6	0.36	211.59	NA	210.65	
CROSSING 5A	12-06	UPPER	PROPOSED	DRAINAGE	HOPE	12	1.00	NA	212.60	212.69	1.50
		LOWER	PROPOSED	WATER-FIRE	DP	4	0.29	211.10	NA	NA	
CROSSING 5B	12-06	UPPER	PROPOSED	DRAINAGE	HOPE	12	1.00	NA	212.54	212.63	1.50
		LOWER	PROPOSED	WATER-DESTRUCTIVE	TYPICAL COPPER	2.5	0.065	211.04	NA	NA	
CROSSING 6A	11-01	UPPER	EXISTING	DRAINAGE	CAP	12	1.00	NA	209.16	209.24	1.50
		LOWER	PROPOSED	WATER-FIRE	DP	4	0.29	207.60	NA	NA	
CROSSING 6B	11-01	UPPER	EXISTING	DRAINAGE	CAP	12	1.00	NA	209.10	209.18	1.50
		LOWER	PROPOSED	WATER-DESTRUCTIVE	TYPICAL COPPER	2.5	0.065	207.60	NA	NA	

* WATER MAIN DEPTH SHALL PROVIDE FOR MINIMUM 4' CLEARANCE VERTICALLY BETWEEN WATER MAIN AND CROSSING OF DRAINAGE OR SANITARY PIPES. USE OF VERTICAL SIDES ON WATER MAIN MAY BE REQUIRED.

one inch = one foot
one quarter inch = one foot
one half inch = one foot
three eighths inch = one foot
one quarter inch = one foot
one eighth inch = one foot



WATER MAIN PROFILE
SCALE: HORIZONTAL: 1" = 30'
VERTICAL: 1" = 3'

CROSSING TABLE

CROSSING 1A	20-06 + 41-05	UPPER	PROPOSED	DRAINAGE	HDPE	15	1.35	NA	213.18	213.28	5.93
		LOWER	PROPOSED	SANITARY	PVC	8	0.24	207.23	NA	208.54	
CROSSING 1B	20-08	UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	215.30	215.33	7.92
		LOWER	PROPOSED	SANITARY	PVC	8	0.24	207.28	NA	208.59	
CROSSING 2A	15-01	UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	215.30	215.33	1.50"
CROSSING 2B	15-01	LOWER	PROPOSED	VATER-FRPE	DP	4	0.29	213.80	NA	NA	1.50"
CROSSING 3A	13-02 + 40-08	UPPER	PROPOSED	FOOTING DRAIN	TYREK, CORNER	2.5	0.095	214.30	NA	215.33	2.18
LOWER	PROPOSED	VATER-FRPE	DP	4	0.29	214.30	NA	NA	NA		
CROSSING 3B	13-03 + 40-05	UPPER	PROPOSED	DRAINAGE	HDPE	8	0.73	NA	216.52	216.59	2.22
LOWER	PROPOSED	WATER-DOMESTIC	TYREK, CORNER	2.5	0.095	214.30	NA	NA	NA		
CROSSING 3C	40-03	UPPER	PROPOSED	DRAINAGE	HDPE	8	0.73	NA	216.51	216.67	0.92
LOWER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	215.69	NA	215.33	NA		
CROSSING 4A	30-13 + 13-27	UPPER	PROPOSED	VATER-FRPE	DP	4	0.29	NA	213.11	NA	1.78
LOWER	PROPOSED	SANITARY	PVC	8	0.30	211.35	NA	210.82	17.8		
CROSSING 4B	30-10 + 13-23	UPPER	PROPOSED	WATER-DOMESTIC	TYREK, CORNER	2.5	0.095	NA	213.27	NA	1.86
LOWER	PROPOSED	SANITARY	PVC	8	0.30	211.41	NA	209.89	NA		
CROSSING 4C	30-03	UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	213.22	213.25	0.63
LOWER	PROPOSED	SANITARY	PVC	6	0.38	211.59	NA	211.06	NA		
CROSSING 5A	12-56	UPPER	PROPOSED	DRAINAGE	HDPE	12	1.10	NA	212.80	212.69	1.50"
LOWER	PROPOSED	VATER-FRPE	DP	4	0.29	211.10	NA	NA	NA		
CROSSING 5B	12-56	UPPER	PROPOSED	DRAINAGE	HDPE	NA	NA	212.54	212.63	NA	1.50"
LOWER	PROPOSED	WATER-DOMESTIC	TYREK, CORNER	2.5	0.095	211.04	NA	NA	NA		
CROSSING 6A	11-01	UPPER	EXISTING	DRAINAGE	CUP	12	1.00	NA	209.16	209.24	1.50"
LOWER	PROPOSED	VATER-FRPE	DP	4	0.29	207.68	NA	209.10	209.18		
CROSSING 6B	11-01	UPPER	EXISTING	DRAINAGE	CUP	12	1.00	NA	209.10	209.18	1.50"
LOWER	PROPOSED	WATER-DOMESTIC	TYREK, CORNER	2.5	0.095	207.60	NA	NA	NA		

* WATER IN DEPTH SHALL PROVIDE FOR MINIMUM 1" CLEARANCE VERTICALLY BETWEEN WATER AND CROSSING OF DRAINAGE OR SANITARY PIPE. USE OF VERTICAL, 60 DEGREE OR WATER MAIN MAY BE REQUIRED.

* WATER MAIN DEPTH SHALL PROVIDE FOR MINIMUM 18" CLEARANCE VERTICALLY BETWEEN WATER AND CROSSING DRAINAGE OR SANITARY PIPES. USE OF VERTICAL BENDS ON WATER MAIN MAY BE REQUIRED.

Lothrop

Lothrop Associates LLP Architects
333 Westchester Avenue
White Plains, New York 10604
914-741-1115

White Plains Rochester Red Bank Hartford

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1	10/28/2021	RELEASED FOR BID
0	10/13/2021	RELEASED FOR BID
ISSUE NO.	ISSUE DATE	DISCUSSION



ORANGETOWN
TOWN HALL
ADDITION AND
ALTERATIONS

26 ORANGEBURG RD
ORANGEBURG, NY 10962

WATER PROFILE

PROJECT NO.: 2219-05 SCALE: NONE

DRAWING NO.:

C-302

THE MAXIMUM SOIL EXPOSURE
LIMIT IS 14 DAYS

TECTONIC WORK ORDER NO.: 10128.01

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CROSSING ID	DATE	UPPER	PROPOSED	DRAINAGE	H/F#	15	1.51	NA	213.18	213.28		5.93
CROSSING 1A	20-06 = 41+09	LOWER	PROPOSED	SANITARY	PVC	8	0.24	207.23	NA	206.54		
		UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	213.30	213.33		
CROSSING 1B	20+08	LOWER	PROPOSED	SANITARY	PVC	4	0.24	207.38	NA	208.69		7.92
		UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.25	213.30	NA	213.33		
CROSSING 2A	15-01	LOWER	PROPOSED	WATER-PIPE	DP	8	0.29	213.80	NA	NA		1.50
		UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	NA	213.30	213.33		1.50
CROSSING 2B	15-01	LOWER	PROPOSED	WATER-DRUM	TYPE K COPPER	2.5	0.095	213.80	NA	NA		1.50
		UPPER	PROPOSED	DRAINAGE	H/F#	8	0.73	NA	216.48	216.54		2.18
CROSSING 3A	13+02 = 40+08	LOWER	PROPOSED	WATER-PIPE	DP	4	0.29	214.30	NA	NA		1.50
		UPPER	PROPOSED	DRAINAGE	H/F#	8	0.73	NA	216.52	216.59		2.22
CROSSING 3B		LOWER	PROPOSED	WATER-DRUM	TYPE K COPPER	2.5	0.095	214.30	NA	NA		1.50
		UPPER	PROPOSED	DRAINAGE	H/F#	8	0.73	NA	216.51	216.67		0.92
CROSSING 3C	40-03	LOWER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	216.69	NA	215.33		
		UPPER	PROPOSED	WATER-PIPE	DP	4	0.29	213.15	NA	213.15		1.70
CROSSING 4A	50+13 = 13+23	LOWER	PROPOSED	SANITARY	PVC	6	0.36	211.35	NA	210.82		1.70
		UPPER	PROPOSED	FOOTING DRAIN	TYPE K COPPER	2.5	0.095	NA	213.27	NA		
CROSSING 4B	50+13 = 13+23	LOWER	PROPOSED	FOOTING DRAIN	PVC	6	0.36	211.41	NA	210.88		1.88
		UPPER	PROPOSED	FOOTING DRAIN	PERFORATED PVC	4	0.36	212.52	NA	212.25		
CROSSING 4C	30-03	LOWER	PROPOSED	SANITARY	PVC	6	0.36	211.59	NA	211.06		
CROSSING 5A	12+56	UPPER	PROPOSED	DRAINAGE	H/F#	12	1.10	NA	212.80	212.69		1.50
		LOWER	PROPOSED	WATER-PIPE	DP	4	0.29	211.10	NA	211.00		
CROSSING 5B	12+58	UPPER	PROPOSED	DRAINAGE	H/F#	12	1.10	NA	212.54	212.63		1.50
		LOWER	PROPOSED	WATER-DRUM	TYPE K COPPER	2.5	0.095	NA	211.04	NA		
CROSSING 6A	11+01	UPPER	EXISTING	DRAINAGE	CMP	12	1.00	NA	209.16	209.24		1.50
		LOWER	PROPOSED	WATER-PIPE	DP	4	0.29	207.68	NA	207.63		1.50
CROSSING 6B	11+01	UPPER	EXISTING	DRAINAGE	CMP	12	1.00	NA	209.10	209.18		1.50
		LOWER	PROPOSED	WATER-DRUM	TYPE K COPPER	2.5	0.095	207.60	NA	NA		

* WATER MAIN DEPTH SHALL PROVIDE FOR MINIMUM 1' CLEARANCE VERTICALLY BETWEEN WATER MAIN AND CROSSING OR DEPTH OF SANITARY PIPE. (USE VERTICAL BODIES ON WATER MAIN REQUIRED)

* WATER MAIN DEPTH SHALL PROVIDE FOR MINIMUM 18" CLEARANCE VERTICALLY BETWEEN WATER MAIN AND CROSSING DRAINAGE OR SANITARY PIPES. USE OF VERTICAL BENDS ON WATER MAIN IS REQUIRED.



ISSUE NO.	ISSUE DATE	DESCRIPTION
1	10/29/2021	RELEASED FOR BID
0	10/13/2021	RELEASED FOR BID



C-303

0 1 2
ORIGINAL SIZE IN INCHES



APPENDIX M

Orangetown Town Hall

Stormwater Management Maintenance Plan

Efficient and timely maintenance of the stormwater practices is necessary to ensure the proper function and longevity of the stormwater management system. The maintenance plan is an outline of the maintenance tasks and schedules. The maintenance is to be performed by the lease holder or their representative and contact information is presented below. Sample Maintenance Logs are attached.

Contact Information

Contact Name: _____

Address: _____

Phone: _____

GENERAL

- The maintenance plan must be evaluated for effectiveness at least annually and must be revised as needed.
- A record of when the inspection was performed, by whom and which structures should be kept. A sample inspection record is attached.
- See attached proprietary Maintenance Guidelines for additional information on specific practices.

STORMWATER STRUCTURES/COLLECTION PIPING

- Includes catch basins, diversion structures, hydrodynamic separators, subsurface storage, cistern, outlet control structures, conveyance piping and cleanouts.
- Inspections should be performed at least quarterly. If the frequency appears insufficient based on the level of sediment build up or erosion, modifications should be made to the maintenance plan.
- Inspections should be performed in dry weather conditions.
- Visual inspection of grates and remove any trash or debris.
- The sump areas should be checked for debris and sedimentation. The amount of sediment and debris should be measured using a tape measure or calibrated dipstick for the structure.
- Stormwater conveyance piping may need to be cleaned out through hydro-excavating or alternative pipe cleaning method.
- Vacuuming as needed.

[illegible]

Orangetown Town Hall –Cascade Hydrodynamic Separator (Western)

[illegible]

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Orangetown Town Hall –Cascade Hydrodynamic Separator (Eastern)

[illegible]

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

Orangetown Town Hall –Cistern/Duromaxx

[illegible]

Notes:

Orangetown Town Hall –ACF R-Tank Detention

Date	Inspector	Depth of Sediment	Depth of Trash	Maintenance Performed	Comments

Notes:

Orangetown Town Hall –Diversion Structure, Catch Basins, Drainage MHs

Date	Inspector	Depth of Sediment	Depth of Trash	Maintenance Performed	Comments

Notes:

Orangetown Town Hall	MAINTENANCE INSPECTION STRUCTURE CHECKLIST		INSPECTOR NAME:	PAGE OF
				DATE
Cascade- HDS	Y	N	Notes	
1. Standing water?				
2. Sediment Present?				
3.Oil Sheen Observed?				
4. Cover Clear of Sediment and Debris?				
5. Vacuuming Required?				
6. Backwash Required?				
7. Additional Maintenance Required?				
Cistern- Duromaxx	Y	N	Notes	
1. Standing water?				
2. Sediment Present?				
3.Oil Sheen Observed?				
4. Cover Clear of Sediment and Debris?				
5. Vacuuming Required?				
6. Backwash Required?				
7. Additional Maintenance Required?				
ACF R-Tank Storage	Y	N	Notes	
1. Unit protected from sediment laden runoff?				
2. Sediment Present?				
3.Oil Sheen Observed?				
4. Cover Clear of Sediment and Debris?				
5. Vacuuming Required?				
6. Backwash Required?				
7. Additional Maintenance Required?				
Additional Comments:				

Cascade Separator™ Inspection and Maintenance Guide



Maintenance

The Cascade Separator™ system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall). However, more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment wash-down areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

A visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet chamber, flumes or outlet channel. The inspection should also quantify the accumulation of hydrocarbons, trash and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided in this Inspection and Maintenance Guide.

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

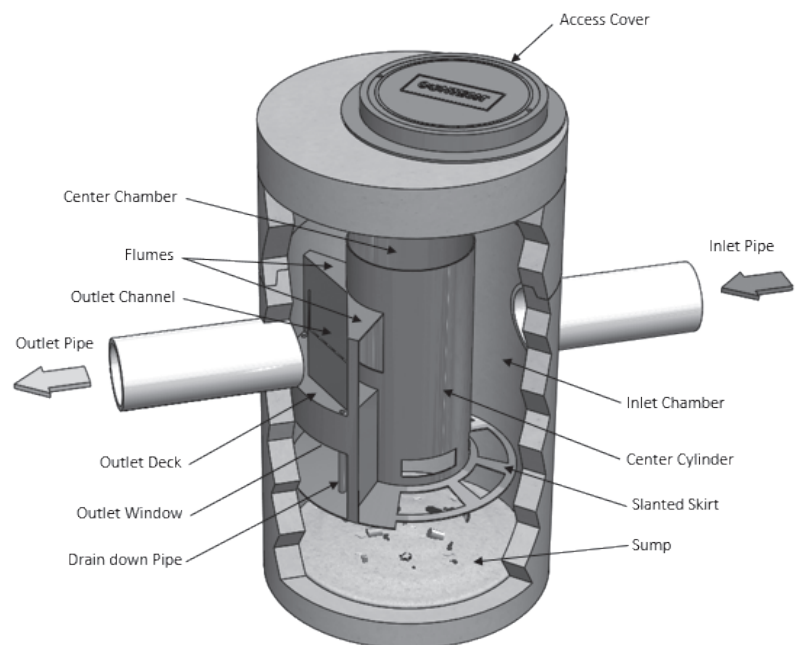
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. Then the system should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator™ Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y ³	m ³
CS-4	4	1.2	1.5	0.5	0.7	0.5
CS-5	5	1.3	1.5	0.5	1.1	0.8
CS-6	6	1.8	1.5	0.5	1.6	1.2
CS-8	8	2.4	1.5	0.5	2.8	2.1
CS-10	10	3.0	1.5	0.5	4.4	3.3
CS-12	12	3.6	1.5	0.5	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.



A Cascade Separator unit can be easily cleaned in less than 30 minutes.



A vacuum truck excavates pollutants from the systems.

Cascade Separator™ Inspection & Maintenance Log

[illegible]

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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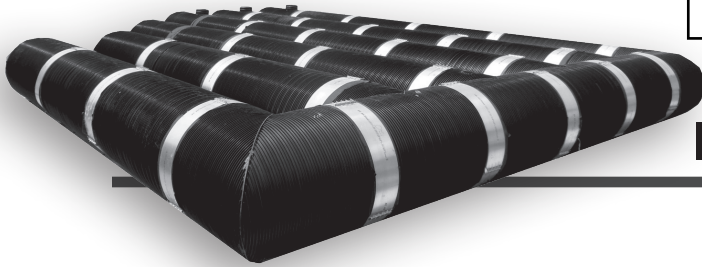
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Rainwater Harvesting/Cistern

DuroMaxx[®] SRPE Detention & Infiltration Maintenance Guide



DuroMaxx® Steel Reinforced Polyethylene (SRPE) Detention and Infiltration Systems

Maintenance

Underground storm water detention and infiltration systems should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size or configuration of the system.

Inspection

Inspection is the key to effective maintenance and is easily performed. Contech Engineered Solutions recommends ongoing quarterly inspections of the accumulated sediment. Sediment deposition and transport may vary from year to year and quarterly inspections will help insure that systems are cleaned out at the appropriate time. Inspections should be performed more often in the winter months in climates where sanding operations may lead to rapid accumulations, or in equipment washdown areas. It is very useful to keep a record of each inspection. A sample inspection log is included for your use.

Systems should be cleaned when inspection reveals that accumulated sediment or trash is clogging the discharge orifice. Contech suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

Cleaning

Maintaining an underground detention or retention system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities.

Inspection & Maintenance Log Sample Template

_____ " Diameter System			Location: Anywhere, USA		
Date	Depth of Sediment	Accumulated Trash	Maintenance Performed	Maintenance Personnel	Comments
12/01/14	2"	None	Removed Sediment	B. Johnson	Installed
03/01/15	1"	Some	Removed Sediment and Trash	B. Johnson	Swept parking lot
06/01/15	0"	None	None		
09/01/15	0"	Heavy	Removed Trash	S. Riley	
12/01/15	1"	None	Removed Sediment	S. Riley	
04/01/15	0"	None	None	S. Riley	
04/15/15	2	Some	Removed Sediment and Trash	ACE Environmental Services	



Support

Drawings and specifications are available at www.ContechES.com.

Site-specific support is available from our engineers.

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R-TANK OPERATION, INSPECTION & MAINTENANCE

Operation

Your ACF R-Tank System has been designed to function in conjunction with the engineered drainage system on your site, the existing municipal infrastructure, and/or the existing soils and geography of the receiving watershed. Unless your site included certain unique and rare features, the operation of your R-Tank System will be driven by naturally occurring systems and will function autonomously. However, upholding a proper schedule of Inspection & Maintenance is critical to ensuring continued functionality and optimum performance of the system.

Inspection

Both the R-Tank and all stormwater pre-treatment features incorporated into your site must be inspected regularly. Inspection frequency for your system must be determined based on the contributing drainage area, but should never exceed one year between inspections (six months during the first year of operation).

Inspections may be required more frequently for pre-treatment systems. You should refer to the manufacturer requirements for the proper inspection schedule.

With the right equipment your inspection and measurements can be accomplished from the surface without physically entering any confined spaces. If your inspection does require confined space entry, you **MUST** follow all local/regional requirements as well as OSHA standards.

R-Tank Systems may incorporate Inspection Ports, Maintenance Ports, and/or adjoining manholes. Each of these features are easily accessed by removing the lid at the surface. With the cover removed, a visual inspection can be performed to identify sediment deposits within the structure. Using a flashlight, ALL access points should be examined to complete a thorough inspection.

Inspection Ports

Usually located centrally in the R-Tank System, these perforated columns are designed to give the user a base-line sediment depth across the system floor.

Maintenance Ports

Usually located near the inlet and outlet connections, you'll likely find deeper deposits of heavier sediments when compared to the Inspection Ports.

Manholes

Most systems will include at least two manholes - one at the inlet and another at the outlet. There may be more than one location where stormwater enters the system, which would result in additional manholes to inspect.

Bear in mind that these manholes often include a sump below the invert of the pipe connecting to the R-Tank. These sumps are designed to capture sediment before it reaches the R-Tank, and they should be kept clean to ensure they function properly. However, existence of sediment in the sump does **NOT** necessarily mean sediment has accumulated in the R-Tank.

After inspecting the bottom of the structure, use a mirror on a pole (or some other device) to check for sediment or debris in the pipe connecting to the R-Tank.

R-TANK OPERATION INSPECTION & MAINTENANCE

If sediment or debris is observed in any of these structures, you should determine the depth of the material. This is typically accomplished with a stadia rod, but you should determine the best way to obtain the measurement.

All observations and measurements should be recorded on an Inspection Log kept on file. We've included a form you can use at the end of this guideline.

Maintenance

The R-Tank System should be back-flushed once sediment accumulation has reached 6" or 15% of the total system height. Use the chart below as a guideline to determine the point at which maintenance is required on your system.

R-Tank Unit	Height	Max Sediment Dept
Mini	9.5"	1.5"
Single	17"	3"
Double	34"	5"
Triple	50"	6"
Quad	67"	6"
Pent	84"	6"

Before any maintenance is performed on your system, be sure to plug the outlet pipe to prevent contamination of the adjacent systems.

To back-flush the R-Tank, water is pumped into the system through the Maintenance Ports as rapidly as possible. Water should be pumped into ALL Maintenance Ports. The turbulent action of the water moving through the R-Tank will suspend sediments which may then be pumped out.

If your system includes an Outlet Structure, this will be the ideal location to pump contaminated water out of the system. However, removal of back-flush water may be accomplished through the Maintenance Ports, as well.

For systems with large footprints that would require extensive volumes of water to properly flush the system, you should consider performing your maintenance within 24 hours of a rain event. Stormwater entering the system will aid in the suspension of sediments and reduce the volume of water required to properly flush the system.

Once removed, sediment-laden water may be captured for disposal or pumped through a Dirtbag™ (if permitted by the locality).



2831 Cardwell Road
Richmond, Virginia, 23234
800.448.3636
FAX 804.743.7779
acfenvironmental.com

Step-By-Step Inspection & Maintenance Routine

1) Inspection

- a. Inspection Port
 - i. Remove Cap
 - ii. Use flashlight to detect sediment deposits
 - iii. If present, measure sediment depth with stadia rod
 - iv. Record results on Maintenance Log
 - v. Replace Cap
- b. Maintenance Port/s
 - i. Remove Cap
 - ii. Use flashlight to detect sediment deposits
 - iii. If present, measure sediment depth with stadia rod
 - iv. Record results on Maintenance Log
 - v. Replace Cap
 - vi. Repeat for ALL Maintenance Ports
- c. Adjacent Manholes
 - i. Remove Cover
 - ii. Use flashlight to detect sediment deposits
 - iii. If present, measure sediment depth with stadia rod, accounting for depth of sump (if present)
 - iv. Inspect pipes connecting to R-Tank
 - v. Record results on Maintenance Log
 - vi. Replace Cover
 - vii. Repeat for ALL Manholes that connect to the R-Tank

2) Maintenance

- a. Plug system outlet to prevent discharge of back-flush water
- b. Determine best location to pump out back-flush water
- c. Remove Cap from Maintenance Port
- d. Pump water as rapidly as possible (without over-topping port) into system until at least 1" of water covers system bottom
- e. Replace Cap
- f. Repeat at ALL Maintenance Ports
- g. Pump out back-flush water to complete back-flushing
- h. Vacuum all adjacent structures and any other structures or stormwater pre-treatment systems that require attention
- i. Sediment-laden water may be captured for disposal or pumped through a Dirtbag™.
- j. Replace any remaining Caps or Covers
- k. Record the back-flushing event in your Maintenance Log with any relevant specifics



**Company Responsible:
for Maintenance:**

Contact: _____

Phone Number: _____

For more information about our products, contact Inside Sales at 800.448.3636 or email at info@acfenv.com

APPENDIX N

SECTION 312500 - EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
1. Soil Erosion and Sediment Control shall include implementation and maintenance of soil erosion and sediment control devices and construction methods, as shown on the Plans, as required under the Guidelines or as directed by the Owner's Representative, State or Municipality, which will reduce or prevent soil losses and associated damages from sedimentation during construction of this project. All costs associated with the provision of Soil Erosion and Sediment Control acceptable to the above parties shall be included in the price bid for the project. Work shall include, but not necessarily be limited to the following:
 - a. Install and maintain silt fence as required by the Contractor's staging of construction, or as directed.
 - b. Install and maintain construction entrance pad(s) at all access points.
 - c. Install and maintain inlet protection as required by the Contractor's staging of construction, or as directed.
 - d. Install and maintain diversion swales and/or berms as required by the Contractor's staging of construction, or as directed.
 - e. Install and maintain sediment traps/ponds as required by the Contractor's staging of construction, or as directed.
 - f. Plant and maintain temporary seeding to control surface runoff by site conditions.
 - g. Construct and maintain stockpile areas as required by the Contractor's staging of construction, or as directed.
 - h. Install and maintain tree protection during construction as required by the Contractor's staging of construction, or as directed.
 - i. Implement ongoing dust control.
 2. All work under this item must comply with the New York State Guidelines for Urban Erosion and Sediment Control, revised and adopted through 2016, and the latest revisions thereto. Additionally, this work is subject to the review and inspection by the owner's representative, and the Contractor shall comply with all corrective directives issued by these entities without additional payment. Any penalties levied by the Municipality, County, or State, or any direct or consequential damages arising out of a Stop Work Order issued by the Municipality, County, or State, if due to inaction by the Contractor, shall be borne solely by the Contractor, at no additional cost to the Owner.
- B. The Owner's Representative has the authority to limit the surface area of erodible earth exposed by earthwork operations and to direct the Contractor to provide immediate

temporary or permanent erosion or pollution control measures to minimize damage to property.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. New York State Standards and Specifications for Erosion and Sediment Control, revised and adopted through 2016, and the latest revisions thereto.
- D. Stormwater Pollution Prevention Plan prepared for this project.

1.3 RELATED WORK SPECIFIED ELSEWHERE:

- A. Site Clearing: Section 311000.
- B. Earth Moving: Section 312000.

1.4 SUBMITTALS:

- A. Product Data:
 - 1. Silt fence: Manufacturer's catalog sheets, specifications, and installation instructions.
 - 2. Filter Fabric: Manufacturer's catalog sheets, specifications, and installation instructions.
- B. Certifications:
 - 1. Proof of current endorsed NYSDEC 4-hour training for Contractor's trained individual
 - 2. Completed Contractor's SPDES certification (see SWPPP appendix).
 - 3. Completed Subcontractor's SPDES certification(s) as applicable (see SWPPP appendix).

PART 2 - PRODUCTS

2.1 EROSION CONTROL DEVICES

- A. Hay or Straw bales shall conform to NYS DOT Section 713-18 or 713-19 and shall be bound with wire or baling twine. The twine shall be polypropylene which has a knot strength of 170 pounds and straight break strength of 300 pounds, minimum.

- B. Silt Fence may be commercially available silt fence systems, consisting of synthetic geotextile fabrics and hardwood stakes. The height of the fence shall be a minimum of two (2) feet, and the fabric shall be wide enough to allow for a minimum embedment in the ground of two (2) feet of fabric. Sections shall be joined in a manner such that the fence shall function continuously.
- C. Rapid germination grasses such as fescue or rye.
- D. Stakes for securing bales may either be steel or wood and shall conform to the sizes shown on the Plans.
- E. Mulches: Hay, straw, wood cellulose, fiber mats, geotextiles, and other materials approved by the owner's representative.
- F. Stone: Well-graded aggregate compliant with NYSDOT Section 703.
- G. Filter Fabric shall be commercially available non-woven geotextile with the following properties:
 - 1. Grab Tensile Strength ASTM D4632: 120 lbs.
 - 2. Mullen Burst Strength ASTM D3786: 225 psi.
 - 3. Trapezoidal Tear Strength ASTM D4355: 50 lbs.
 - 4. Puncture Strength ASTM D4833: 70 lbs.
 - 5. UV Resistance after 500 hours ASTM D4355: 70% strength
 - 6. Apparent Opening Size ASTM D4751: US Sieve #70
 - 7. Permittivity ASTM D4491: 1.8 sec-1

PART 3 - EXECUTION

3.1 GENERAL

- A. The contractor shall incorporate all temporary soil erosion and sediment control measures into the project at the earliest practicable time, to maintain the maximum protection against soil erosion and sedimentation possible, throughout the life of the contract.
- B. All erosion and sediment control practices shall conform to the Standards for Soil Erosion and Sediment Control in the State of New York.
- C. A schedule of construction operations shall be submitted to the Owner's Representative for approval. Said schedule shall outline construction phasing and shall indicate how and where erosion control measures will be utilized. The schedule shall include indications of locations for construction staging, soil stockpiles, etc., and any disturbances outside the limit of excavation shown on the Plans.
- D. Prior to initial clearing of the area to be excavated, erosion control measures shall be installed, such as stone construction entrance, hay bales, silt fence, and inlet protection.
- E. The smallest practicable area of land shall be disturbed at any one time during the project and, whenever feasible, natural vegetation shall be retained and protected. Stripping of

vegetation, grading and other soil disturbances shall be completed in a manner that will minimize soil erosion and sedimentation.

1. The Owner's Representative may limit the area of clearing and grubbing and earthwork operations in progress commensurate with the Contractor's demonstrated capability in protecting erodible earth surfaces with temporary or permanent erosion control measures.
 2. Under no circumstances will the area of erodible material exposed at one time exceed five (5) acres without prior written approval of the Owner's Representative and NYSDEC.
 3. The Owner's Representative may increase or decrease the area of erodible earth material exposed at one time as determined by his analysis of project, weather and other conditions.
- F. All other construction procedures shall conform to the NYS DOT Standard Specifications Section 209.
- G. Incorporate permanent control features into the work at the earliest practical time.
- H. Sweeping of hardscape shall be performed weekly (as a minimum), at the end of a work day when construction activity results in the tracking of sediment onto hardscape, or as directed by the Owner's Representative to remove accumulated sediment generated by construction operations.

3.2 STOCKPILE

- A. Stockpile topsoil in storage piles in areas where directed by the Owner's Representative. Construct storage piles to freely drain surface water. Cover storage piles if required to prevent windblown dust.
- B. Protect all soil and topsoil stockpiles as directed by the Owner's Representative or other authority having jurisdiction over the project.

3.3 TREE PROTECTION

- A. Fencing or other barrier will be installed at the drip line of the tree branches.
- B. Boards will not be nailed to trees during building operations.
- C. Feeder root should not be cut in an area inside the drip line of tree branches.
- D. Damaged trunks or exposed roots will be painted immediately with a good grade of "tree paint". Care of serious injury should be prescribed by a professional forester or licensed tree expert.
- E. Tree limb removal, where necessary, will be done flush to trunk or main branch and that area painted with a good grade of "tree paint".
- F. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction.

- G. Additional requirements are provided on the details shown on the project plans.

3.4 SPDES COMPLIANCE PROVISIONS

- A. The Contractor shall install, maintain and service as needed all construction run-off collection/prevention measures as indicated on the drawings and the Stormwater Pollution Prevention Plan (SWPPP) or as directed by the Owner's Representative.
- B. The Contractor must have at least one trained person responsible for implementation of the SWPPP, and have at least one trained person on site on a daily basis when soil disturbance activities are being performed. Trained contractors must have 4 hours of training in the principles and practices of erosion and sediment control endorsed by NYS DEC. Proof of training shall be submitted to the Owner's Representative prior to commencing construction.
- C. A qualified person from the Owner will perform SPDES-compliance inspections required by the Permit on a weekly basis. All recommendations and suggested modifications must be addressed by the Contractor within 1 working day of issuance of notice by the Owner's Representative. Under certain circumstances, the Owner and/or the NYSDEC has the right to direct more than one weekly inspection and visit the project construction site at any point over the course of construction.

END OF SECTION 312500

BEGIN ATTACHMENT TO SECTION 31 25 00

SWPPP

END ATTACHMENT TO SECTION 31 25 00

SWPPP

SECTION 31 31 00 – SOIL MANAGEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This specification describes requirements for soil management as specified herein, including segregation and storage, field organic vapor monitoring, sampling and analysis, transportation and disposal, and reuse of soils.
- B. The Contractor shall provide all labor, materials, tools, and equipment to perform all operations necessary to characterize, classify and determine the requirements for handling, disposal, and/or reuse of all materials to be excavated.

1.2 GENERAL INFORMATION AND REQUIREMENTS

- A. The Contractor is responsible for assuring compliance with all applicable Federal and State regulations and policies in place at the time of construction. This includes, but is not limited to, any Federal or State modifications to sampling or analytical methods, standards, or policies specified herein.
- B. Soil contaminants may potentially include:
 - 1. Petroleum products, which may include, but are not limited to: gasoline, heating oils, diesel fuel, kerosene, lubricating oils, motor oils, greases, and other fractions of crude oil;
 - 2. Other contamination by organic constituents including volatile organic compounds;
 - 3. Metal(s) such as lead, chromium, and/or other heavy metals; and/or
 - 4. Any other constituents that require specialty disposal of the soil.

Additional information regarding contaminated soil is available in a Field Sampling Summary Report drafted in September 2020, as detailed under Specification Item 1.6: Existing Soil Conditions.

- C. Segregation and Storage
 - 1. This work shall consist of segregating contaminated soil from non-contaminated soil during excavation, and the temporary storage and management of contaminated soil (pending sampling, analysis and ultimate disposition) in accordance with an accepted Contaminated Material Handling Plan.
- D. Field Organic Vapor Monitoring

NOT USED

E. Sampling and Analysis

1. This work shall consist of collecting soil samples and arranging for samples to be analyzed at a laboratory in accordance with an accepted Field Sampling Plan. The laboratory shall be accredited for the specified parameters by the New York State Department of Health (NYSDOH) under the Environmental Laboratory Approval Program (ELAP). The results of the laboratory analysis will determine or confirm the final regulatory classification of the soil for appropriate handling, transportation, treatment and disposal/reuse methods and requirements.

F. Transportation and Disposal

1. This work shall consist of transporting and disposing of soil that is not otherwise reused on site, and completing any other related activities, in accordance with an accepted Disposal Plan. For shipping and disposal purposes, the regulatory classification of the soil (as either contaminated non-hazardous waste or RCRA regulated hazardous waste) will be based on investigations conducted prior to award or based on the results of laboratory analysis included in this Specification Section.

G. Reuse of Soils

1. This work shall consist of the reuse of soil within the contract limits as embankment, fill or other appropriate on-site use (unless gross contamination is discovered). Soil areas and reuse locations, if provided, are indicated in the contract documents or shall be determined and approved by the Engineer. The reuse of soil must be compliant with applicable sections of 6 NYCRR Part 360.12 and Part 350.13 as deemed appropriate based upon the following a) an investigation conducted prior to the contract award and/or sampling and analysis conducted during project construction and the qualification of the soil placement as a generic beneficial use determination (BUD) or b) as a site-specific BUD obtained from the New York State Department of Conservation (NYSDEC). The material must and can be considered suitable material as per the Geotechnical Investigation Report, as detailed under Specification Item 1.6: Existing Soil Conditions.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving: Section 31 20 00.

1.4 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

- C. Field Sampling Summary Report: Preliminary Soil Waste Characterization – Orangetown Town Hall Expansion, prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C., dated September 4, 2020.
- D. Geotechnical Investigation Report – Proposed Addition to Orangetown Town Hall, prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C., dated March 8, 2021.

1.5 DEFINITIONS

- A. NYSDOH: New York State Department of Health
- B. ELAP: Environmental Laboratory Approval Program
- C. RCRA: Resource Conservation and Recovery Act
- D. BUD: Beneficial Use Determination
- E. NYSDEC: New York State Department of Environmental Conservation
- F. PID: Photoionization Detector
- G. PPM: Parts Per Million
- H. FID: Flame Ionization Detector
- I. PPC: Personal Protective Clothing
- J. PPE: Personal Protective Equipment
- K. OSHA: Occupational Safety and Health Administration
- L. EPA: United States Environmental Protection Agency
- M. USDOT: United States Department of Transportation

1.6 EXISTING SOIL CONDITIONS

- A. A preliminary soil waste characterization field study was conducted by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C. (Tectonic) between August 12 – 14, 2020. Full details of this preliminary investigation are available a Field Sampling Summary Report prepared by Tectonic and drafted in September 2020. Relevant conclusions and recommendations of the preliminary waste characterization studies are as follows:
 - 1. The soils sampled and analyzed would be classified as non-hazardous regulated material by the State on New York. Material scheduled for excavation and off-site disposal should be disposed of at an appropriate, permitted facility that can accept the waste. Material considered for on-site reuse would be regulated as follows:

- a. As per the NYSDEC Pre-determined BUD Part 360.12(c)(1)(ii), “fill material generated outside of New York City with no evidence of historical impacts such as reported spill events, or visual or other indications (odors, etc.) of chemical or physical contamination,” may be re-used on Site. In the event that visual or other indications of contamination are observed during soil disturbance activities, NYSDEC Part 360.13(c) states, “fill material used as backfill for the excavation from which the fill material was taken, or as fill in areas of similar physical characteristics on the project property is exempt from regulation under this Part [360]”.
- b. If fill material exhibits historical or visual evidence of contamination (including odors), and will be used in an area with public access, the relocated fill material must be covered with a minimum of 12 inches of soil or fill material that meets the criteria for general fill as defined in this Part [360]. General fill is defined in in Table 2 of Part 360 as:

TABLE 2: Fill Material Beneficial Use

Fill Material Type	Fill Material End Use	Physical Criteria	Maximum Concentration Levels
General Fill	Any setting where the fill material meets the engineering criteria, for use, except: 1. Undeveloped land; and 2. Agricultural crop land. General Fill may also be used in the same manner as Restricted-Use Fill and Limited-Use Fill.	Only soil, sand, gravel or rock; no non-soil constituents.	Lower of Protection of Public Health-Residential Land Use and Protection of Groundwater in Table 375-6.8(b) of this Title.

1.7 SUBMITTALS

- A. Contaminated Material Handling Plan
- B. Field Sampling Plan
- C. Field Sampling Summary Report
- D. Disposal Plan

PART 2 - MATERIALS

2.1 GENERAL

- A. As per the Contaminated Material Handling Plan, (Item 3.2 (C) (1))

2.2 SEGREGATION AND STORAGE

- A. A minimum of 10-mil or two (2) layers of 6-mil polyethylene sheeting shall be used as soil stockpile(s) liner(s) and cover(s).
- B. A partial containment berm made up of hay bales, silt fences, or timbers shall be utilized around stockpiled soils to direct runoff and minimize erosion.

2.3 FIELD ORGANIC VAPOR MONITORING

NOT USED

2.4 SAMPLING AND ANALYSIS

- A. All reusable sample collection devices, such as shovels or hand trowels, shall be stainless steel. All devices shall be decontaminated before and after collection of each sample. All methods necessary to decontaminate the sampling equipment shall be used. Contractor shall be responsible for proper handling and disposal of all decontamination materials and fluids.
- B. All disposable sampling devices shall be constructed of inert materials such as polyethylene, silicon, or Teflon. All disposable sampling devices shall be used only once and properly disposed.

2.5 TRANSPORTATION AND DISPOSAL

- A. The Contractor must assure that the waste transporter's appropriate choice of vehicles and operating practices are fitted to prevent spillage or leakage of contaminated material during transportation.

2.6 REUSE OF SOILS

- A. As per the NYSDEC Pre-determined BUD Part 360.12(c)(ii), "fill material generated outside of New York City with no evidence of historical impacts such as reported spill events, or visual or other indications (odors, etc.) of chemical or physical contamination," may be re-used on Site. In the event that visual or other indications of contamination are observed during soil disturbance activities, NYSDEC Part 360.13(c) states, "fill material used as backfill for the excavation from which the fill material was taken, or as fill in areas of similar physical characteristics on the project property is exempt from regulation under this Part [360]".
- B. If fill material exhibits historical or visual evidence of contamination (including odors), and will be used in an area with public access, the relocated fill material must be covered with a minimum of 12 inches of soil or fill material that meets the criteria for general fill as defined in this Part [360]. General fill is defined in in Table 2 of Part 360 as:

TABLE 2: Fill Material Beneficial Use

Fill Material Type	Fill Material End Use	Physical Criteria	Maximum Concentration Levels
General Fill	Any setting where the fill material meets the engineering criteria, for use, except: 1. Undeveloped land; and 2. Agricultural crop land. General Fill may also be used in the same manner as Restricted-Use Fill and Limited-Use Fill.	Only soil, sand, gravel or rock; no non-soil constituents.	Lower of Protection of Public Health-Residential Land Use and Protection of Groundwater in Table 375-6.8(b) of this Title.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Specification Section 31 20 00 "Earth Moving."

3.2 GENERAL

- A. Work activities shall be performed in accordance with the contract documents and with applicable Contaminated Material Handling Plan, Field Sampling Plan and Disposal Plan. The Contractor shall initiate any measures necessary to protect the safety and health of workers and the general public based on the potential hazards associated with potentially contaminated soil.
- B. **Regulatory Compliance:** The Contractor shall conduct all tasks in accordance with all applicable Federal, State, County, and local regulations including, but not necessarily limited to:
- 29 CFR 1910.120 and 29 CFR 1926.65 - Hazardous Waste Operations and Emergency Response.
 - 6 NYCRR 360 - Solid Waste Management Facilities.
 - 6 NYCRR 364 - Waste Transporter Permits.
 - 6 NYCRR 371 - Identification and Listing of Hazardous Wastes (Defines Resource Conservation and Recovery Act (RCRA) defined hazardous wastes.
 - 6 NYCRR 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (applicable to soils regulated as hazardous wastes only).
 - 6 NYCRR 373 - Hazardous Waste Management Facilities.
 - 6 NYCRR Part 375 - Environmental Remediation Program.
 - 6 NYCRR Part 376 - Land Disposal Restrictions.
 - 49 CFR 100 to 180 - USDOT Hazardous Materials Transport and Manifest System Requirements (applicable to soils regulated as hazardous wastes only).
 - Local restrictions on transportation of waste/debris.
 - 40 CFR 260 to 272 - Hazardous Waste Management (RCRA).
 - Posted weight limitations on roads and bridges.

13. Resource Conservation and Recovery Act (RCRA).
14. NYSDEC Program Policy DER-10: Technical Guidance for Site Investigation and Remediation (DER-10).
15. NYSDEC Policy CP-51: Soil Cleanup Guidance.

C. ***Preparation of Plans / Reports:*** The Contractor shall be required to prepare the plans and reports described below. Two (2) copies of each applicable plan shall be submitted to the Engineer for acceptance at least thirty (30) calendar days prior to commencing work.

Plans and reports shall be prepared based on the type(s) of contamination and locations identified in the contract documents. If a different type of contamination is encountered during work, and additional plans must be written, the thirty (30) calendar day lead time for submittals may be modified by the Engineer as appropriate.

1. ***Contaminated Material Handling Plan (CMHP):*** The CMHP shall describe the procedures to be used to segregate contaminated soil during excavation, soil storage/stockpile procedures, and safety and health issues. The following information shall be included in the CMHP:
 - a. Name and address of the plan preparer;
 - b. Contract name, contract number and description;
 - c. Describe procedures to be used to segregate contaminated soil during excavation;
 - d. Location of intended soil stockpile, trucks, roll-off container and other storage areas;
 - e. Describe how contaminated soil will be moved to soil storage locations;
 - f. Describe how soil storage/stockpile locations will be prepared and managed;
 - g. Describe how potential air quality impacts such creation of dust particulates and vapors will be minimized to protect air quality within, adjacent to or downwind from the project;
 - h. Describe air monitoring procedures to be used during work, define action levels, and explain the response if action levels are exceeded; The protocol and procedures shall consider action levels for both work personnel and also perimeter/community action levels based on the nature of the contamination and activities conducted;
 - i. Hazardous substance evaluation - types of chemicals associated with the waste to be generated,
 - j. Hazard assessment - physical and toxic effects associated with the waste to be generated; Personal protective clothing (PPC) and personal protective equipment (PPE) to be used or available on-site;
 - k. Names of key personnel, emergency contacts and phone numbers;
 - l. List the OSHA training each worker has received. At least one worker must have completed supervisor training per 29 CFR 1910.120(E)(4);
 - m. General and site-specific safety rules, with emergency response procedures and directions to the nearest hospital (with map);
 - n. Decontamination procedures for personnel and equipment; and
 - o. Disposal of contaminated PPC and PPE;

2. **Field Sampling Plan:** A Field Sampling Plan (FSP) must be prepared and submitted to the Engineer for approval prior to mobilization for any sampling activities. The FSP shall include protocols for the collection and analysis of samples that represent all soils to be excavated and stockpiled. The Engineer will approve the FSP only if it clearly provides the information to allow for classification of all material proposed for excavation. No sampling shall be conducted until the Engineer has reviewed and formally approved the FSP in writing. At a minimum, the following information shall be included in the FSP:
 - a. Name and address of the plan preparer;
 - b. Name, telephone number, and ELAP certification number of the proposed NYSDOH ELAP accredited laboratory;
 - c. Name, address, experience and qualifications of each individual who will collect soil samples. Each individual shall be thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements;
 - d. For materials destined for offsite disposal at a permitted facility, the FSP shall include a detailed outline of the disposal facility requirements for sampling, testing and analysis including specific number and types of samples per unit volume of soil to be excavated;
 - e. For all materials to be disposed, the sampling frequency shall be, at a minimum, in accordance with NYSDEC DER-10 Table 5.4(e)10, unless otherwise specified by the disposal facility:

Table 5.4(e)10			
Recommended Number of Soil Samples for Soil Imported To or Exported From a Site			
Contaminant	VOCs	SVOCs, Inorganics & PCBs/Pesticides	
Soil Quantity (cubic yards)	Discrete Samples	Composite	Discrete Samples/Composite
0-50	1	1	3-5 discrete samples from different locations in the fill being provided will comprise a composite sample for analysis
50-100	2	1	
100-200	3	1	
200-300	4	1	
300-400	4	2	
400-500	5	2	
500-800	6	2	
800-1000	7	2	
➤ 1000	Add an additional 2 VOC and 1 composite for each additional 1000 Cubic yards or consult with DER		

- f. Description of QA/QC samples required by the reuse or disposal facilities;
- g. Description of additional reuse or disposal facility requirements;
- h. A scaled map of the site showing existing fixed landmarks and the proposed excavation limits. The map shall contain specific sampling locations that will conform to the applicable sampling frequency requirements;
- i. Proposed sampling, handling, preservation, and storage of equipment and procedures, including transfer procedures, and sampling equipment decontamination procedures;
- j. Analytical Methods: proposed analytical methods shall be in accordance with EPA SW-846, latest edition;
- k. Data Quality Objectives: Procedures for assessing precision, accuracy, degree of representation, comparability and completeness of samples and data, including performance audits and proposed protocols for corrective

- measures where problems are identified shall be defined and meet standards set forth in this Specification;
- l. Schedule of field inspections;
 - m. Planned preparation of daily and project summary quality control reports; and
 - n. Manufacturer, catalog data and calibration records of all analytical equipment to be used on-site.
3. **Field Sampling Summary Report:** The field sampling summary report (FSSR) shall contain all laboratory analytical results obtained from the field sampling event(s). A detailed account of any field procedures used which deviated from those established in the FSP shall be included, as well as a complete set of field notes. The Contractor shall submit hard copies of the FSSR which shall include a Summary Table listing the analytical results with highlighted exceedances of RCRA Characteristics, BUD, or applicable parameters of 6NYCRR Part 375 and all disposal facility limits, including any alternate acceptance criteria. Detailed field notes shall be maintained by the Contractor during sampling to allow identification of sample analysis results with the respective areas / volumes of soil that the data represent, and to verify quantities of materials to be beneficially reused or disposed of as regulated solid waste. The field notes shall be made available to the Engineer during the sampling program and included in the FSSR and shall consist of:
- a. Boring and/or test pit logs from each sampling location containing a continuous stratigraphic description of all material encountered. Descriptions of material shall include, but not be limited to, color, odor, staining, field screening measurement, relative grain size distribution, material composition, moisture content, and cohesive properties;
 - b. The location of each sampling point on a scaled map;
 - c. Depth intervals for each sample, whether a grab or composite, and any special notes, which are included on the laboratory chain-of-custody forms; and
 - d. Copies of all laboratory chain-of-custody forms for samples that are collected for analysis.
4. **Disposal Plan:** The following information shall be included in the Disposal Plan:
- a. Name and address of plan preparer;
 - b. Name of disposal/treatment facility, address, telephone number and contact person;
 - c. Copy of applicable permits and/or licenses held by the disposal/treatment facility;
 - d. EPA Identification Number and/or State Facility Identification Number issued to the disposal/treatment facility;
 - e. Method(s) of disposal/treatment that will be used;
 - f. Signed letter from the disposal/treatment facility stating it is authorized under law to accept the type of waste being generated, their intent to accept the waste generated by this contract, and a list of the laboratory tests required by the facility;
 - g. Name of waste transporter, address, telephone number and contact person;

- h. EPA Identification Number and/or State Transporter Identification Number issued to waste transporter; and
- i. Copies of all waste transporter permits and/or license plate numbers for vehicles that will be used for transport of waste from the site to the intended disposal/treatment facility;

3.3 SEGREGATION AND STORAGE

- A. The Contractor shall have an accepted CMHP prior to commencing work within potentially contaminated soil areas. Soil determined to be contaminated (by PID/FID screening or observation) shall be segregated from non-contaminated soil and stored pending sampling, analysis and disposal. For the purposes of this project, contaminated versus non-contaminated soils are defined as follows:

1. ***Non-Contaminated Soil:*** Soil with PID/FID head space readings less than 25 ppm and exhibiting no other evidence of contamination (visual or olfactory evidence) shall be considered non-contaminated. Unless further analysis is performed for confirmation of the non-contaminated soil, this soil will be considered uncontaminated.
2. ***Contaminated Soil:*** Soil with PID/FID head space readings equal to or greater than 25 ppm and/or soil exhibiting other evidence of contamination (visual or olfactory evidence) shall be considered contaminated. This soil shall be segregated from non-contaminated soil and placed in stockpiles or containers. The results of laboratory analysis will be used to determine its regulatory classification. If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil.

If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil. The Contractor shall notify the Engineer immediately if soil is discovered that appears to contain unknown contaminants or soil that varies significantly from the type of contamination identified in the contract documents. The Engineer will determine the preliminary regulatory classification of the suspect soil and will determine how the soil is to be managed.

- B. The Contractor shall not store contaminated soil for more than forty (40) calendar days, with this time limit beginning on the first day soil is placed in a stockpile, truck-bed or roll-off container. If the Engineer approves additional storage time for soil determined to be contaminated non-hazardous waste, the Contractor shall also request approval from NYSDEC for any storage greater than sixty (60) calendar days. If the Engineer approves additional storage time for soil determined to be RCRA regulated hazardous waste, the Contractor shall also obtain approval from NYSDEC for any storage greater than ninety (90) calendar days. Contaminated soil may be placed in stockpiles, trucks or roll-off containers as follows:

1. ***Stockpiles:*** The Contractor shall prepare and maintain stockpiles as follows:

a. ***Preparation of Stockpile Areas***

- 1) The area shall be graded to provide positive drainage away from intended stockpile locations;
- 2) All stones, roots, debris and other objects that may puncture polyethylene ground protection shall be removed;
- 3) The ground surface where soil will be stockpiled shall be covered with a minimum of 10-mil or two (2) layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants; and
- 4) Stockpile locations shall be accepted by the Engineer prior to use.

b. ***Stockpile Protection***

- 1) At the end of each work day, contaminated soil stockpiles shall be completely covered with a minimum of 10-mil or two (2) layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
- 2) Stockpile covers shall be weighted or secured by appropriate means to prevent tearing or removal by weather conditions.
- 3) Stockpiles shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.
- 4) A partial containment berm made up of hay bales, silt fences, or timbers shall be utilized around stockpiled soils to direct runoff and minimize erosion.

c. ***Maintenance***

- 1) Stockpile covers, site grading, signing and security measures shall be properly maintained for the duration of storage.
- 2) Damaged covers and other protections shall be repaired or replaced by the Contractor within 24-hours after notification. If this work is not satisfactorily completed within 24-hours, no further stockpiling shall be allowed until such work is completed.

2. ***Trucks or Roll-off Containers:*** The Contractor shall prepare and maintain trucks and roll-off containers as follows:

- a. The interior of truck-beds and roll-off containers shall be lined with 10-mil or two (2) layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
- b. At the end of each work day, trucks and roll-off containers storing soil shall be completely covered with waterproof tarpaulins. Tarpaulins shall be placed over the top of the truck bed or container (rather than over the soil inside) and shall extend over the sides to prevent water accumulation and the evaporation of contaminants.

- c. Tarpaulins shall be weighted or secured by appropriate means to prevent tearing or removal by climatic conditions.
- d. Trucks and roll-off containers shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.
- e. Trucks, roll-off containers and tarpaulins shall be properly maintained for the duration of soil storage.
- f. Damaged tarpaulins and protections shall be repaired or replaced by the Contractor within 24-hours after notification. If this work is not satisfactorily completed within 24-hours, no further soil storage shall be allowed until such work is completed.
- g. Trucks and roll-off containers storing contaminated soil shall be located as described in CMHP.

3.4 FIELD ORGANIC VAPOR MONITORING

NOT USED

3.5 SAMPLING AND ANALYSIS

- A. The Contractor shall have an accepted FSP prior to commencing work. Sampling shall be conducted by individuals thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements. Accepted sampling practices shall be used to obtain representative composite sample(s) and/or grab sample(s) as required for the specific analyses to be completed. Representative samples shall be collected from stored soil as soon as possible after excavation. Soil shall be taken from a depth greater than one (1) foot within the stockpile. Each composite sample shall include a minimum of three (3) to five (5) sample points. Grab samples shall be collected in a manner so as to best characterize the extent of contamination of the soil in question and best characterize the extent of contamination of the stockpile. If any soil areas are present with field indications of contamination discretely different than the other areas (i.e., significantly elevated PID/FID readings, staining, etc.), the area may require a separate sample and the Engineer shall be alerted to approve additional sample and analysis. Analyses shall be completed at a NYSDOH ELAP accredited laboratory that is certified to perform the required tests. Analyses shall be completed within ten (10) work days of sample collection. The Contractor shall provide the Engineer with a copy of all reports within two (2) work days of their receipt from the laboratory.
- B. All material shall be sampled and analyzed in accordance with the disposal facility requirements or as required by a site-specific NYSDEC or applicable Out-of-State Regulatory Agency BUD.
- C. Soil shall not be added to any stockpile, truck or roll-off container after its contents have been sampled. If soil is added after sampling, or sampled soil is otherwise tampered with, the Contractor shall re-sample the soil at no additional cost to the Town.
- D. All sampling equipment shall be certified clean or precleaned prior to the collection of each sample, by the following method:

1. Wash all sampling equipment and secondary containers with non-phosphate laboratory grade detergent and distilled water.
 2. Triple rinse with distilled water.
 3. Rinse with isopropyl alcohol, or if samples are visibly contaminated with petroleum use a solvent, such as hexane or other alternate approved by the Engineer.
 4. Triple rinse with analyte free water.
- E. All samples shall be identified with a sample label in addition to an entry on a chain-of-custody record. The label shall be identified upon receipt by the laboratory and cross-referenced to the chain-of-custody record. Any inconsistencies shall be noted on the custody record. Laboratory personnel shall notify the Contractor's sampling and analysis representative immediately if any inconsistencies exist in the paperwork associated with the samples, and the Contractor shall be responsible for collecting new samples to replace those with inconsistencies that cannot be rectified.
- F. Custody of samples shall be maintained through the shipment of samples to the selected laboratory(ies). All samples shall be packaged and shipped daily to ensure that no sample is held at the site for more than 24-hours. Samples shall be delivered directly to the laboratory.
- G. Conduct specified analyses as follows:
1. ***Petroleum Contamination Parameter Analysis:*** Samples shall be analyzed for petroleum contamination constituents (total constituent analysis) in accordance with CP – 51/Soil Cleanup Guidance, Gasoline and Fuel oil, Tables 2 and 3 using USEPA Method 8260 for volatile organics and methyl t-butyl ether (MTBE) and USEPA Method 8270 for base/neutrals.
 2. ***Hazardous Waste RCRA Toxicity Characteristic Analysis:*** Samples shall be analyzed for Hazardous Waste RCRA Toxicity Characteristics Leaching Procedure (TCLP) constituents. Analysis shall be for full TCLP constituents on the sample extract as prepared by USEPA Method 1311.
 3. ***Ignitability of Solids Analysis:*** Samples shall be analyzed for ignitability by USEPA Method 1030.
 4. ***pH of Soil and Waste:*** Samples shall be analyzed for pH measurement by USEPA Method 9045.
 5. ***Polychlorinated Biphenyls (PCB) Analysis:*** Samples shall be analyzed for PCBs by USEPA Method 8082.
 6. ***Total Petroleum Hydrocarbons (TPH) Analysis:*** Samples shall be analyzed for petroleum hydrocarbons, USEPA Method 8015, gasoline range organics (GROs) and/or diesel range organics (DROs).

3.6 TRANSPORTATION AND DISPOSAL

- A. The Contractor shall have an accepted Disposal Plan prior to the transportation and disposal of soils. Soils shall not be transported until all sampling and analysis, as required by the Engineer or by the Disposal facility, have been performed and laboratory reports have been provided and accepted by the Engineer and/or Town.
- B. Disposal Facility Selection Requirements
 - 1. The Contractor shall submit the name(s) of the selected offsite soil disposal facilities and their location(s) to the Engineer for approval. Note that some companies may have multiple disposal facilities, each possessing differing requirements regarding the types of materials accepted, the specific analytical testing parameters that must be performed for each material, and the frequency of sampling required for each material. It is the Contractor's responsibility to determine the specific waste acceptance criteria and testing requirements for each of its proposed facilities. If the Contractor chooses to use a facility that has not previously been approved by the Engineer or the Town, the Contractor must seek approval from the Engineer to use the facility, and all additional sampling and testing procedures associated with the facility shall be provided at no additional expense to the Town.
 - a. The Contractor shall confirm the permit status, types of materials accepted, as well as check for outstanding violations and enforcement actions at each selected disposal facility. The Engineer shall verify the information provided by the Contractor for each facility prior to approval.
 - b. The Contractor shall verify the location(s) of the selected disposal facility(ies), as well as the types of materials accepted, the specific analytical testing parameters that must be performed for each material, and the frequency of sampling required for each material, at each of the selected facilities. The analytical testing parameters and the frequency of sampling required for each material are subject to change. It shall be the Contractor's responsibility to confirm and comply with all requirements of the selected facility(ies) prior to submittal to the Engineer for review and approval.
 - c. If an approved facility is not available during construction, the Contractor shall be fully responsible for procuring alternate approved facilities at no additional expense to the Town. Any additional sampling and analysis required and labor involved in selecting new facilities after the initial reuse or disposal facilities are accepted shall be the responsibility of the Contractor.
- C. Transportation Off Site
 - 1. For the duration of transportation, roll-off containers and truck beds shall be completely covered with secured waterproof tarpaulins to prevent water infiltration, evaporation of contaminants and spillage of soil.
 - 2. The Contractor shall take immediate action to remedy any situation involving a release of soil during loading or while in transit.

3. Soil shall not be combined with material from any other source.
4. Soil shall be transported in vehicles with valid Waste Transporter permits for New York State (and other required permits/licenses from any other states as applicable). The Contractor shall provide a copy to the Engineer of the waste transporter permit documenting that the transporter is authorized to transport waste to the intended disposal/treatment facility. The Contractor shall complete any required shipping papers, labeling, placarding, and weighing/load measurements and shall provide copies of required documentation to the Engineer.
5. Soil that is determined to be a regulated hazardous waste per the criteria of 6 NYCRR Part 371 shall be shipped with a hazardous waste manifest to a treatment/disposal facility permitted to accept the waste. The Contractor shall complete all required manifests, labeling, placarding, land disposal restriction notifications, and other requirements for shipping and tracking hazardous wastes and shall provide copies of required documentation to the Engineer. The Engineer will provide the Contractor with the EPA Identification Number(s) issued to the Town as the hazardous waste generator and will sign the generator certification statements.

D. Disposal / Treatment

1. Soil shall be disposed of by the methods and procedures described in the accepted Disposal Plan. Soil characterization information, field identification and confirmation laboratory analyses will be used to determine appropriate classification and category of soil for disposal. Each category of surplus or waste soil shall be handled and disposed of based upon its characterization in accordance with applicable regulatory requirements.
2. Soil shall be transported to a disposal/treatment facility within forty (40) calendar days from the start of storage. The Contractor shall complete under this item any soil sampling and analysis required by the disposal/treatment facility that is not specifically included in the contract.

E. Documentation

1. The Contractor shall provide the Engineer with copies of all receipts from the disposal/treatment facility which indicate the actual quantity of waste received within two (2) work days of receipt from the facility. For soil determined to be RCRA regulated hazardous waste, the Contractor shall also provide the Engineer with the appropriate copies of each signed manifest within two (2) work days of receipt. Any manifest discrepancies, including the need for exception reporting, shall be reported immediately to the Engineer and shall be resolved by the Contractor.

3.7 REUSE OF SOILS

- A. The Contractor shall place soil as embankment, fill or other appropriate on-site use as determined and approved by the Engineer and/or Town, and in accordance with the contract documents. Only appropriate soils placed in appropriate locations as included in the contract documents shall be reused.

- B. The material must be considered suitable material as per the Geotechnical Investigation Report, as detailed under Specification Item 1.6: Existing Soil Conditions.
- C. If fill material exhibits historical or visual evidence of contamination (including odors), and will be used in an area with public access, the relocated fill material must be covered with a minimum of 12 inches of soil or fill material that meets the criteria for general fill as defined in this Part [360]. General fill is defined in in Table 2 of Part 360 as:

TABLE 2: Fill Material Beneficial Use

Fill Material Type	Fill Material End Use	Physical Criteria	Maximum Concentration Levels
General Fill	Any setting where the fill material meets the engineering criteria, for use, except: 1. Undeveloped land; and 2. Agricultural crop land. General Fill may also be used in the same manner as Restricted-Use Fill and Limited-Use Fill.	Only soil, sand, gravel or rock; no non-soil constituents.	Lower of Protection of Public Health-Residential Land Use and Protection of Groundwater in Table 375-6.8(b) of this Title.

1. A demarcation layer will be installed for soil covers. Material meeting the criteria for general fill as defined above will be placed over a demarcation layer (i.e., an identifiable barrier between reused soils and the soil cap). Where existing soil meets the applicable soil cleanup objectives (SCOs) and where no reused soil exists, there will not be a need to install a demarcation layer

END OF SECTION 31 31 00

SECTION 328000 – LANDSCAPE IRRIGATION

PART 1-GENERAL

1.1 WORK INCLUDED

- A. General Contractor shall develop and install a complete automatically controlled lawn irrigation system supplied by a rain-harvesting cistern (specified elsewhere) including, but not limited to PVC pipe, fittings, sprinkler heads, electric zone valves, isolation valves, ball valves, quick coupler valves, valve boxes, control wires, sleeves, level monitoring, controllers and all necessary equipment, testing, and materials as required to provide a complete and fully operational irrigation system in accordance with the performance standards herein. Subcontracting to a specialized irrigation subcontractor is acceptable to meet installers qualifications.
- B. Cooperation and interface with the other prime contractors.
 - 1. Electrical contractor will prepare interior space, conduit, and access for the irrigation contractor to install controls, wiring in the space allocated. Electrical connections from the controls to the building electrical system will be furnished and made by the electrical contractor.
 - 2. Furnishing and installing all associated irrigation electrical equipment and wiring outside the building five (5) feet from the point of exit. The electrical contractor shall be responsible for all penetrations and connections into the proposed building.
 - 3. Construction of all piping and specialties for irrigation services outside the building. No connections will be made into the proposed building or to a potable water source.

1.2 REFERENCE SPECIFICATIONS

- A. Manufacturer's Standard Materials Cut Sheets.
- B. Manufacturer's recommended installation standards
- C. New York State Department of Transportation Standard Specifications, as currently amended.

1.3 SITE FEATURES AND UTILITIES

The contractor shall verify all site features and utilities prior to installation of the irrigation system. The contractor shall call for mark out and notify the Owner's Agent four (4) days prior to his commencement of installation of the irrigation system. The contractor shall verify all site features and utilities to but limited to the items below.

- A. Existing Landscape Plantings
- B. All Site Utilities
- C. Plumbing

- D. Architectural
- E. Electrical
- F. Mechanical

1.4 REQUIRED SYSTEM PARAMETERS

- A. Irrigation (cistern water source)
 - 1. 16,000 (min) square feet of irrigated area
 - 2. 4 zones (min)
 - 3. Delivery pressure at main control valve inlet: 50 psi (min)
 - 4. Delivery rate to furthest zone : 20 gpm (min)
 - 5. Automatic calendar controller (panel located within building)
 - 6. Remote rain sensor (panel located within building)
 - 7. Remote cistern level sensor (panel located within building)
 - 8. Rotor, spray, or drip application.
 - 9. 1 inch (min) distribution polyethylene tubing to connect each zone to a valve box adjacent to the cistern housing 4 automatic zone valves
 - 10. 1 inch (min) main pipe between cistern and distribution valve box
 - 11. Winterizing tee with threaded brass or stainless plug in cistern riser
 - 12. Main shut off ball valve
 - 13. Submersible pump with floating intake sleeve and controller, installed in most westerly cistern riser.
 - 14. Associated fittings, electrical and appurtenances
- B. On-Demand Water (cistern water source)
 - 1. Delivery pressure at furthest point: 40 psi (min)
 - 2. Delivery rate at furthest point: 12 gpm (min)
 - 3. 3 spigots (frost-free/freezless yard hydrants) adjacent to west and south faces of building (approximate location shown on plans)
 - 4. 1.5 inch (min) distribution polyethylene tubing to connect each spigot to a valve box adjacent to the cistern housing 3 manual ball valves
 - 5. 1 inch (min) main pipe between cistern and distribution valve box
 - 6. Winterizing tee with threaded brass or stainless plug in cistern riser
 - 7. Main shut off ball valve
 - 8. 2-gallon (min) pressure tank
 - 9. Bottom suction cistern pump with floating intake sleeve and controller, installed in most westerly cistern riser.
 - 10. Associated fittings, electrical and appurtenances

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Companies regularly engaged in manufacturing irrigation system materials and products, of types and sizes required as specified, whose products have been in satisfactory use in similar projects for not less than fifteen (15) years.
- B. Installer's Qualifications: Companies who have successfully designed and completed a minimum of five (5) contracts over a three (3) year period involving installation of irrigation and piping projects similar in size and scope to that required for this project. Such experiences and references shall be included in the shop drawings submitted for the project.

Codes and Standards:

1. Comply with all applicable State and Local ordinances and codes.
2. All materials and work shall meet the requirements of ASTM, AWWA, and UL.
3. Contractor shall be an experienced irrigation contractor. Include signed statement below:

I am a bona fide irrigation contractor with _____ years of installation experience and possess the equipment to complete this project within _____ days from starting the project.

Signature

Company name

1.6 SUBMITTALS

- A. Contractor shall develop a submittal package meeting the performance standards of this specification including: shop drawings, irrigation layout, zone configuration, catalog sheets for all equipment, manufacturers' data for materials to be used, and operation and maintenance information for a complete system. The Contractor shall submit legible PDF copies of the complete package with all selections clearly indicated. If providing paper copies, four (4) original binder copies of the package for review (Two (2) copies for the Owner's representative and two (2) copies to be returned to the Contractor upon execution). Fax submissions of shop drawings for review and approval shall not be accepted. Include:

1. Sprinkler Heads and spigots
2. Controllers
3. Electric Valves
4. Isolation Valves
5. Ball Valves
6. PVC Piping and SCH 40 Fittings
7. Valve Boxes
8. Control Wire
9. Wire Splices
10. Polyethylene Tubing
11. Quick Coupler Valves
12. Swing Joints
13. Level Sensors
14. Pumps

- B. Drawings of Record: At the project close a drawing of record shall be delivered to the Owner in both record mylar and digital format. Digital submissions shall be in AutoCAD, 2017 format on a compact disc in compatible format, or higher showing all the locations of the irrigation plan and any and all changes. The main elements of the drawing of record, i.e.; Main line fittings, Electric valves, gate valves, quick coupler, splice boxes and locations of ends of sleeves shall be shown on the drawing of record. All measurements shall be triangulated by means of tape measurements, no wheel measurements will be

allowed. Contractor may use GPS. During the installation process the contractor shall keep a field copy of changes on site.

1.10 INSPECTION OF SITE

- A. The contractor shall acquaint himself/herself with all site conditions. Should utilities not shown on the plans be found during excavations, the contractor shall promptly notify the owner site agent for instructions as to further action? Failure to do so will make the Contractor liable for any and all damage that arises from his neglect.
- B. The contractor shall take the necessary precautions to protect all existing site conditions, including plant materials. Should damage be incurred, the contractor shall repair or replace the damage to its original condition at his expense.

1.11 PERMITS AND FEES

- A. Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work including all inspection fees that may be required by local ordinances.

1.12 DRAWINGS, SPECIFICATIONS AND DETAILS

- A. Scale and Dimensions:
 - 1. Consider drawings and specifications as being compatible and therefore work called for by one and not the other shall be furnished and installed as though called for by both. When discrepancies exist between scale and dimensions or between the works to be accomplished by each trade, they shall be called to the attention of the project manager immediately. The project manager decision regarding such discrepancies shall be final and binding.
 - 2. Where diagrams and details not to scale have been shown to piping connections and other accessories the contractor is cautioned that these are diagrammatic only and not to be used for obtaining lineal runs or numbers and types of fittings or materials used.
 - 3. All measurements shall be verified at the site; all pipe routing is for diagrammatic purposes and shall be staked out in the field prior to installation. And approved by the Owner's representative.

1.13 PIPING ARRANGEMENTS

- A. The contractor shall make necessary adjustments in the layout of the irrigation system and the pipe routing. Should conflicts arise during installation the contractor shall obtain a change order for this adjustment to the plan. This change order shall not authorize an additional fee but shall resolve any existing site condition problems.
- B. The contractor shall not proceed with out the work order and shall provide in written assurance that such changes will not cause any extra costs due to these changes. Any work that does not receive a work order and is in conflict with existing site conditions shall be removed and reinstalled by the contractor at no expense to the owner or owner's agent.

1.14 WORKMANSHIP

- A. The Contractor shall follow the manufacturer's recommendations for installing all pipe, fittings, valves, electric valves, sprinklers, controllers and all other appurtenances. The Contractor shall also follow all standards and installation practices which have been established by all related associations and local, state, and federal codes. The Contractor shall always perform his work in a professional and orderly manner. The Contractor at all times shall have a Project Superintendent on the site who is completely familiar with all installed materials and will be responsible for the installation of all materials.

1.15 ACCURACY

- A. Lay out work as accurately as possible to the drawings. The drawings, though carefully drawn, are generally diagrammatic to the extent that swing joints, offsets, and all fittings are not shown.

1.16 COVERAGE

- A. The Contractor shall be responsible for full and complete coverage of all irrigated areas and shall make any necessary minor adjustments at no additional cost to the Owner. If not specified on the plans, the Contractor shall be responsible for proper nozzle choice and arc adjustment to assure:
 - 1. Matched precipitation of all heads within each area and zone.
 - 2. Proper flow rates not to exceed 5.0 feet/second in any piping.

1.17 REVISIONS

- A. Any major revisions to the irrigation system must be submitted and answered in written form, along with any negotiated change in contract price.

1.18 COORDINATION

- A. All work shall be coordinated with other trades on the site; any conflicts shall be resolved by the project manager in order to proceed with the work as rapidly and efficiently as possible.

1.19 GUARANTEE

- A. All work shall be guaranteed for one (1) year from date of acceptance of the completed installation against all defects in materials, equipment and workmanship. Guarantee shall cover the repair of damage to any part of the installation site resulting from leaks or other defects in materials, equipment and workmanship to the satisfaction of the owner. Repairs if required under the guarantee period shall be done at no costs to the owner. All manufacturers' extended warranties shall be transferred to owner with the caveat that any labor after the one year general contractor guarantee shall be billable by the contractor should the owner decide to use the contractor's service to install any manufacturer's equipment through extended warranty.
- B. Guarantee shall include system shut down for 1st winterization, spring start up, and 2nd winterization. The development of an approved water application schedule by the

contractor and approved by the Owner's representative. Winter damage due to improper winterizations will be the responsibility of the contractor and repairs to the irrigation system through both included winterizations shall be performed at no cost to the Owner.

1.20 RELATED WORK SPECIFIED ELSEWHERE

Earth Moving	Section 312000
Erosion and Sediment Control	Section 312500
Turf and Grasses	Section 329200

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, provide materials by the following irrigation manufacturers, or approved equal. Mixing manufacturers for single system elements is not acceptable, but multiple manufacturers for disparate elements may be submitted if operationally compatible.

THE TORO COMPANY
5825 Jasmine Street
Riverside, CA 92504
www.toro.com

BUCKNER IRRIGATION
4381 N. Brawley Ave
Fresno, CA 93722
www.bucknerirrigation.com

HUNTER
1940 Diamond Street
San Marcos, CA 92078
www.hunterindustries.com

RAINBIRD
970 West Sierra Madre Ave.
Azusa, CA 91702
www.rainbird.com

HydroPoint Data Systems
1720 Corporate Circle
Petaluma, CA 94954
www.hydpoint.com

SWISS PACIFIC (STROM)
4160 Weaver Court South

Hilliard, Ohio 43026
www.swisspacific.com

PENTAIR (STA-RITE, MYERS)
5500 Wayzata Blvd, Suite 900
Golden Valley, MN 55416-1261
www.pentair.com

GRUNDFOS
902 Koomey Road
Brookshire TX 77423
www.grundfos.com

WCM INDUSTRIES, INC.
2121 Waynoka Rd.
Colorado Springs CO 80915
www.woodfordmfg.com

2.2 MATERIALS

- A. Provide all irrigation materials and factory-fabricated products of size, types, pressure ratings and capacities as indicated. If there are any discrepancies in materials or interpretation or their use the contractor shall be responsible to obtain proper clarification before any materials are installed
- B. All materials throughout the irrigation system shall be new and undamaged and in perfect working condition.

2.3 PIPING AND FITTINGS

- A. All rigid piping 2 ½ inch and smaller shall be solvent weld SDR 21 class 200 PVC pipe, extruded from 100 percent virgin polyvinyl chloride conforming to ASTM D 2241 and shall be continuously and permanently marked with the manufacturers name, material, size and schedule or type. Pipe shall conform to all specifications form ASTM, Department of Commerce, NSFTL (NSF) or the latest revisions.
 - 1. All fittings on 2 inch and smaller shall be SCH 40 PVC conforming to ASTM D-2466. No saddle or clamp type fittings shall be used
- B. All pipes under vehicular traffic shall be sleeved by SCH 40 PVC conforming to ASTM D-1785. Sleeve sizes shall be large enough to accommodate the bell housing of the ring tight pipe or the solvent weld belled end pipe. As a minimum, **the sleeve pipe ID shall be 1 ¼ times the irrigation pipe OD at the bell housing.**
- C. All flexible piping 2 ½ inch and smaller shall be polyethylene tubing conforming to ASTM F 771 or current, and shall be continuously and permanently marked with the manufacturers name, material, size and schedule or type. Pressure rating for 1 inch tubing shall be 100 psi. Pressure rating for 1.5 inch tubing shall be 160 psi. Tubing shall be rated for direct burial.

2.3 VALVES

- A. Ball valves shall be forged brass, 600W.O.G./150WSP two piece, full port, conforming to WWV 35, type II style with T-style handles
- B. Electric control valves for each zone of irrigated area shall be sized to match the connecting pipe with pressure regulation.
- C. All electric and line size isolation valves shall be in standard composite valve boxes with extensions and lids as required.
- D. Quick coupler valves shall be 1 inch brass with swing joint with top flange to prevent QCV from being unscrewed from swing joint. Swing joint shall accommodate brass nipple to connect the QCV all QCV shall be in 10 inch round composite valve boxes with a 6 inch PVC sleeve.

2.4 VOLT ELECTRICAL WIRE

- A. All 24-volt control wires from controller to the electric valves shall be #14/1 red wire for direct burial. All 24-volt common wire from the controller to the electric valves shall be #12/1 white wire for direct burial. Splices and connections to the electric valves shall be with 3M DBY and DBR connectors. There will be no tee splices allowed. The common wire will be one continuous run; more than one common run may be used and spliced at the controller. Spare wires shall be run from the controller a minimum of six (6) from each controller location to the last electric valve on the run. Spare wire shall be #14/1 blue wire for direct burial. No wire splices will be allowed in wire runs of less than 1000'.
- B. When control wires must go into the building the proper splice boxes must be used and the same size corresponding wire size shall be used at the splice box location. All wire shall conform to ASTM B3 or B-8 for soft drawn bare copper wire with polyethylene insulation.

2.5 SPRINKLER HEADS, SWING JOINTS, AND SPIGOTS

- A. Turf sprinklers shall be sized to produce the coverage required. The sprinklers shall have a swing joints. The lay on all swing joints shall not be less than 35 degrees nor greater than 55 degrees from the horizontal lateral zone pipe.
 - 1. The electric valve pressure setting shall be set at 40 PSI for all zones no sprinkler head shall be spaced greater than 35'-0". The contractor is required to provide 100% coverage in all areas.
- B. Spigots shall be free-standing freezeless/frost-free cast yard hydrants, 1 inch nominal diameter riser, buried 5 feet, with 1 CF pea stone drainage pocket around the 1/8 inch (min) drain hole. Provide manual lever operating handle. Outlet shall daylight 24 inches above finished grade. Woodford models Y1 or U100, or approved equal.

2.7 CONTROLLERS

- A. The controller shall be capable of twenty four (24) stations. The controller shall operate as a stand-alone controller. The controller shall have 16 total start times; the controller shall have 4 independent programs offer concurrent operation capability, with a 7 day calendar, odd/even or day interval options for one to 30 days. The Controller shall have excluded day option, when used with the odd/even day option, allows for no watering on specific days. The station run times shall be from one (1) minute to ten (10) hours with percent of adjust by program from ten (10) to two hundred fifty (200) percent.
- B. Zone valves shall be paired at the controller all paired zones shall be of similar sprinkler type or drip zones and of similar flows in zones. No zones shall be paired with greater than five (5) percent differences in zone flow. The contractor shall submit a controller zone pairing schedule to the Owner's representative for approval prior to starting of system. No more than two (2) zones will be on any controller station.
- C. Pump controller shall be compatible with furnished equipment.

2.8 VALVE BOXES

- A. All electric zone valves, isolation valves, drain valves, quick coupler valves, splices; air vent valves and flush valves shall be in composite valve boxes or approved equal. All electric zone valves shall be placed in standard valve boxes with the extensions required to provide the proper drainage and cover of the zone valve. The valve boxes and extensions shall extend to the bottom of the zone pipe feeding the zone and installed in accordance with the these and the manufacturer's specifications.
 - 1. All isolation valves, drain valves, splices and quick coupler valves shall be placed in ten inch (10") circular valve boxes, with a piece of six inch (6") PVC pipe reach wells.
 - 2. All valve box-lifting tools and unlocking tools shall be supplied to the owner after installation. The contractor shall provide three (3) sets of these tools.

2.9 PUMPS

- A. General
 - 1. 304 stainless steel construction
 - 2. Pumps shall be suspended by non-powered 1/8 inch diameter synthetic cables or stainless steel chains secured to the pump and riser by mechanical connections. Riser connection point shall be within 1 foot of finished grade.
 - 3. Pump discharge lines shall be flexible PEX tubing rated at least twice the pump operating discharge pressure and connected to the main discharge pipe.
 - 4. Include compatible synthetic floating intake sleeves
 - i. Float shall be bright orange or yellow, spherical
 - ii. Adjust to suspend intake 6 to 12 inches below cistern water surface
- B. Irrigation
 - 1. Submersible
 - 2. 1 HP (min)
 - 3. 2 wire, 60hz
 - 4. 115V, GFCI-protected circuit
 - 5. Strom 4SF25P series, or approved equal

- C. On-Demand Water
 - 1. Bottom suction with integral automatic pressure switch
 - 2. $\frac{3}{4}$ HP (min)
 - 3. 2 wire, 60 Hz
 - 4. 115V, GFCI-protected circuit
 - 5. Strom BSP007PF series, or approved equal
 - 6. Pressure tank:
 - i. 2 gallon, welded steel, painted
 - ii. 100 percent butyl rubber diaphragm with polypropylene liner
 - iii. 125 psi maximum pressure rating
 - iv. Install within cistern riser, above maximum water level

2.10 RAIN & LEVEL SENSORS

- A. All controllers shall have separate rain and cistern level sensors that will shut the irrigation cycle off during periods of low storage, rain or rainfall accumulated amounts. The sensors shall interrupt the controller's common wire and be able to have a bypass switch for testing and to override the sensors. Rain Sensor location shall be located by Owner's representative. Cistern sensor shall be located in the most westerly riser. Wireless sensors are acceptable if the base station is wired to the building power and equipped with a sensor battery warning indicator on station.

2.11 GROUNDING

- A. All controllers shall be grounded in accordance with the manufacturer's recommendations and shall be 10 Ohms or less.

PART 3 - INSTALLATION

3.1 STAKE OUT

- A. The Contractor shall stake out all proposed lines prior to trenching operations. The location of said lines shall conform in general with the locations shown on the approved submittals. The location of the stakes will be checked by the Owner's representative and approved prior to trenching.
- B. Of particular importance is the location of sprinkler heads where prevailing winds, surface slope and special ground conditions must be taken into consideration. The final location of all sprinklers must be approved by the Owner's representative.

3.2 EXCAVATION

- A. Trench for pipe shall be wide enough to allow for proper tamping around the pipe in accordance with the manufacturer's recommendations. Trenches shall also be made wide enough to allow a minimum of 2 inches between parallel pipelines. Trenches for pipelines shall be made of sufficient depths to provide minimum cover from finish grade as follows:

1. 24" minimum cover over main lines.
2. 16" minimum cover over control wires from controller to valves (or as required by code).
3. 16" minimum cover over lateral lines to heads.

B. Maintain all warning signs, shoring, barricades, flares and red lanterns as required by OSHA, and any local ordinances. The bottom of the trench shall be clean and smooth, with all rock, loose soil, and organic matter removed. The Contractor shall insure that there are no conditions in the trench that could damage the pipe or the wires. Any deviations from the above must be approved by the Owner. Vibratory plowing of wire and solvent weld pipe will be acceptable subject to Owner approval of plowing equipment and procedures. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original condition and in a manner approved by the Owner.

3.3 ROCK REMOVAL

A. See Section 312000

3.4 DELETERIOUS MATERIAL

A. See Section 312000

3.5 PIPE LINE ASSEMBLY

A. Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench bottom to allow for expansion and contraction. Make all connections between plastic pipe and metal valves or steel pipe with threaded fittings using SCH 80 PVC.

3.6 THRUSTING

A. Install thrust blocks or anchoring for all isolation valves larger than 3", and all piping including changes in direction and reducers, in strict accordance with pipe manufacturer's recommendations. Construct thrust blocks of Sakrete or concrete of the following mix, having a compressive strength of 2000 PSI: 1 part concrete; 2.5 parts sand; 4 parts washed gravel. All thrust blocks must bear against undisturbed soil. In no case will fieldstone or wood of any form be acceptable for thrusting.

3.7 SPRINKLER HEADS

A. Install sprinklers as per manufacturer's recommended specifications. Install all sprinkler heads on specified swing joints.

3.8 CLOSING PIPE AND FLUSHING LINES

- A. Cap or plug all openings as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation. Thoroughly flush out all water lines before installing heads. Test in accordance with paragraph on Hydrostatic Tests. Upon completion of the testing, the Contractor shall complete assembly and adjust sprinkler heads for proper distribution.

3.9 HYDROSTATIC TESTS

- A. Request the presence of the Owner's Representative in writing at least 48 hours in advance of testing. Testing to be accomplished at the expense of the Contractor and in the presence of the Owner. Center load piping with small amount of backfill to prevent arching or slipping under pressure. Apply a continuous and static water pressure of 80 PSI when welded plastic joints have cured at least 24 hours and with the risers capped as follows:
 - 1. Main lines and sub mains to be tested for 3 hours.
 - 2. Lateral lines to be tested for 2 hours. (If laterals and individual sub-mains downstream of control valves have less than 45 PSI working pressure or less than 5 GPM flow, hydrostatic tests are waived for these laterals.)
- B. Repair leaks resulting from tests.

3.10 AUTOMATIC CONTROLLERS

- A. Connect sprinkler valve wires to controller in a logical sequence to correspond with specification. Controller wires shall not be connected until system is ready to be activated.

3.11 ELECTRIC ZONE VALVES

- A. All electric zone valves shall be installed as proposed on the approved submittal. The Contractor shall take extra caution to avoid over tightening the nipples on the inlet side or the discharge side of the electric valve. No pipe dope shall be used: only Teflon tape.
- B. The Contractor shall lower the electric zone valve assembly completely with valve boxes and extension to cover the PVC lateral pipe with the valve box. All brick supports shall be complete around the valve box and brick shall be placed on undisturbed soil.
- C. Prior to installation of zone valves all main line piping shall be flushed and free from contaminants.

3.12 WIRE AND WIRE SPLICING

- A. Do not yank, stretch, or pull wires during installation. Provide a minimum of one foot of slack, in an expansion loop, in each 100 feet of wire. Lay wire on a firm even bed in the trench, which shall support the entire length. At splice locations, provide sufficient slack to allow the splice to be raised a minimum of 24 inches above grade for inspection. Do not lay wire above, or on top of the pipe, except when wire and pipe are being plowed simultaneously. When power wire runs do not follow the pipe, lay them in a straight line which shall be carefully located on the as-built plan. Minimum 2.5" pipe shall be used as wire conduit for all sleeves.

- B. Splice all wires to requirements of local minimum regulations or to the following recommendations, whichever is more restrictive: Make all splices by baring a minimum of three-quarters of an inch of copper conductor, twisting the leads together, and soldering them with a non-acid core solder. Wire nuts are acceptable in lieu of soldering. Make the splice completely waterproof by using connector kits in strict accordance with the manufacturer's recommendations.

3.13 AUTOMATIC CONTROL WIRING

- A. Install control wires, sprinkler mains and laterals in common trenches wherever possible. Install control wires at least 12 inches below finish grade and lay to the side and below main line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten foot intervals. Control wire splices will be allowed only in runs more than 1000 feet. Any splices must be installed in an existing valve box or separate valve box installed flush with finished grade. On runs longer than 2500 feet contractor shall use 12/1 field and 10/1 common.
- B. All wire passing under existing or future paving, construction, etc., shall be encased in plastic or galvanized steel conduit extending at least 16 inches beyond edges of paving or construction.

3.14 VALVE BOXES

- A. All valve boxes shall be set at finished grade and supported by brick foundations on undisturbed soil. All valve box sizes shall include all special tools necessary for removal and unlocking of lids. Contractor shall clean out all sedimented materials from valve boxes and provide 1 CF pea gravel sumps. The Contractor shall maintain the valve boxes during the construction process to protect them from damage and excessive sedimentation.

3.16 BACKFILL AND COMPACTING

- A. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil, free of rubbish and deleterious material.
- B. See Section 312000

3.17 CLEAN-UP

- A. Remove from the site all debris resulting from work of this section.

END OF SECTION 328000

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the Drawings and specified herein, including, but not limited to, the following:
 - 1. The preparation of the topsoil to receive stabilization.
 - 2. The seeding, establishment, watering and maintenance of lawns until the Owner accepts the project.
 - 3. The placement of fertilizers.
 - 4. The placement and maintenance of mulches.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Site Clearing: Section 311000.
- B. Earth Moving: Section 312000.
- C. Erosion and Sedimentation Controls: Section 312500.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

1.4 SUBMITTALS

- A. The Contractor shall submit a schedule of his proposed methods and operations of Site Preparation.
- B. The Contractor shall provide material certifications and/or shop drawings for the materials stated herein.

1.5 QUALITY ASSURANCE

- A. The Contractor shall perform all his operations in accordance with the rules, regulations and ordinances of those governing bodies having jurisdiction.

1.6 JOB CONDITIONS

- A. General: The Contractor shall place all required topsoil, replace sod or provide seeding and mulching in accordance with the lines and grades shown on the Drawings and as specified herein. The Contractor shall provide all topsoil required from the approved stockpile accumulated from the Site stripping operations or from offsite sources where a deficiency exists in the stockpiled amount, within the Contract Sum for the Project. No additional cost to the Owner will be incurred for topsoil which must be provided from offsite sources.
- B. Time of Planting: The Contractor shall notify the Owner's Representative when sections of the Work have progressed sufficiently, to commence Work on lawns, including placing of topsoil to finished grade. Thereafter, planting operations shall be performed under favorable weather conditions during the next season or seasons which are normal for such work.
- C. Unless otherwise approved the seeding schedule shall be as follows:

Seeding of Permanent Lawns

March 15 (if soil is frost-free and not excessively moist) to May 15.
August 15 to October 15.

If the lawn areas are not ready for seeding between the time periods designated above, the areas shall be seeded immediately upon completion of topsoil operations, with ryegrass (annual or perennial) at a rate of thirty (30) lbs. per acre for a temporary lawn. Lawn work will not be permitted when the soil is frozen or excessively moist. If temporary lawn work has to be provided, the permanent lawn shall be installed during the next seeding season as specified.

- D. All areas within the limit of disturbance not required to be developed otherwise shall be planted with grass under the Contract Sum.

1.7 WARRANTY

- A. Maintenance shall begin immediately following each operation of installation for each portion of lawn and shall continue for the length of this Contract.
- B. Inspection of the Work to determine completion of Contract Work will be performed by the Owner's Representative at the conclusion of the maintenance period upon written notice requesting such inspection, submitted by the Contractor at least ten (10) days prior to the anticipated date. The condition of lawns will be noted and a determination made by the Owner's Representative whether maintenance shall continue in any part.
- C. Acceptance - After inspection, the Contractor will be notified in writing by the Owner's Representative of acceptance of all Work under this Section.
- D. Acceptance in Part - The Work may be accepted in part by the Owner's Representative upon written application by the Contractor, provided the Work offered for acceptance is completed in accordance with this Section.

- E. Any areas which fail to show a "catch" for any reason whatsoever, shall be reseeded at the Contractor's expense until a "catch" is obtained. Damage resulting from erosion, rills, gulleys, construction activity, washouts or other causes shall be repaired by filling with topsoil, tamping and reseeded by Contractor at his own expense, until final acceptance of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. TOPSOIL

1. The Contractor shall furnish, at his expense, any additional quantities of topsoil to properly install all work as specified herein and as shown on the Drawings.
2. Topsoil shall consist of natural loam topsoil, free from subsoil. Topsoil shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods, partially disintegrated stone, or any other undesirable material.
3. Topsoil shall contain at least 6% and not more than 25% organic matter as determined by loss of ignition on a moisture-free sample dried in accordance with the current method of the Association of Official Agricultural Chemists. The acidity range shall be pH 5.5 to pH 7.5, inclusive. Largest object size shall be three (3) inches. Amend as necessary to achieve these standards using amendments specified herein. The mechanical gradation analysis of the soil shall be as follows:

Sieve Size	Percent Passing by Weight
2 inch	100
1 inch	85 to 100
¼ inch	65 to 90
No. 200	20 to 50

B. COMMERCIAL FERTILIZER

1. Shall be a complete fertilizer formula (5-10-10, or equivalent) and shall conform to the applicable State Fertilizer laws. It shall be uniform in composition, dry and free flowing, and shall be delivered to the Site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.

C. WATER

1. The Contractor shall make, at his expense, whatever arrangements necessary to ensure an adequate supply of water to meet the needs of this Contract. He shall also furnish all necessary hose, equipment, attachments and accessories for the adequate

irrigation of lawns and planted areas as may be required to complete the Work as Specified.

D. SCREEN

1. Shall be one-half (1/2) inch mesh galvanized hardware cloth.

E. LAWN MATERIAL

1. Grass seed for mowed lawn areas shall be mixed and guaranteed by the Dealer as follows:
 - a. 65 lbs Kentucky Bluegrass per acre
 - b. 65 lbs. Perennial Ryegrass per acre
2. Grass seed for occasional mowing areas shall be mixed and guaranteed by the Dealer as follows:
 - a. 8 lbs Empire Birdsfoot, Trefoil or Dutch White Clover per acre
 - b. 20 lbs Tall Fescue per acre
 - c. 2 lbs Redtop or 5 lbs Perennial Ryegrass per acre
3. Grass seed for stabilization of steep slopes (including and exceeding 3:1) shall be mixed and guaranteed by Pennington Seed (800.285.SEED), or approved equal:
 - a. "Slopemaster"
 - b. 200 lbs. per acre
 - c. Mixture:
 - 1) 75% Turf Type Tall Fescue
 - 2) 11% Annual Ryegrass
 - 3) 9% Unhulled Serecia Lespedeza
 - 4) 5% Durana White Clover (low, spreading habit)
4. Total weed content shall not exceed 1.5% of the total seed mixture.
5. If the plans indicate a seed mixture other than as specified above, use the plan values.

F. EROSION CONTROL MATERIALS

1. Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6-inches long. North American Green (800.772.2040) or approved equal. See plan for type.
2. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6-inches long.

G. SOIL AMENDMENTS

1. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 sieve and a minimum 75 percent passing a No. 60 sieve.
 - a. Provide lime in the form of dolomitic limestone.

2. Aluminum Sulfate: Commercial grade, unadulterated.
3. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.
4. Perlite: Horticultural perlite, soil amendment grade.
5. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.
6. Select paragraph above or below or delete when not required. Sphagnum moss is too acid for many trees, shrubs, and plants.
7. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.
8. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - a. When site treated, mix with at least 0.15 lb of ammonium nitrate or 0.25 lb of ammonium sulfate per cu. ft. of loose sawdust or ground bark.
9. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
10. Herbicides: EPA registered and approved, of type recommended by manufacturer.
11. Water: Potable.

H. STRAW MULCH

1. Provide clean, seed-free salt hay or threshed straw of wheat, rye, oats, or barley.

I. TURFGRASS SOD

1. Turfgrass sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specification for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
2. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not less than 0.5 percent weed seed
 - a. Athletic Field proportioned by weight as follows:
 - 1) 80 percent turf type Tall Fescue
 - 2) 10 percent perennial Ryegrass
 - 3) 10 percent Kentucky Bluegrass

PART 3 - EXECUTION

3.1 LAWN PLANTING PREPARATION

- A. The contractor shall be responsible to restore all site disturbance generated as a direct result of this project with topsoil, fertilizing, seeding, and straw mulching in accordance with the requirements of this specification.
- B. Limit subgrade preparation to areas that will be planted in the immediate future.

- C. Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous materials.
- D. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
 - 1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
 - 2. Allow for sod thickness in areas to be sodded.
- E. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
 - 1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
 - 2. Till surface soil to a depth of at least 6 inches. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
 - 3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - 4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- F. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches in any dimension, and other objects that may interfere with planting or maintenance operations.
- G. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- H. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.2 INSTALLATION

A. TOPSOIL

- 1. Upon completion of grading operations for each respective area of Work, the Contractor shall place topsoil to a minimum depth of four (4) inches on all embankments and seed areas, first scarifying the subgrade for a depth of two (2) inches for the bonding of the topsoil with the subsoil. Where embankments are too steep for hand raking or tamping, topsoil may be compacted by mechanical means. Topsoil shall not be spread in a frozen or muddy condition. Topsoil from stockpile shall be raked to remove objectionable and oversized material as directed by the Owner's Representative.

B. LIME

1. Ground limestone shall be applied sufficiently to the lawn areas being prepared for seeding to attain a acidity pH of 6.0 to 7.0. Incorporate limestone into top three (3) inches of the soil at least three (3) days prior to seeding.

C. COMMERCIAL FERTILIZER

1. Commercial fertilizer shall be applied at the rate of 600-lbs per acre of lawn area.

D. EROSION CONTROL MATTING

1. Prepare location to receive matting as specified in subpart 3.1 above.
2. Install matting at locations indicated on the plans, as directed by the Owner's Representative, or at locations of surface erosion in accordance with manufacturer's recommendations.
3. Secure matting to ground in a manner and pattern that is in accordance with the manufacturer's recommendations and appropriate for the installation location.

E. SODDING

1. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
2. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - a. Lay sod across angle of slopes exceeding 1:3
3. Saturate sod with fine water spray within two hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.3 HYDROSEEDING NEW LAWNS

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic tackifier.

- B. Apply slurry uniformly to all areas to be seeded in a 1-step process. Apply mulch at the minimum rate of 1500 lb per acre (16.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.

- C. Apply slurry uniformly to all areas to be seeded in a 2-step process. Apply first slurry application at the minimum rate of 500 lb per acre (5.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb per acre (11 kg per 100 sq. m).

3.4 RECONDITIONING LAWNS

- A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.
 - 1. Recondition other existing lawn areas.
- B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.
- C. Where substantial lawn remains, mow, dethatch, core aerate, and rake. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Till stripped, bare, and compacted areas thoroughly to a depth of 6 inches.
- F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Provide new planting soil as required to fill low spots and meet new finish grades.
- G. Apply seed and protect with straw mulch as required for new lawns.
- H. Apply sod as required for new lawns.
- I. Water newly planted areas and keep moist until new grass is established.

3.5 MAINTENANCE

- A. The Contractor shall provide necessary watering, fertilizer, etc. as required to establish perennial vegetation cover with a minimum density of 80% over the entire pervious surface of the disturbed area, or until sufficient vegetation is established to prevent erosion, whichever is greater.
- B. The Contractor shall provide necessary watering, fertilizer, etc., required to establish and maintain seeded areas until same are accepted by the Owner.
- C. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. 60 days after date of Substantial Completion.
 - a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.

- D. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth lawn.
- E. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches.
 - 1. Water lawn at the minimum rate of 1 inch per week.
- F. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- G. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. of lawn area.
- H. Repair of eroded areas:
 - 1. Restore soil and reseed
 - 2. If problem persists, install erosion control materials as directed by the Owner's Representative.
 - 3. All repair work shall be performed at no additional cost to the Owner.

3.6 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 – General Requirements, apply to this Section.
- B. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Trees.
 - 2. Fertilizers and mulches.
 - 3. Stakes and guys.
- C. RELATED WORK SPECIFIED ELSEWHERE:
 - 1. Site Clearing Section 311000
 - 2. Earth Moving Section 312000
 - 3. Turf and Grasses Section 329200

1.2 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 – General Requirements.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.
- C. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with analysis of existing surface soil.
- D. Submit three (3) copies of planting schedule showing scheduled dates for planting in each area of site.
- E. Submit typewritten instructions recommending procedures to be established by the Owner for maintenance of lawn and grass work for one full year. Submit prior to expiration date of required maintenance period(s).
- F. All bags need to be saved for lime, fertilizer, seed, and liquid mulch binder (if used as mulch anchoring method). Such proofs may need to be submitted to the Owner's Representative for verification of materials and quantities used for all seedings.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Municipal Engineer's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- C. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Construction Manager. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.
- C. Handle balled and burlapped stock by the root ball.
- D. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots in water for 2 hours if dried out.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.5 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Construction Manager before planting.

1.6 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Warrantee the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
 - 1. Trees.
- C. Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season.
- D. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- E. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

1.8 TREE AND SHRUB MAINTENANCE

- A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintain trees and shrubs for the following period:
 - 1. Maintenance Period: 12 months following Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Construction Manager, with a proportionate increase in size of roots or balls.
- C. Label at least 1 tree and 1 shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

2.2 FERTILIZER

- A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.3 MULCHES

- A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of lawns, consisting of one of the following:
 - 1. Type: Unrotted pine straw, salt hay, or threshed straw.
- B. Peat Mulch: Provide peat moss in natural, shredded, or granulated form, of fine texture, with a pH range of 4 to 6 and a water-absorbing capacity of 1100 to 2000 percent.

- C. Asphalt Emulsion Tackifier: Asphalt emulsion, ASTM D 977, Grade SS-1, nontoxic shall not be permitted for use on this project.
- D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic and free of plant growth- or germination-inhibitors.
- E. Shredded Wood Landscaping Mulch: shredded, uncolored, natural cedar bark from a source located within the United States suitable for placement under trees, shrub planting beds, and other locations indicated on the plans.

2.4 WEED-CONTROL BARRIERS

- A. Sheet Polyethylene: Black, 0.006-inch (0.15-mm) minimum thickness.
- B. Nonwoven Fabric: Polypropylene or polyester fabric, 3 oz. per sq. yd. (100 g per sq. m) minimum.
- C. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz. per sq. yd. (160 g per sq. m).

2.5 STAKES AND GUYS

- A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.
- B. Guy and Tie Wire: ASTM A 641 (ASTM A 641M), Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.
- C. Guy Cable: 5-strand, 3/16-inch (4.8-mm) diameter, galvanized-steel cable, with zinc-coated turn buckles, 3-inch- (75-mm-) long minimum, with two 3/8-inch- (10-mm-) galvanized eyebolts.
- D. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.
- E. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

2.6 MISCELLANEOUS MATERIALS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions.
- B. Anti-Erosion Mulch: Provide clean, seed-free salt hay or threshed straw of wheat, rye, oats, or barley.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Lay out individual tree locations and areas for multiple plantings. Stake locations, outline areas, and secure Owner's acceptance before the start of planting work. Make minor adjustments as may be required.
- B. Finish grading for areas to be seeded shall be done with previously stockpiled (if any) and supplementary topsoil. Do not complete topsoil work until the installation of all underground utilities, sewers, storm drainage systems, etc. have been completed.
- C. Apply fertilizers by mechanical rotary or drop type distributor and thoroughly and evenly incorporate with soil to a depth of 3" by discing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.

3.3 PLANTING SOIL PREPARATION

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
- B. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.
 - 1. A "Planting Soil Amendments Schedule" is included at the end of this Section.
- C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.
- D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
 - 1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime from contacting roots of acid-tolerant plants.
 - 2. Apply phosphoric acid fertilizer, other than that constituting a portion of complete fertilizers, directly to subgrade before applying planting soil and tilling.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Pits and Trenches: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation.
 - 1. Bare-Root Trees and Shrubs: Excavate at least 12 inches (300 mm) wider than root spread and deep enough to allow setting of roots on a layer of planting soil and with collar set at same grade as in nursery, but 1 inch (25 mm) below finish grade, unless otherwise indicated.
 - a. Setting Layer: Allow 3 inches (75 mm) of planting soil.
 - 2. Balled and Burlapped Trees and Shrubs: Excavate approximately 1-1/2 times as wide as ball diameter and equal to ball depth, plus the following setting layer depth:
 - a. Setting Layer: Allow 3 inches (75 mm) of planting soil.
 - 3. Container-Grown Trees and Shrubs: Excavate to container width and depth, plus the following setting-layer depth:
 - a. Setting Layer: Allow 3 inches (75 mm) of planting soil.
- B. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.
- C. Obstructions: Notify Construction Manager if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Construction Manager if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- E. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs.

3.5 PLANTING TREES AND SHRUBS

- A. Set balled and burlapped stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 - 1. Place stock on setting layer of compacted planting soil.
 - 2. Remove burlap and wire baskets from tops of balls and partially from sides, but do not remove from under balls. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
 - 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water

thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

- B. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 - 1. Carefully remove containers so as not to damage root balls.
 - 2. Place stock on setting layer of compacted planting soil.
 - 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
- C. Dish and tamp top of backfill to form a 3-inch- (75-mm-) high mound around the rim of the pit. Do not cover top of root ball with backfill. Place mulch 4" thick.

3.6 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs as directed by Construction Manager.
- B. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Construction Manager, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are size after pruning.

3.7 TREE AND SHRUB GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1800 mm) above grade. Set vertical stakes and space to avoid penetrating balls or root masses. Support trees with 2 strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Guying and Staking: Guy and stake trees exceeding 14 feet (4.2 m) and more than 3-inch (75-mm) caliper unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches (760 mm) long, driven to grade. Attach flags to each guy wire, 30 inches (760 mm) above finish grade.

3.8 MULCHING

- A. Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.

- B. Weed-Control Barriers: Install the following weed-control barriers according to manufacturer's recommendations, before mulching. Completely cover area to be mulched, lapping edges a minimum of 6 inches (150 mm).
 - 1. Material and Seam Treatment: Sheet polyethylene with seams taped.
 - 2. Material and Seam Treatment: Nonwoven fabric with seams pinned.
 - 3. Material and Seam Treatment: Composite fabric with seams pinned.
- C. Organic Mulch: Apply the following average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.
 - 1. Thickness: 4 inches.

3.9 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
 - 1. When deciduous trees or shrubs are moved in full-leaf, spray with antidesiccant at nursery before moving and again 2 weeks after planting.

3.10 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

3.12 PLANTING SOIL AMENDMENTS SCHEDULE

- A. Tree Pits or Trenches: Provide soil amendments in not less than the recommended quantities as determined by the independent testing laboratory. The cost of all testing, fertilizer and amendments are the responsibility of the contractor, and shall be included as part of the price bid for each item.
- B. Ground Cover and Planting Beds:
 - 1. Provide soil amendments in not less than the recommended quantities as determined by the independent testing laboratory. The cost of all testing, fertilizer and amendments are the responsibility of the contractor, and shall be included as part of the price bid for each item.

END OF SECTION 32 93 00

SECTION 334000 - STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Installation of all exterior storm drainage elements outside of the building five (5) feet from the point of exit.
 - 2. The general contractor shall be responsible for coordinating all horizontal and vertical locations of connections into the building line with the plumbing contractor.
 - 3. The general contractor shall be responsible for closing and sealing all existing storm sewer connections that are no longer required by the proposed configuration.
 - 4. Facilitating the Owner's visual inspection of the storm sewer piping installed under this project.
- B. Cooperation and interface with the other prime contractors.
 - 1. The plumbing contractor shall be responsible for all penetrations and connections into the proposed building.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving: Section 312000.
- B. Flexible Paving Section 321200.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

1.4 DEFINITIONS

- A. HDPE: High Density Polyethylene plastic.
- B. PVC: Polyvinyl chloride plastic.
- C. DIP: Ductile Iron Pipe

1.5 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.6 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
1. Precast concrete manholes, inlets and other structures, including frames, covers, and grates.
 2. Perimeter drain, grates, catch basins, layout, and manufacturer installation instructions.
 3. Cast-in-place concrete manholes, inlets and other structures, including frames, covers, and grates.
 4. Signed by a Licensed New York Professional Engineer specializing in structural design.
 5. Product specifications for pipes, clean-outs, connections and gaskets.
- B. Coordination Drawings: Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
- C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Record Drawings in accordance with Division 01 Section "Contract Close-Out".
1. These drawings shall show the following information:
 - a. As-built location of storm sewer line in plan
 - b. Invert elevation
 - c. Rim elevation
 - d. Pipe diameter, material, length and percent slope
 - e. Locations of lateral cleanouts (by triangulation)
 - f. Above-ground Detention pond structures and earthworks (if indicated on plans)
 - g. Under-ground Detention pond structures and earthworks (if indicated on plans)
 - h. Utility crossing locations
 2. These drawing shall comply with the following standards:
 - a. Clearly marked and easily readable
 - b. A scale identical to the construction plans
 - c. Horizontal datum: North American Datum (NAD) 1983
 - d. Vertical datum: North American Vertical Datum (NAVD) 1988
 - e. Signed and sealed by a Licensed New York Professional Land Surveyor

3. As-builts shall be delivered to the Owner in both record mylar and digital format. Digital submissions shall be in AutoCAD, 2017 format on a compact disc in compatible format.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. If piping and structures are to be stored on site prior to placement in accordance with the construction documents, the following shall be required:
 1. All pipes shall be stored on grade. Stacking is not permitted.
 2. Sufficient barricades shall be provided around piping and structures to prevent unauthorized access to the storage area.
- C. Protect pipe, pipe fittings, and seals from dirt and damage.
- D. Handle precast concrete manholes, inlets and other structures according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Proposed material manufacturers shall be supplied and approved at the time of shop drawing submission.

2.2 PIPING MATERIALS

- A. Refer to Part C "Piping Applications" Article for applications of pipe and fitting materials.

2.3 PIPES AND FITTINGS

- A. Drainage Pipe and Fittings, NPS 8 and Smaller:
 - 1. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40
 - 2. Solvent-cemented joints.
- B. Sewer Pipe and Fittings, NPS 8 and Smaller:
 - 1. ASTM D 3034, SDR 35
 - 2. Solvent-cemented or gasketed joints.
 - a. Gaskets: ASTM F 477, elastomeric seals.
- C. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B, for gasketed joints.
 - 1. Gaskets: ASTM C 443, rubber.
- D. HDPE storm sewer pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, and M294. Pipe and fittings shall be made from virgin PE compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350.
 - 1. Storm sewer piping greater than eight (8) inch in diameter shall be smooth interior/corrugated exterior pipe fitted with watertight joints meeting or exceeding ASTM 3212 lab test and ASTM 1417 watertight field test. N-12 IB WT® Product as manufactured by Advanced Drainage Systems, Inc. (ADS), Columbus, OH, (614) 457-3051 or approved equal.
 - 2. Underdrain piping less than or equal to eight (8) inch in diameter shall be perforated single-wall pipe fitted with soil-tight joints meeting ASTM standards F405 and F606 as manufactured by Advanced Drainage Systems, Inc. (ADS), Columbus, OH, (614) 457-3051 or approved equal.
- E. Ductile Iron pipe (DIP), Class 52, cement lined, and shall have push on joints. (ANSI/AWWA 151/A21.51)
- F. Underground Stormwater Vault ACF Model UD-Double-Mini, or approved equal.
- G. Hydrodynamic Separator: Contech CS-4 Unit, or approved equal.
- H. Yard Drains: As specified on plans, or approved equal.

2.4 SPECIAL PIPE COUPLINGS AND FITTINGS

- A. Sleeve-type and bushing-type pipe couplings ('Fernco') shall not be permitted.

- B. Pipe Couplings shall be DIP, PVC, HDPE or other approved rigid connectors for joining existing and dissimilar piping materials as manufactured by Dresser (814) 362-9200, Genco (800) 345-6454, Harco (502) 366-4596 or other approved equal.

2.5 MANHOLES

- A. Normal-Traffic Precast or cast-in-place Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 3. Base Section: 8-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4. Precast Riser Sections: 5-inch minimum thickness, and lengths to provide depth indicated.
 - 5. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 - 6. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 7. Gaskets: ASTM C 443, rubber.
 - 8. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 30-inch- diameter frame and cover.
 - 9. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12-inch
 - 10. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 - 11. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".
- B. Cast-in-Place Concrete Manhole (Doghouse): Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
 - 1. Ballast: Increase thickness of concrete, as required to prevent flotation.
 - 2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 30-inch diameter frame and cover.
 - 3. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 - 4. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-inch intervals.
 - 5. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".
- C. Manhole Frames and Covers: ASTM A 536, Grade 60 ID by 4- to 10-inch riser with 4-inch minimum width flange, and 30-inch- diameter cover. Include indented top design with lettering per Owner requirements cast into cover

2.6 CATCH BASINS

- A. Normal-Traffic, Precast or Cast-in-place Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Base Section: 10-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 2. Riser Sections: 6-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 - 3. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 - 4. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 5. Gaskets: ASTM C 443, rubber.
 - 6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and grate.
 - 7. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps or anchor ladder into base, riser, and top section sidewalls at 12-inch intervals. Pipe Connectors: ASTM C 923M, resilient, of size required, for each pipe connecting to base section.
 - 8. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".
 - 9. Channels and Benches: Concrete.
- B. Cast-in-Place Concrete Structure (Doghouse): Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
 - 1. Ballast: Increase thickness of concrete, as required to prevent flotation.
 - 2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match inlet dimensions of frame and cover.
 - 3. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 - 4. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-inch intervals.
 - 5. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".

2.7 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to local standards.
- B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to local standards. Include heavy-duty frames and grates.
- C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to local standards. Include heavy-duty frames and grates.

- D. Frames and Grates: Heavy-duty cast iron frames and grates according to local standards with bicycle-safe grate patterns.
- E. Yard Inlets: As specified on plans or approved equal.

2.8 FILTER FABRIC

- A. Filter fabric shall be AASHTO M288 class 2 non-woven, TC Mirafi 140N or approved equal.
- B. Filter fabric in high-scour applications (e.g. riprap aprons) shall be AASHTO M288 class 1 woven, TC Mirafi FW500 or approved equal.
- C. See Plans for specified locations/USGS.

2.9 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert slope shall be one (1) percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel. Slope shall be four (4) percent.
- D. Include channels in catch basins.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: shall be one (1) percent through catch basin.
- E. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.

2.10 PROTECTIVE COATINGS

- A. Description: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
1. Concrete Manholes: On exterior and interior surfaces.
 2. Catch Basins: On exterior and interior surfaces.
 3. Stormwater Inlets: On exterior and interior surfaces.

2.11 CLEANOUTS

- A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.12 UNDERGROUND STORMWATER VAULT

- A. Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height and envelope shown on plans.
- B. Units shall meet the following Physical Characteristics:
- a. Void Area: 95%
 - b. Comprehensive Strength: 134.2 psi
 - c. HS-20 Minimum Cover: 12" (Stone Backfill)
- C. Supplier: ACF Environmental 2831 Cardwell Road Richmond, VA 23234 (T): 800-448-3636; (F): 804-743-7779 www.acfenvironmental.com, or approved equal.
- D. Bedding Materials: Stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the system (3" minimum). Material must be free from lumps, debris, and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.
- E. Side and Top Backfill: Free draining material shall be used adjacent to (24" minimum) and above (for the first 12") the system. Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.
- F. For UD modules in traffic loaded (HS-20) applications with less than 14" of top cover, backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter). The use of soil backfill on the sides and top of the UD module is not permitted unless the modules are installed outside of traffic areas or with cover depths of 14" or more. Top

backfill material (from top of module to bottom of pavement base or 12" maximum) must be consistent with side backfill.

- G. System shall provide 3,524 cf of storage at a depth of 3.35 feet.

2.13 STORMWATER TREATMENT DEVICE (SWTD): HYDRODYNAMIC SEPARATOR

- A. This item shall govern the furnishing and installation of the SWTD, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.
- B. The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a hydrodynamic separation device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

- C. The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period at the cost to the manufacturer. The use of SWTD components shall be limited to the application for which it was specifically designed.
- D. The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that the SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research.
- E. No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.
- F. Performance
1. The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns.

2. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the following requirements: Minimum Sump Storage Capacity of 0.70 cubic yards and Minimum Oil Storage Capacity of 141.0 gallons. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.
3. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity as discussed in Section 2 of the Performance Specifications for the unit.
4. The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of New York. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

2.14 STORMWATER TREATMENT DEVICE: CISTERN

- A. This item shall govern the furnishing and installation of a cistern for rainwater harvesting and other underground water storage for nominal diameters 30" (750mm) through 120" (3000mm).
- B. A stormwater treatment device upstream of the cistern is recommended as the appropriate means of pretreating for the purpose of extending the maintenance interval on the cistern system and reducing the life cycle cost. Both engineered solutions shall be provided by a single supplier/manufacturer.
- C. Site layout drawings, product specifications, materials, hydraulic storage data and supported calculations of proposed alternatives shall be submitted to the Engineer of Record (EOR) for review at a minimum of 10 working days prior to bid closing.
- D. The cistern system proposal shall be sized in accordance with the design provided and approved by the Engineer of Record (EOR). Any Contractor deviating from the design shown on the plans, to include: material, footprint, etc., shall provide to the Engineer of Record (EOR) a summary report on stage-storage curves, design calculations, system modeling and engineering drawings.
- E. Shop drawings shall be annotated to indicate all materials to be furnished and installed under this section, and all applicable standards for materials, required tests of materials and design assumptions for structural analysis.
- F. Virgin high density polyethylene stress-rated resins are used to manufacture the cistern and complimentary fabricated fittings. Resins shall conform to the minimum requirements of cell classification 345464C as defined and described in the latest version of ASTM D3350
- G. Performance

1. All tanks must be leak tested and results documented using a positive pressure air test prior to shipment from the manufacturing location. Testing documentation shall include test air pressure and hold time. A copy of the leak test report must be provided to the Engineer of Record as requested.
2. Bulkheads shall be constructed of material in conformance with Section 2.14 F and designed for H-20/HS-25 final live loading conditions.
3. All cistern inlets shall be equipped with an inlet calming device that they may introduce water to the tank with little to no turbulence.
4. The cistern shall provide a minimum of one 36 inch diameter access riser.
5. Cistern tank spacing, and stone base thickness cannot be altered with consultation from the manufacturer.
6. The cistern shall be designed for a minimum HS-20/HS-25 final live loading conditions. The cistern shall meet HS-20/HS-25 loading requirements with a minimum cover of 1.5 ft. and a maximum cover of 8' measured from the top of tank to the bottom of flexible pavement. The cistern shall have a unit weight of 65.6 lbs./ft. and a minimum wall thickness of 0.220 in.

2.15 SWTD – PERFORMANCE

- A. The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns.
- B. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.
- C. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.
- D. The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.
 - 3. Install detectable warning tape 6-inches to 12-inches below finished grade.

3.3 PIPING APPLICATIONS

- A. General: Include watertight or soil-tight joints as specified.
- B. Refer to Part B of this Section for detailed specifications for pipe and fitting products. Use pipe, fittings, and joining methods according to applications indicated.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods. Use the following pipe couplings for nonpressure applications:
 - 1. Rigid connection fittings
- B. Encase all dissimilar connections or connections to existing piping materials located under proposed structures (buildings, roadways, etc.) with concrete.

3.5 INSTALLATION, GENERAL

- A. Unloading and Handling
 - 1. Follow all Occupational Safety and Health Administration (OSHA) safety requirements.
 - 2. When the truckload of pipe is initially received, it should be inspected for damage and quantities should be verified with shipping papers. Any damage or discrepancies should be noted on the delivery receipt and the supplier notified. The Owner shall not be responsible for acceptance and installation of defective materials.
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of

piping layout take design considerations into account. Install piping as indicated, to extent practical.

- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- D. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- E. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
 - 1. Install piping pitched down in direction of flow, at minimum slope of 0.25 percent, unless otherwise indicated.
- F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.6 INSTALLATION REQUIREMENTS, HDPE OR PVC

A. Unloading and Handling

- 1. HDPE pipe is designed to withstand normal field handling and can be easily unloaded by hand or with equipment. To avoid damage, the pipe should not be dropped. When using equipment to unload or move the pipe, a fork extension can be used. When unloading by hand, gloves should be worn.
- 2. Do not use chains or wire rope to lift the pipe. Use nylon slings and do not pick up 20-foot lengths from only one place on pipe.

B. Trenching

- 1. Excessive groundwater necessitates dewatering. Plastic pipe will float in standing water, requiring immediate haunching and initial backfill to hold line and grade. If the contractor encounters this condition. Dewatering shall be employed.
- 2. An unstable trench bottom must be stabilized with gravel or stone bedding materials.
- 3. Excavation from 0 to 12 inches below the pipe should be filled with acceptable bedding material and compacted to a minimum 95 percent Proctor density in accordance with ASTM D 1557. Fill area of over-excavation beyond 12 inches with processed stone or gravel.
- 4. Before installing pipe, bring bedding material to grade along the entire length of the pipe.
- 5. When excavating in Class IV materials (silt, silty clays, and clays), provide a uniform, improved trench bottom in accordance with the plan details.

C. Field cutting

1. Use a handsaw or power pipe cutoff saw.
2. For ribbed pipe, cut in the valley of a corrugation. Do not cut into the sidewall of an annular corrugation. For pipe with external spiral corrugations, place a split coupling around it and use the coupling edge as a cutting guide.
3. It is not necessary to bevel the cut pipe edge prior to installing an o-ring gasket joint system.
4. Skew or bevel cuts shall not be permitted.

D. Laying plastic pipe

1. Curvilinear installation shall not be permitted.
2. Plastic pipe can be easily carried to the trench and in sizes below 24 inches, installed by hand without the use of special equipment. Do not drop the pipe into the trench.

E. Embedment for bedding, haunching and initial backfill

1. Embedment materials are those used for bedding, haunching and initial backfill. ASTM D-2321 classifies soil materials as:
 - a. Class I: Angular crushed stone or rock, dense or open-graded, with little or no fines (1/4 inch to 1-1/2 inches in size).
 - b. Class II: Clean, coarse-grained materials, such as gravel, coarse sands, and gravel/sand mixtures (1-1/2 inches in size).
 - c. Class III: Coarse-grained material with fines including silty or clayey gravels or sands. Gravel or sand must comprise more than 50 percent of Class III: materials (1-1/2 inches maximum size.)
 - d. Class IV: Fine-grained materials, such as fine sand and soils, containing 50 percent or more clay or silt. Soils classified as Class IVa (ML or CL) have medium to low plasticity and are not recommended in the embedment zone. Soils classified as Class IVb (MH or CH) have high plasticity and are not recommended for embedment materials.
 - e. Class V: These materials include organic silts and clays, peat, and other organic materials. They are not recommended for embedment materials.
2. Do not place lumps of frozen soil or ice in the embedment zone.

F. Bedding

1. The contractor shall place bedding material providing uniform support to hold the pipe on line and grade in accordance with the plan details. Bedding materials under pipe shall be Class I, II or III.

G. Haunching

1. Proper haunching provides a major portion of the pipe's strength and stability. Poor workmanship will lead to excessive pipe deflection and grade and alignment problems. Haunching materials shall be Class I, II or III and must be compacted to minimum 90 percent standard Proctor.
2. Haunching Requirements

- a. Work enough material under the haunch of the pipe to provide proper compaction and side support.
- b. Where trench walls are unstable, prevent loss of side support by controlling sloughing, etc.
- c. Do not allow the pipe move when placing material under the haunch of the pipe.
- d. Take care not to damage the smaller size pipe with shovels or tamping equipment.
- e. Haunching shall be in 6-inch lifts.
- f. Controlled low strength material (CLSM) slurry is suitable for embedment. Trench width may be narrower if allowed by the Owner. Prevent floating with stakes or other methods.

H. Initial Backfill

1. Initial backfill materials extend from the spring line to 6 inches to 12 inches above the pipe to provide the remainder of the pipe support and protect the pipe from stones or cobbles in the final backfill. Class I, II, III materials shall be used. However:
 - a. Class I materials shall be used in wet trenches if Class I bedding and haunching materials are used.
 - b. Class II materials shall be compacted in 6-inch lifts to 95 percent modified Proctor density in accordance with ASTM D 1557.
 - c. Class III materials shall be compacted in 6-inch lifts to 95 percent modified Proctor density in accordance with ASTM D 1557.

I. Construction Loads

1. During construction, avoid heavy equipment wheel loads over the pipe or place additional cover at vehicle crossings. If a hydro-hammer or hoe-pak is to be used to compact the trench at least 48 inches of cover must be provided.
2. When connections to structures, laterals, deep laterals, risers, or drop manholes are required, the installation must be designed to ensure that the pipe and fittings are not damaged by loads generated due to soil settlement, dragdown, and/or poor installation practices.
3. When removing sheeting or other trench protection, do not disturb the embedment material. If sheeting or trench protection must be used below the top of the pipe, bracing shall be cut at the top of pipe elevation and left in place.
4. If any damage occurs due to construction loading of the pipes, contractor shall bear entire expense for repair and/or replacement.

3.7 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PVC Sewer Pipe and Fittings: As follows:
 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.

2. Install according to ASTM D 2321.
- C. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:
 1. Round Pipe and Fittings: ASTM C 443, rubber gaskets.
- D. HDPE Pipe and Fittings: Install split couplings as follows:
 1. Split Couplings: This joint system is used where a soil-tight system is required.
 2. The sides of these split couplings are "hinged" so they easily open up to accept each end of adjacent pipe sections. There are matching holes at the split in the top of the coupling that are secured for a tight fit with nylon ties.
- E. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- F. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.
- G. All labor, materials, and equipment required to join and provide fittings for all pipe joints shall be included in the price bid for the proposal.

3.8 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated in accordance with manufacturer's guidelines and recommendations.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 2 inches above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- E. Construct cast-in-place manholes as indicated.

3.9 STORMWATER CATCH BASIN/INLET INSTALLATION

- A. Construct catch basins/inlets to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.10 UNDERDRAIN

- A. General: Install filter fabric, stone, piping and backfill as indicated.

3.11 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.12 PIPE BENEATH BUILDING SLABS AND FOUNDATIONS

- A. All pipe shall be Ductile Iron, Class 52.
- B. Reinforced pipe material shall extend from structure to structure. Material changes shall not be permitted mid-run.
- C. Pipe shall be cement-lined where used to sleeve PVC/HDPE principal conduit material.
 - 1. Principal conduit shall be aligned along the central axis of the sleeve pipe, braced into position utilizing cement or HDPE shims, and the annular space filled with pea gravel (1/2" maximum particle size).
- D. Pipe backfill shall be 3/4" quarry process clean stone placed in 1 foot lifts and compacted in place in accordance with Division 31 section "Earth Moving". Stone backfill shall extend from the pipe springline to finished grade.

3.13 CONNECTION TO EXISTING STRUCTURES

- A. Where connection into an existing storm sewer structure is required, the Contractor shall be responsible for maintaining the integrity of the existing structure. No separate payment shall be made for repair work required to correct damage to the structure because of the connection work.
- B. All cuts into the existing structure walls shall be made with an approved power saw.
- C. All joints and excess wall surface removed to facilitate pipe installation shall be sealed water-tight with masonry block and grout.
- D. All backfill shall be in accordance with Section 31 20 00 Earth Moving.

3.14 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use HDPE/PVC pipe fittings in sewer pipes at branches for cleanouts and HDPE/PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1/4 inch below surrounding earth grade.
- C. In roadway traffic areas, enclosed top of cleanout stack in a cast iron casting set in concrete to prevent crushing of the stack.

- D. All labor, materials, and equipment required to join and provide fittings for all cleanout assemblies shall be included in the price bid for the proposal.

3.15 UNDERGROUND STORMWATER VAULT

- A. Install in accordance with manufacturer specifications and requirements.

3.16 STORM WATER TREATMENT DEVICE

- A. Install in accordance with manufacturer specifications and requirements.

3.17 REHABILITATE EXISTING STRUCTURES

- A. This work shall consist of removing and cleaning the existing castings, replacement of any damaged block and/or brick, replacement of any loose or missing mortar, parging of the inlet interior, resetting of any loose ladder rings, resetting of the existing castings to the final grade and any work necessary as directed by the Owner.

3.18 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below as appropriate:
 - 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
 - 3. Fill with flowable fill where indicated on the plans.
- B. Abandoned Structures: Excavate around structure as required and remove structure and close open ends of remaining piping.

3.19 ADJUSTMENTS TO GRATE RIM ELVATIONS

- A. Raise or lower the existing frames, covers and gratings of manholes, and drainage structures to the grades shown on the plans or directed by the Owner.
- B. Parge exterior surface with mortar when brick or masonry units are added or when the exterior surface is disturbed.
- C. Replace frames, covers or gratings damaged during the Work of the Contract

3.20 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and when work stops.
 - 3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- C. Upon completion of storm sewer installation, the contractor shall schedule a final acceptance inspection with the Owner's Representative. The contractor shall furnish at his expense, labor and equipment to inspect all pipe runs (i.e. lights, mirrors, pry-bars, laborers, etc.)
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate reports for each test.
- D. Leaks constitute defects that must be repaired.
- E. Replace leaking piping using new materials.

END OF SECTION 334000

SECTION (____)
STORM WATER TREATMENT DEVICE

1.0 GENERAL

- 1.1 This item shall govern the furnishing and installation of the Cascade Separator® by Contech Engineered Solutions LLC, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.
- 1.2 The Contractor shall furnish all labor, equipment and materials necessary to install the storm water treatment device(s) (SWTD) and appurtenances specified in the Drawings and these specifications.
- 1.3 The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a Cascade Separator™ device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

1.4 Related Sections

- 1.4.1 Section 02240: Dewatering
 - 1.4.2 Section 02260: Excavation Support and Protection
 - 1.4.3 Section 02315: Excavation and Fill
 - 1.4.4 Section 02340: Soil Stabilization
- 1.5 All components shall be subject to inspection by the engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification. Components which have been identified as defective may be subject for repair where final acceptance of the component is contingent on the discretion of the Engineer.
- 1.6 The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.
- 1.7 The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that each SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research

- 1.8 No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

2.0 MATERIALS

- 2.1 Housing unit of stormwater treatment device shall be constructed of pre-cast or cast-in-place concrete, no exceptions. Precast concrete components shall conform to applicable sections of ASTM C 478, ASTM C 857 and ASTM C 858 and the following:

- 2.1.1 Concrete shall achieve a minimum 28-day compressive strength of 4,000 pounds per square-inch (psi);
- 2.1.2 Unless otherwise noted, the precast concrete sections shall be designed to withstand lateral earth and AASHTO H-20 traffic loads;
- 2.1.3 Cement shall be Type III Portland Cement conforming to ASTM C 150;
- 2.1.4 Aggregates shall conform to ASTM C 33;
- 2.1.5 Reinforcing steel shall be deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A 615, A 185, or A 497.
- 2.1.6 Joints shall be sealed with preformed joint sealing compound conforming to ASTM C 990.
- 2.1.7 Shipping of components shall not be initiated until a minimum compressive strength of 4,000 psi is attained or five (5) calendar days after fabrication has expired, whichever occurs first.

- 2.2 Internal Components and appurtenances shall conform to the following:

- 2.2.1 Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
- 2.2.2 Support brackets shall be manufactured of 5052 aluminum
- 2.2.3 Fiberglass components shall conform to applicable sections of ASTM D-4097
- 2.2.4 Access system(s) conform to the following:
- 2.2.5 Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

3.0 PERFORMANCE

- 3.1 The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns.
- 3.2 The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table

1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.
- 3.3 The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.
- 3.4 The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

4.0 EXECUTION

- 4.1 The contractor shall exercise care in the storage and handling of the SWTD components prior to and during installation. Any repair or replacement costs associated with events occurring after delivery is accepted and unloading has commenced shall be borne by the contractor.
- 4.2 The SWTD shall be installed in accordance with the manufacturer's recommendations and related sections of the contract documents. The manufacturer shall provide the contractor installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.
- 4.3 The contractor shall fill all voids associated with lifting provisions provided by the manufacturer. These voids shall be filled with non-shrinking grout providing a finished surface consistent with adjacent surfaces. The contractor shall trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.
- 4.4 The contractor shall removal all loose material and pooling water from the SWTD prior to the transfer of operational responsibility to the Owner.

TABLE 1: Storm Water Treatment Device Storage Capacities

Cascade Model	Minimum Sump Storage Capacity (yd ³)	Minimum Oil Storage Capacity (gal)
CS-4	0.70	141.0
CS-5	1.09	269.3
CS-6	1.57	475.9
CS-8	2.79	1128.0
CS-10	4.36	2203.2
CS-12	6.28	3807.1

END OF SECTION

Section 33 46 23 MODULAR STORMWATER STORAGE UNITS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, technical specification and general provisions of the Contract as modified herein apply to this section.

1.02 DESCRIPTION OF WORK INCLUDED

- A. Provide excavation and base preparation per geotechnical engineer's recommendations and/or as shown on the design drawings, to provide adequate support for project design loads and safety from excavation sidewall collapse. Excavations shall be in accordance with the owner's and OSHA requirements.
- B. Provide and install R-Tank^{LD}, R-Tank^{HD}, R-Tank^{SD}, or R-Tank^{UD} system (hereafter called R-Tank) and all related products including fill materials, geotextiles, geogrids, inlet and outlet pipe with connections per the manufacturer's installation guidelines provided in this section.
- C. Provide and construct the cover of the R-Tank system including; stone backfill, structural fill cover, and pavement section as specified.
- D. Protect R-Tank system from construction traffic after installation until completion of all construction activity in the installation area.

1.03 QUALITY CONTROL

- A. All materials shall be manufactured in ISO certified facilities.
- B. Installation Contractor shall demonstrate the following experience:
 - 1. A minimum of three R-Tank or equivalent projects completed within 2 years; and,
 - 2. A minimum of 25,000 cubic feet of storage volume completed within 2 years.
 - 3. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.
- C. Installation Personnel: Performed only by skilled workers with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.
- D. Contractor must have manufacturer's representative available for site review if requested by Owner.

1.04 SUBMITTALS

- A. Submit proposed R-Tank layout drawings. Drawings shall include typical section details as well as the required base elevation of stone and tanks, minimum cover requirements and tank configuration.
- B. Submit manufacturer's product data, including compressive strength and unit weight.
- C. Submit manufacturer's installation instructions.
- D. Submit R-Tank sample for review. Reviewed and accepted samples will be returned to the Contractor.
- E. Submit material certificates for geotextile, geogrid, base course and backfill materials.
- F. Submit required experience and personnel requirements as specified in Section 1.03.
- G. Any proposed equal alternative product substitution to this specification must be submitted for review and approved prior to bid opening. Review package should include third party reviewed performance data that meets or exceeds criteria in Table 2.01 B.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect R-Tank and other materials from damage during delivery, and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds two weeks. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.
- B. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.
- C. Cold weather:
 - 1. Care must be taken when handling plastics when air temperature is 40 degrees or below as plastic becomes brittle.
 - 2. Do not use frozen materials or materials mixed or coated with ice or frost.
 - 3. Do not build on frozen ground or wet, saturated or muddy subgrade.

1.06 PREINSTALLATION CONFERENCE.

- A. Prior to the start of the installation, a preinstallation conference shall occur with the representatives from the design team, the general contractor, the excavation contractor, the R-Tank installation contractor, and the manufacturer's representative.

1.07 PROJECT CONDITIONS

- A. Coordinate installation for the R-Tank system with other on-site activities to eliminate all non-installation related construction traffic over the completed R-Tank system. No loads heavier than the design loads shall be allowed over the system, and in no case shall loads higher than a standard AASHTO HS20 (or HS25, depending on design criteria) load be allowed on the system at any time.
- B. Protect adjacent work from damage during R-Tank system installation.
- C. All pre-treatment systems to remove debris and heavy sediments must be in place and functional prior to operation of the R-Tank system. Additional pretreatment measures may be needed if unit is operational during construction due to increased sediment loads.
- D. Contractor is responsible for any damage to the system during construction.

PART 2 – PRODUCTS

2.01 R-TANK UNITS

- A. R -Tank - Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height (custom for each project).
- B. R-Tank units shall meet the following Physical & Chemical Characteristics:

PROPERTY	DESCRIPTION	R-Tank ^{LD} VALUE	R-Tank ^{HD} VALUE	R-Tank ^{SD} VALUE	R-Tank ^{UD} VALUE
Void Area	Volume available for water storage	95%	95%	95%	95%
Surface Void Area	Percentage of exterior available for infiltration	90%	90%	90%	90%
Vertical Compressive Strength	ASTM D 2412 / ASTM F 2418	30.0 psi	33.4 psi	42.9 psi	134.2 psi
Lateral Compressive Strength	ASTM D 2412 / ASTM F 2418	20.0 psi	22.4 psi	28.9 psi	N/A
HS-20 Minimum Cover	Cover required to support HS-20 loads	N/A	20"	18"	12" (Stone Backfill)
HS-25 Minimum Cover	Cover required to support HS-25 loads	N/A	24"	19"	15" (Stone Backfill)
Maximum Cover	Maximum allowable cover depth	3 feet	< 7 feet	< 10 feet	5 feet
Unit Weight	Weight of plastic per cubic foot of tank	3.29 lbs / cf	3.62 lbs/cf	3.96 lbs / cf	4.33 lbs / cf
Rib Thickness	Thickness of load-bearing members	0.18 inches	0.18 inches	0.18 inches	N/A
Service Temperature	Safe temperature range for use	-14 – 167° F	-14 – 167° F	-14 – 167° F	-14 – 167° F

- C. Supplier: ACF Environmental 2831 Cardwell Road Richmond, VA 23234
(T): 800-448-3636; (F): 804-743-7779 www.acfenvironmental.com

2.02 GEOSYNTHETICS

- A. Geotextile. A geotextile envelope is required to prevent backfill material from entering the R-Tank modules.
- Standard Application:** The standard geotextile shall be an 8 oz per square yard nonwoven geotextile (ACF N080 or equivalent).
 - Infiltration Applications:** When water must infiltrate/exfiltrate through the geotextile as a function of the system design, a woven monofilament (ACF M200 or equivalent) shall be used.

- B. **Geogrid.** For installations subject to traffic loads and/or when required by project plans, install geogrid (ACF BX12 or equivalent) to reinforce backfill above the R-Tank system. Geogrid is not always required for R-Tank^{UD} installations, and is often not required for non-traffic load applications.

2.03 BACKFILL & COVER MATERIALS

- A. **Bedding Materials:** Stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the R-Tank system (3" minimum). Material must be free from lumps, debris, and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.
- B. **Side and Top Backfill:** Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.
 - 1. Traffic Applications - Free draining material shall be used adjacent to (24" minimum) and above (for the first 12") the R-Tank system.
 - a. For HD, and SD modules, backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System).
 - b. For UD modules with less than 14" of top cover, backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter). The use of soil backfill on the sides and top of the UD module is not permitted unless the modules are installed outside of traffic areas or with cover depths of 14" or more. Top backfill material (from top of module to bottom of pavement base or 12" maximum) must be consistent with side backfill.
 - 2. Non-Traffic / Green Space Applications - For all R-Tank modules installed in green spaces and not subjected to vehicular loads, backfill materials may either follow the guidelines for Traffic Applications above, or the top backfill layer (12" minimum) may consist of AASHTO #57 stone blended with 30-40% (by volume) topsoil to aid in establishing vegetation.
- C. **Additional Cover Materials:** Structural Fill shall consist of granular materials meeting the gradational requirements of SM, SP, SW, GM, GP or GW as classified by the Unified Soil Classification System. Structural fill shall have a maximum of 25 percent passing the No. 200 sieve, shall have a maximum clay content of 10 percent and a maximum Plasticity Index of 4. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

2.04 OTHER MATERIALS

- A. **Utility Marker:** Install metallic tape at corners of R-Tank system to mark the area for future utility detection.

PART 3 – EXECUTION

3.01 ASSEMBLY OF R-TANK UNITS

- A. Assembly of modules shall be performed in accordance with the R-Tank Installation Manual, Section 2.

3.02 LAYOUT AND EXCAVATION

- A. Installer shall stake out, excavate, and prepare the subgrade area to the required plan grades and dimensions, ensuring that the excavation is at least 2 feet greater than R-Tank dimensions in each direction allowing for installation of geotextile filter fabric, R-Tank modules, and free draining backfill materials.
- B. All excavations must be prepared with OSHA approved excavated sides and sufficient working space.
- C. Protect partially completed installation against damage from other construction traffic by establishing a perimeter with high visibility construction tape, fencing, barricades, or other means until construction is complete.
- D. Base of the excavation shall be uniform, level, and free of lumps or debris and soft or yielding subgrade areas. A minimum 2,000 pounds per square foot bearing capacity is required.
 - 1. **Standard Applications:** Compact subgrade to a minimum of 95% of Standard Proctor (ASTM D698) density or as required by the Owner's engineer.
 - 2. **Infiltration Applications:** Subgrade shall be prepared in accordance with the contract documents. Compaction of subgrade should not be performed in infiltration applications.
- E. **Unsuitable Soils or Conditions:** All questions about the base of the excavation shall be directed to the owner's

engineer, who will approve the subgrade conditions prior to placement of stone. The owner's engineer shall determine the required bearing capacity of the R-Tank subgrade; however in no case shall a bearing capacity of less than 2,000 pounds per square foot be provided.

1. If unsuitable soils are encountered at the subgrade, or if the subgrade is pumping or appears excessively soft, repair the area in accordance with contract documents and/or as directed by the owner's engineer.
2. If indications of the water table are observed during excavation, the engineer shall be contacted to provide recommendations.
3. Do not start installation of the R-Tank system until unsatisfactory subgrade conditions are corrected and the subgrade conditions are accepted by the owner's engineer.

3.03 PREPARATION OF BASE

- A. Place a thin layer (3" unless otherwise specified) of bedding material (Section 2.03 A), over the subgrade to establish a level working platform for the R-Tank modules. Level to within $\frac{1}{2}$ " (+/- $\frac{1}{4}$ ") or as shown on the plans. Native subgrade soils or other materials may be used if determined to meet the requirements of 2.03 A and are accepted by the owner's engineer.
 1. **Standard Applications:** Static roll or otherwise compact bedding materials until they are firm and unyielding.
 2. **Infiltration Applications:** Bedding materials shall be prepared in accordance with the contract documents.
- B. Outline the footprint of the R-Tank system on the excavation floor using spray paint or chalk line to ensure a 2' perimeter is available around the R-Tank system for proper installation and compaction of backfill.

3.04 INSTALLATION OF THE R-TANKS

- A. Where a geotextile wrap is specified on the stone base, cut strips to length and install in excavation, removing wrinkles so material lays flat. Overlap geotextile a minimum 12" or as recommended by manufacturer. Use tape, special adhesives, sandbags or other ballast to secure overlaps. As geotextiles can be damaged by extreme heat, smoking is not permissible on/near the geotextile, and tools using a flame to tack the overlaps, such as propane torches, are prohibited.
- B. Where an impervious liner (for containment) is specified, install the liner per manufacturer's recommendations and the contract documents. The R-Tank units shall be separated from impervious liner by a non-woven geotextile fabric installed accordance with Section 3.04A.
- C. Install R-Tank modules by placing side by side, in accordance with the design drawings. No lateral connections are required. It is advisable to use a string line to form square corners and straight edges along the perimeter of the R-Tank system. The modules are to be oriented as per the design drawing with required depth as shown on plans.
 1. For LD, HD, and SD installations, the large side plate of the tank should be placed on the perimeter of the system. This will typically require that the two ends of the tank area will have a row of tanks placed perpendicular to all other tanks. If this is not shown in the construction drawings, it is a simple field adjustment that will have minimal effect on the overall system footprint. Refer to R-Tank Installation Guide for more details
 2. For UD installations, there is no perpendicular end row required.
- D. Wrap the R-Tank top and sides in specified geotextile. Cut strips of geotextile so that it will cover the sides and top, encapsulating the entire system to prevent backfill entry into the system. Overlap geotextile 12" or as recommended by manufacturer. Take great care to avoid damage to geotextile (and, if specified, impervious liner) during placement.
- E. Identify locations of inlet, outlet and any other penetrations of the geotextile (and optional liner). These connections should be installed flush (butted up to the R-Tank) and the geotextile fabric shall be cut to enable hydraulic continuity between the connections and the R-Tank units. These connections shall be secured using pipe boots with stainless steel pipe clamps. Support pipe in trenches during backfill operations to prevent pipe from settling and damaging the geotextile, impervious liner (if specified) or pipe. Connecting pipes at 90 degree angles facilitates construction, unless otherwise specified. Ensure end of pipe is installed snug against R-Tank system.
- F. Install Inspection and Maintenance Ports in locations noted on plans. At a minimum one maintenance port shall be installed within 10' of each inlet & outlet connection, and with a maximum spacing of one maintenance port for every 2,500 square feet. Install all ports as noted in the R-Tank Installation Guide.
- G. If required, install ventilation pipes and vents as specified on drawings to provide ventilation for proper hydraulic

performance. The number of pipes and vents will depend on the size of the system. Vents are often installed using a 90 degree elbow with PVC pipe into a landscaped area with 'U' bend or venting bollard to inhibit the ingress of debris. A ground level concrete or steel cover can be used.

3.05 BACKFILLING OF THE R-TANK UNITS

- A. Backfill and fill with recommended materials as follows:
 - 1. Place freely draining backfill materials (Section 2.03 B) around the perimeter in lifts with a maximum thickness of 12". Each lift shall be placed around the entire perimeter such that each lift is no more than 24" higher than the side backfill along any other location on the perimeter of the R-Tank system. No fill shall be placed over top of tanks until the side backfill has been completed.
 - 2. Each lift shall be compacted at the specified moisture content to a minimum of 95% of the Standard Proctor Density until no further densification is observed (for self-compacting stone materials). The side lifts must be compacted with walk behind compaction equipment. Even when "self-compacting" backfill materials are selected, a walk behind vibratory compactor must be used.
 - 3. Take care to ensure that the compaction process does not allow the machinery to come into contact with the modules due to the potential for damage to the geotextile and R-Tank units.
 - 4. No compaction equipment is permissible to operate directly on the R-Tank modules.
 - 5. Top Backfill: Only low pressure track vehicles shall be operated over the R-Tank system during construction. Dump Trucks and Pans shall not be operated within the R-Tank system footprint at any time. Heavy equipment should unload in an area adjacent to the R-Tank system and the material should be moved over the system using tracked equipment with an operating weight of less than 10 tons.
 - a. Typical Applications: Install a 12" (or as shown on plans) lift of freely draining material (Section 2.03 B) over the R-Tank Units, maintaining 12" between equipment tracks and R-Tank System. Lightly compacted using a walk-behind trench roller. Alternately, a roller (maximum gross vehicle weight of 6 tons) may be used. Roller must remain in static mode until a minimum of 24" of cover has been placed over the modules. Sheep foot rollers should not be used.
 - b. Shallow Applications (< 18" total cover): Install top backfill in accordance with plans.
 - 6. If required, install a geogrid as shown on plans. Geogrid shall extend a minimum of 3 feet beyond the limits of the excavation wall.
 - 7. Following placement and compaction of the initial cover, subsequent lifts of structural fill (Section 2.03 C) shall be placed at the specified moisture content and compacted to a minimum of 95% of the Standard Proctor Density and shall cover the entire footprint of the R-Tank system. During placement of fill above the system, unless otherwise specified, a uniform elevation of fill shall be maintained to within 12" across the footprint of the R-Tank system. Do not exceed maximum cover depths listed in Table 2.01 B.
 - 8. Place additional layers of geotextile and/or geogrid at elevations as specified in the design details. Each layer of geosynthetic reinforcement placed above the R-Tank system shall extend a minimum of 3 feet beyond the limits of the excavation wall.
- B. Ensure that all unrelated construction traffic is kept away from the limits of excavation until the project is complete and final surface materials are in place. No non-installation related loading should be allowed over the R-Tank system until the final design section has been constructed (including pavement).
- C. Place surfacing materials, such as groundcovers (no large trees), or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.
- D. Backfill depth over R-Tank system must be within the limitations shown in the table in Section 2.01 B. If the total backfill depth does not comply with this table, contact engineer or manufacturer's representative for assistance.

3.06 MAINTENANCE REQUIREMENTS

- A. A routine maintenance effort is required to ensure proper performance of the R-Tank system. The Maintenance program should be focused on pretreatment systems. Ensuring these structures are clean and functioning properly will reduce the risk of contamination of the R-Tank system and stormwater released from the site. Pre-treatment systems shall be inspected yearly, or as directed by the regulatory agency and by the manufacturer (for proprietary systems). Maintain as needed using acceptable practices or following manufacturer's guidelines (for proprietary systems).
- B. All inlet pipes and Inspection and/or Maintenance Ports in the R-Tank system will need to be inspected for accumulation of sediments at least quarterly through the first year of operation and at least yearly thereafter.

- C. If sediment has accumulated to the level noted in the R-Tank Maintenance Guide or beyond a level acceptable to the Owner's engineer, the R-Tank system should be flushed.
- D. All inspection and maintenance activities should be performed in accordance with the R-Tank Operation, Inspection & Maintenance Manual.

END OF SECTION

SECTION ()

Steel Reinforced Polyethylene (SRPE) Tank Standard Specification

1.0 GENERAL

- 1.1 This item shall govern the furnishing and installation of Steel Reinforced Polyethylene (SRPE) Tanks for rainwater harvesting and other underground water storage for nominal diameters 30" (750mm) through 120" (3000mm).
- 1.2 Contractor shall furnish all labor, materials, equipment and incidentals necessary to install the SRPE system, appurtenances and incidentals in accordance with the Drawings and as specified herein.
- 1.3 A stormwater treatment device upstream of the SRPE system is recommended as the appropriate means of pretreating for the purpose of extending the maintenance interval on the SRPE system and reducing the life cycle cost. Both engineered solutions shall be provided by a single supplier/manufacturer.
- 1.4 Applicable provisions of any Division shall govern work in this section.
- 1.5 Related Standards
 - 1.5.1 ASTM F2562 "Standard Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage"
 - 1.5.2 AASHTO Designation MP-20 Section
 - 1.5.3 ASTM D3350 "Standard Specification for Polyethylene Plastics Pipe and Fittings Materials"
 - 1.5.4 ASTM D2321 "Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications"
- 1.6 Site layout drawings, product specifications, materials, hydraulic storage data and supported calculations of proposed alternatives shall be submitted to the Engineer of Record (EOR) for review at a minimum of 10 working days prior to bid closing.
- 1.7 The SRPE system proposal shall be sized in accordance to the design provided and approved by the Engineer of Record (EOR). Any Contractor deviating from the design shown on the plans, to include: material, footprint, etc., shall provide to the Engineer of Record (EOR) a summary report on stage-storage curves, design calculations, HydroCAD modeling and engineering drawings.
- 1.8 Shop drawings shall be annotated to indicate all materials to be furnished and installed under this section, and all applicable standards for materials, required tests of materials and design assumptions for structural analysis:
- 1.9 Before installation of the SRPE system, Contractor shall obtain the written approval of the Engineer of Record (EOR) for the stormwater system and the installation drawings.

2.0 MATERIALS

- 2.1 SRPE shall be manufactured in accordance with the applicable requirements of ASTM F2562 “Standard Specification for Steel Reinforced Thermoplastic Ribbed Pipe and Fittings for Non-Pressure Drainage and Sewerage”.
- 2.2 Virgin high density polyethylene stress-rated resins are used to manufacture SRPE Tank and complimentary fabricated fittings. Resins shall conform to the minimum requirements of cell classification 345464C as defined and described in the latest version of ASTM D3350 “Standard Specification for Polyethylene Plastics Pipe and Fittings Materials”.
- 2.3 The manufacturer of the SRPE system shall be one that has regularly been engaged in the engineering design and production of these systems for at least eight (8) years and which has a history of successful production, acceptable to the Engineer of Record (EOR). In accordance with the Drawings, the SRPE system shall be supplied by:

Contech Engineered Solutions
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122
- 2.4 Sampling, testing, and inspection of PE resin, metal sheets and coils used for manufacturing the SRPE system shall be in accordance with to the above applicable referenced specifications. All fabrication of the product shall occur within the United States.

3.0 PERFORMANCE

- 3.1 All tanks must be leak tested and results documented using a positive pressure air test prior to shipment from the manufacturing location. Testing documentation shall include test air pressure, and hold time. A copy of the leak test report must be provided to the Engineer of Record as requested.
- 3.2 Bulkheads shall be constructed of material in conformance with Section 2.2 and designed for H-20/HS-25 final live loading conditions.
- 3.3 All SRPE system inlets shall be equipped with an inlet calming device that they may introduce water to the tank with little to no turbulence.
- 3.4 The SRPE system shall provide a minimum of one 36 inch diameter access riser.
- 3.5 SRPE tank spacing and stone base thickness cannot be altered with consultation from Contech Engineered Solutions, LLC.

- 3.6 The SRPE system shall be designed for a minimum HS-20/HS-25 final live loading conditions. The SRPE system shall meet HS-20/HS-25 loading requirements with a minimum cover measured from the top of tank to the bottom of flexible pavement as shown in Table 1.

Table 1: Dimensions and Cover limitations

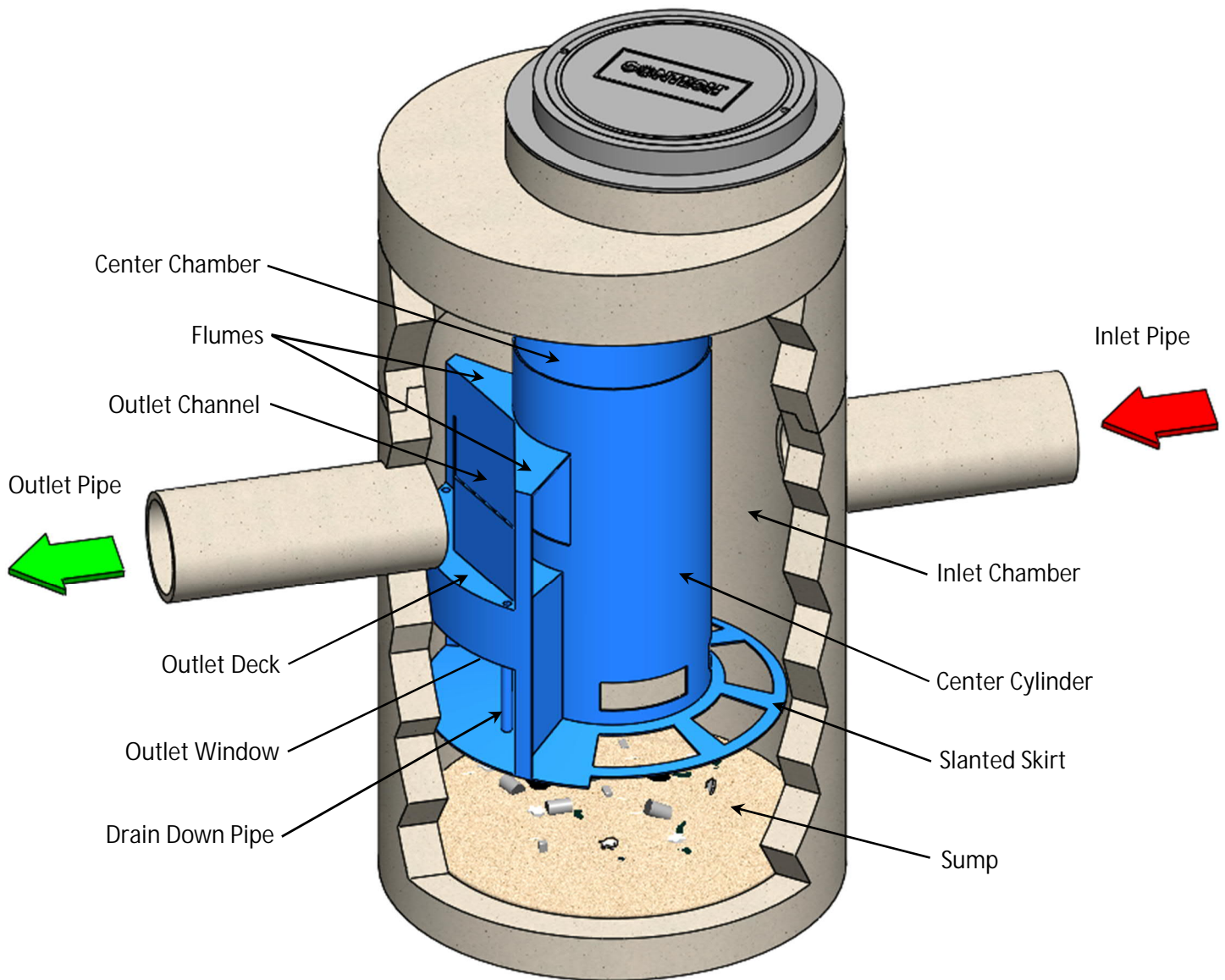
Nominal Tank diam.	Outside Diameter	Unit Weight*	Minimum Wall Thickness (t ₁)		Minimum Cover**		Maximum Cover**	
inch	in. [mm]	lbs./ft	in.	[mm]	ft.	[m]	ft.	[m]
30	30.9 [785]	15.5	.082	[2.08]	1	[.305]	8	[15.2]
36	37.1 [942]	20.8	.082	[2.08]	1	[.305]	8	[15.2]
42	43.2 [1097]	26.5	.082	[2.08]	1	[.305]	8	[15.2]
48	49.5 [1257]	29.1	.130	[3.30]	1	[.305]	8	[15.2]
54	55.5 [1410]	34.7	.130	[3.30]	1	[.305]	8	[15.2]
60	61.4 [1560]	41.6	.130	[3.30]	1	[.305]	8	[15.2]
66	67.8 [1722]	56.9	.220	[5.58]	1.5	[.457]	8	[15.2]
72	74.1 [1882]	65.6	.220	[5.58]	1.5	[.457]	8	[15.2]
84	85.9 [2182]	76.3	.220	[5.58]	2	[.610]	8	[15.2]
96	97.8 [2484]	87.0	.220	[5.58]	2	[.610]	8	[15.2]
108	111.3 [2827]	99.7	.220	[5.58]	2.5	[.762]	8	[15.2]
120	121.9 [3097]	109.0	.220	[5.58]	3	[.914]	8	[15.2]
* Approximate weights. Actual weight will vary with length. **measured from top of tank to bottom of flexible pavement or top of rigid pavement								

4.0 EXECUTION

- 4.1 The SRPE system installation shall be in accordance with ASTM D2321 “Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications” along with Table 1 and product-specific recommendations contained in Contech SRPE Tank Installation Guide, available from local Contech representative or from www.conteches.com.
- 4.2 The contractor shall follow Occupational Safety and Health Association (OSHA) guidelines for safe practices in executing the installation process in accordance with the manufacturer/supplier installation recommendations.
- 4.3 Supplier will conduct an on-site preconstruction meeting with the contractor prior to the scheduled delivery date of the SRPE system.

END SECTION

Installation Guide for Contractors



Overview

These instructions provide installation guidelines for the Cascade Separator stormwater treatment system. Before starting installation, be sure you have all the components, tools, and supplies necessary to complete the work.

Safety Notice

Confined Space Entry

Secure all equipment and training to meet applicable local and OSHA regulations regarding confined space entry.

Personal Safety Equipment

- Fall protection equipment
- Gloves
- Hard hat
- Eye protection
- Ear protection
- Respiratory protection

Cascade Separator Parts List

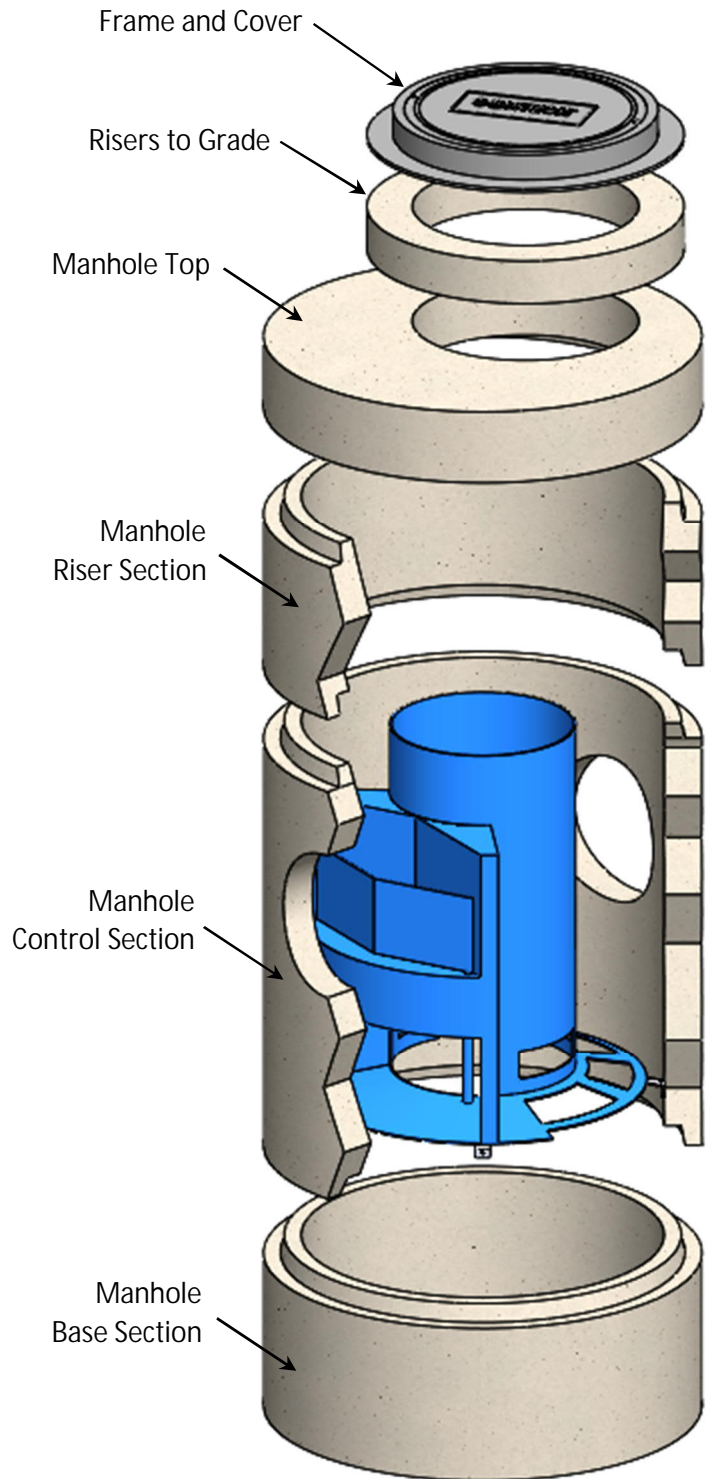
Standard Equipment (What to expect)

Typically, the Cascade Separator will arrive on site with the fiberglass internal components pre-installed within the Manhole Control Section. Large Cascade Separator systems may require the internal components to be installed on site after some manhole sections are placed in the excavated hole. In these cases, Contech will provide additional instructions for the installation of the internal components and possible on site assistance from a trained Contech representative.

- Manhole Base Section
 - May be part of, or attached to, the Manhole Control Section.
- Manhole Control Section
 - Contains the pre-installed internal components and the inlet/outlet core holes.
 - May be made up of multiple section mechanically attached together.
- Manhole Riser Section(s) (if needed, per plans)
- Manhole Top (per plans)
- Risers to Grade (per plans)
- Frame(s) and Cover(s) (per plans)
- Butyl Mastic (sealant for joints)

Unloading and Handling

Any unloading/handling suggestions or guidance is beyond our scope of work but can be obtained from the precaster. Contact your Contech representative if contact information for the precaster is needed.



Contractor Supplied Material

Grout — Non-shrink grout to connect the inlet pipe(s) and outlet pipe to the manhole.

Base Preparation

Compact undisturbed sub-grade materials to 95% of maximum density at +/-2% of optimum moisture content prior to placement of crushed rock. Crushed rock base material shall be six-inch minimum layer of $\frac{3}{4}$ -inch minus rock. Unsuitable material below sub-grade shall be replaced per site engineer's recommendation.

Crane Selection

The contractor is responsible for selecting the appropriate equipment to unload and set the Cascade Separator manhole. Contech will provide the contractor with the weights of the precast manhole sections. A representative from the crane company should visit the jobsite and review pertinent information (shop drawings, weights, etc) prior to the selection of the crane.

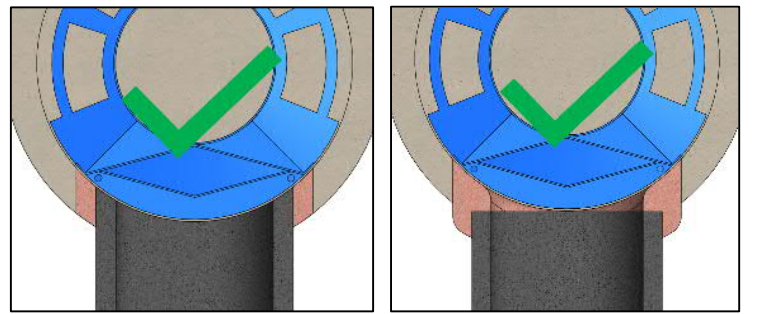
Setting the Cascade Separator

Ensure the inlet(s) and outlet are oriented per the plans. Manhole floor shall slope $\frac{1}{4}$ inch maximum across the "width" and "length". Manhole cover top shall be even with surrounding finish grade surface per the plans unless otherwise directed by the site engineer.

Pipe Connections

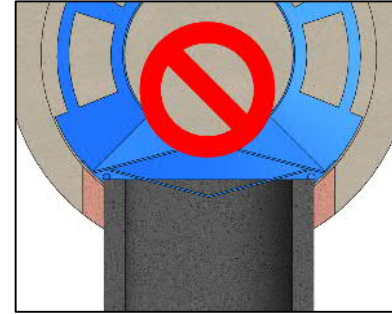
Pipe(s) shall be stubbed in and connected to precast manhole according to Engineer's requirements and specifications. Contractor to grout all inlet pipe(s) and the outlet pipe centered in the inlet and outlet core holes and flush with interior wall of manhole.

Large diameter pipes may need to have the ends cut to match the manhole inside diameter or they may be stubbed in flush to inside wall and a grout connection collar formed. Pipes should never extend in past the inside wall and fiberglass should never be cut to install a pipe connection.



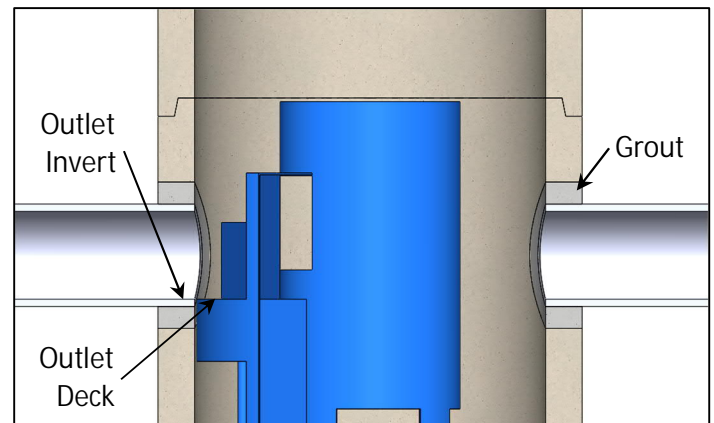
PIPE CUT FLUSH WITH INSIDE WALL

PIPE STUBBED-CONNECTION COLLAR



PIPE SHOULD NEVER EXTEND PAST INSIDE WALL

The inside bottom (invert) of the outlet pipe should be flush with the top of the outlet deck. The outlet pipe invert should never be above the outlet deck, or the system drain down feature will not function correctly.



Ballast

When required, ballast shall be placed to the dimensions specified by the Engineer as noted on the plans.

Risers, Covers and Closing the System

The Cascade Separator is delivered with the necessary risers and covers to bring the unit to grade. It is the contractor's responsibility to assemble the manhole per the plans and as directed by the site engineer.

- Place a layer of $\frac{1}{4}$ x $1\frac{1}{2}$ butyl mastic manhole sealant between all manhole sections and top.
- Manhole access opening(s) should be oriented according to the contract drawing provided by Contech.

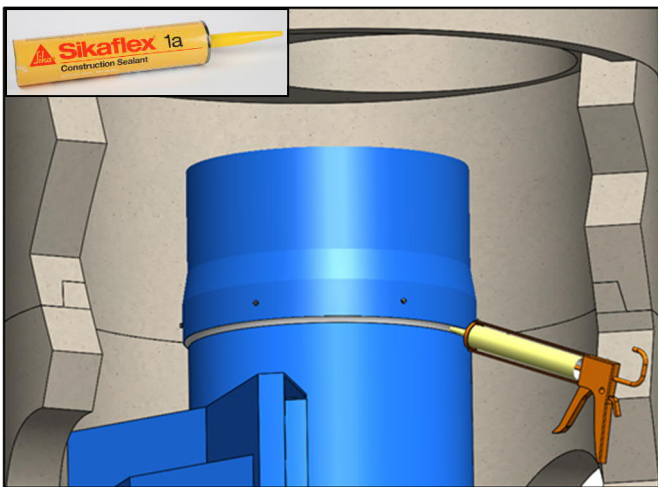
Backfill

Backfill material and placement method should be performed in accordance with the construction plans and as directed by the site engineer.

Optional Equipment if Required

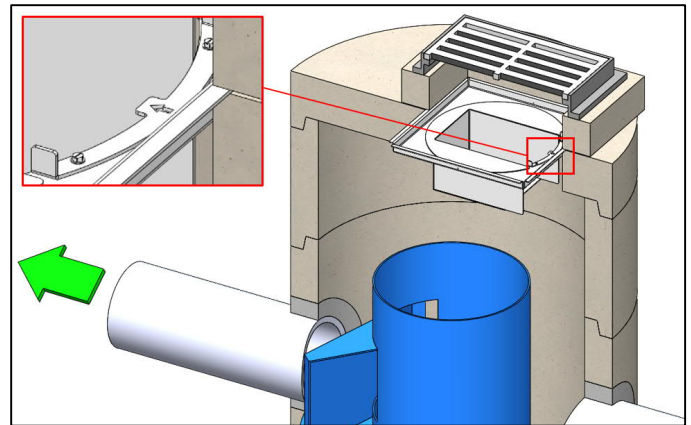
Cylinder Extension Installation

On some projects the Cascade Separator center cylinder may need to be extended. In these situations, a fiberglass cylinder extension is installed by the contractor over the existing center cylinder. This must be done before the manhole top is set. The bell end of the extension will slip over the top of the existing cylinder and rest on the inside ledge. Using #12 self-drilling stainless steel screws spaced approximately 12" apart secure the extension in place. Do not over-tighten the screws or they may strip out of the fiberglass and weaken the connection. Apply SIKAFLEX 1A polyurethane sealant to seal the gap between the cylinder and the cylinder extension.



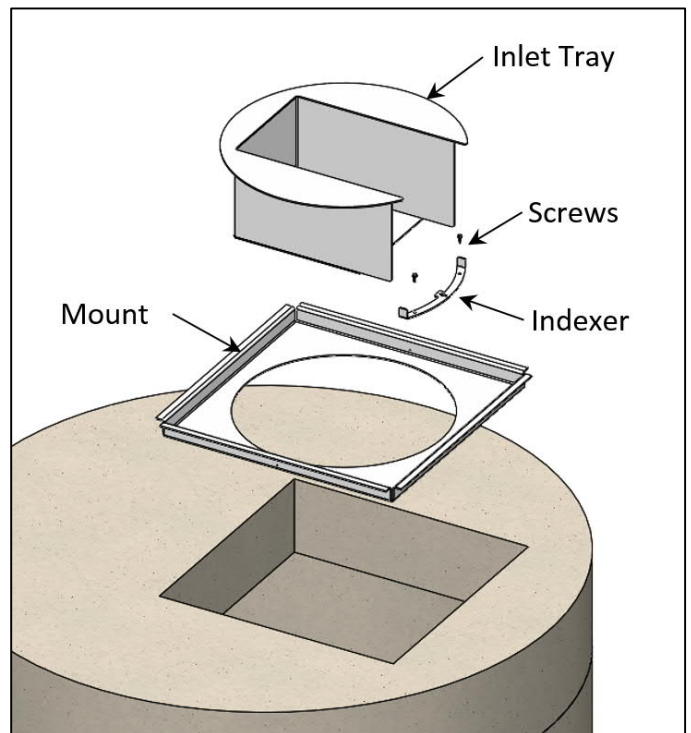
Grate Inlet Installation

The Cascade Separator can be configured with an optional grate inlet in place of the inlet pipe or in addition to the inlet pipe. This configuration requires the installation of an inlet tray assembly to ensure incoming water goes directly into the inlet chamber.



IMPORTANT- Arrow on the indexer must point in direction of outlet pipe.

Align indexer along the edge of hole in mount so that arrow is pointing in direction of outlet pipe. Attach indexer to mount with (2) self-drilling screws, pre-drill 1/8" pilot holes if desired. Set the inlet tray in mount, the indexer will force the inlet tray into proper alignment.



Install any risers to grade and then the inlet frame and grate supplied by Contech.

SRPE TANK INSTALLATION GUIDE





Preface


This installation guide is for your crews. Distribute it to help them unload, handle and install steel reinforced polyethylene (SRPE) tank safely. SRPE tanks can be installed per the requirements of ASTM D2321, “Standard Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.”

Don’t assume that experienced workers know all the answers. Review these instructions with your supervisors and crews. It can mean a safer and better job for you and your customer.


SRPE tanks are made from DuroMaxx® pipe and as such many pipe installation procedures are referenced in this manual.

If you have any questions about these instructions, call your Contech Dealer or your Contech Sales Engineer, or carefully review the installation guide and ASTM D2321.

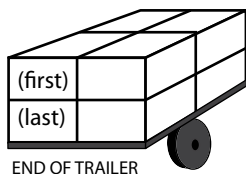
Contents	Page
Safety instructions for unloading & handling	3
Handling weights.....	4
Flotation prevention	5
Assembly and installation references.....	6
Standard backfill details	8
Heavy construction loads.....	10
Cutting instructions.....	11

 This safety alert symbol indicates important safety messages. When you see this symbol, it will alert you to hazards or unsafe practices that **CAN** result in severe personal injury (including death) or property damage. Be sure you understand the message that follows.

Safety Instructions

 Failure to follow these instructions can result in serious injury or death and/or damage to pipe.

1. Only trained and authorized equipment operators are to be permitted to unload the trailer.
2. Wear approved safety hat, shoes, gloves and eye protection.
3. Park the truck and trailer on level ground before you start unloading.
4. Keep all unauthorized persons clear of the area when the driver releases the binders from the trailer and during unloading.
5. Do not release strapping around the wood frame until the pallets or bundles have been placed on level ground and will not be moved again as a unit.
6. On nested loads, cut the internal strapping prior to unloading.
7. Know the capabilities and rated load capacities of your lifting equipment. Never exceed them.
8. Do not stand or ride on the load of pipe while it is being unloaded.
9. If unloading at multiple points, secure pallets between drop off points. Always unload the top pallets first. (See illustration at right)
10. Never attach chains or cable to the pipe. They could damage the pipe.
11. Do not push pallets off the trailer or permit pipe to drop to the ground.
12. Do not stack DuroMaxx pipe over two pallets high. Stacks of three or more pallets can damage bottom pipes and can become unstable.
13. Only use authorized unloading poles to lift pipe. Unauthorized unloading pole can lead to unsafe practices and damaged pipe.



WARNING

14. Falling or rolling pipe can cause severe personal injury or death. Notwithstanding the instructions contained in this booklet, it is the responsibility of the consignee or consignee's agent to devise safe unloading and handling procedures.



WARNING

14. Do not lift from the steel strapping.
15. Do not stand beneath or near the pipe while it is being unloaded.
16. Always follow all project, local, state and OSHA rules and safety requirements including but not limited to confined space, trenching, shoring and excavation procedures.

Handling Weights

These are estimated average weights and are not for specification use.

TABLE 1. DIMENSIONS & HANDLING WEIGHTS

Nom. Volume (gal)	Nom. Diameter (in)	Length (ft)	Pick Weight (lb)	Total Volume (gal)	Total Volume (cf)	Actual Volume (gal)	Actual Volume (cf)
2000	60	16	1250	2280	305	2122	284
3000		24	1750	3420	457	3183	425
4500		32	2000	4560	610	4243	567
6500		48	2750	6840	914	6365	851
3000	72	16	1750	3281	439	3107	415
4500		24	2250	4922	658	4660	623
6500		32	2750	6563	877	6214	831
9500		48	4000	9844	1316	9320	1246
4000	84	16	2250	4465	597	4005	535
6500		24	2750	6697	895	6007	809
8500		32	3250	8929	1194	8010	1071
13000		48	4500	13394	1791	12016	1606
5500	96	16	2500	5830	779	5335	713
8500		24	3250	8744	1169	8003	1070
11500		32	4000	11659	1559	10680	1426
17000		48	5250	17489	2338	16006	2140
14000	108	30	4250	14277	1909	13280	1775
19000		40	5250	19036	2545	17707	2367
16500	120	29	4750	16503	2206	15492	2071
20000		36	5500	20486	2739	19231	2571
22500		40	6000	22762	3043	21368	2856

Unloading and Handling

Read and follow all safety instructions before unloading pipe.

1. Before unloading, observe the pipe for damage while it is still on the truck. Note any pipe damage on the bill-of-lading and have the truck driver initial the notes. Also, report any shipping damage to your local Contech representative.
2. **Do not** overtighten strapping as it may cause dimpling. If dimpling occurs, unstrap pipe to allow for rebound to occur at the dimpling of the pipe.
3. Use a forklift with full-length forks or fork extensions (typically 8 feet), front-end loader or backhoe with fork adapters at full length to engage entire pallet width. Make sure back of forklift is free of protrusions or spikes that could damage the pipe.
4. Use Nylon lifting slings of sufficient strength, length and specifically intended to safely handle entire pallet or individual pipe, whichever is being lifted.
5. Use two (2) sling points for lifting sizes greater than 30" diameter. Sling spacing equal to 1/3rd of the pipe length is generally sufficient.
6. For tank lengths longer than 32 ft, the use of a spreader bar is recommended. The spreader bar should be 1/3rd the length of the tank and appropriately sized for the weight being lifted.
7. **Do not** use steel cables, chains and/or hooks to unload or handle pipe.
8. **Do not** stand or ride on the pipe load during unloading or handling.
9. **Do not** scoop the pipe or strike with forks.
10. **Do not** drag or drop the pipe.



Trench Dimensions

Trenching practices shall be in accordance with OSHA.

1. The trench needs to be wide enough for a person to work safely.
2. Where trench walls are unstable, the contractor may elect to use tight sheeting, bracing, or a trench box for stabilization during pipe laying. If the conditions are severe, sheeting may be left in place.
3. Refer to ASTM D2321, Paragraph 6.4.2, for proper placement and movement of trench boxes. Improper use of trench boxes can affect pipe performance.



Groundwater

1. Excessive groundwater may necessitate dewatering. Dewatering techniques must meet all OSHA and local requirements and codes.
2. In areas of saturated trench conditions or in dewatered trenches, refer to "Foundation and Bedding," and ASTM D2321 for proper selection of bedding and backfill materials.
3. Flotation of the pipe and erosion or wash-out of previously placed soil support must be prevented to ensure that the structure maintains its load carrying capacity.
4. Contact the Engineer of Record, hereinafter referred to as "engineer," for proper cover to prevent flotation.

TABLE 2. MINIMUM COVER NEEDED TO PREVENT FLOTATION

Pipe Dia. (in)	Cover Required
30	1'-4"
36	1'-7"
42	1'-10"
48	2'-2"
54	2'-5"
60	2'-8"
72	3'-2"
84	3'-9"
96	4'-3"
108	5'
120	5'-5"

Foundation and Bedding

1. An unstable trench bottom must be stabilized at the engineer's direction. In such cases, install special foundation and bedding materials in 6 inch layers and compact.
2. Excavation below the final loosely placed bedding material shall be compacted using standard bedding practices or compacted at a minimum of 90% Standard Proctor Density.



3. The final bedding material provides uniform support to hold the pipe on line and grade. A relatively loose 4" to 6" thick bedding layer is usually adequate. Before installing the pipe, bring bedding material to grade along the entire length of the pipe. Bedding materials can be Class I, II or III per ASTM D2321.
4. When excavating in Class IV materials (silts, silty clays and clays), provide a uniform, undisturbed foundation.
5. Class IA materials if used for bedding, must be used as haunching material to the spring line in a dry trench. To minimize the potential for migration, Class IA materials should be used to the top of the pipe in wet trenches or in trenches that will fall below the water table.

Haunching

1. Proper haunching provides a major portion of the pipe's load-carrying capability. Poor workmanship will lead to excessive pipe deflection and grade and alignment problems. Haunching materials can be Class I, II, or III per ASTM D2321.
2. Work enough material under the haunch of the pipe by hand to provide proper compaction and side support. Material shall meet the minimum compaction requirements of ASTM D2321.
3. When trench walls are unstable, sloughing must be prevented so that haunching material can be placed and compacted adequately. The proper use of a trench box or over-excavation can assist in these cases.
4. Don't let the pipe move when placing material under the haunch of the pipe.
5. Take care not to damage the pipe with shovels, or other construction/tamping equipment.
6. Haunch material extends from the bedding/foundation material to the springline elevation.

Backfill and Compaction

1. Initial backfill materials extend from the springline to above the pipe (see page 9 -Standard Backfill Detail) to provide the remainder of the pipe support and protect the pipe from stones or cobbles in the final backfill. Backfill materials that generally follow the requirements of ASTM D2321, such as Class I, II, or III (or approved equal) may be used.
2. Native materials meeting the acceptable materials on page 7 can be used as backfill, but should be approved by the Engineer.
3. Materials must be free from large stones, frozen lumps or other debris.
4. Typical trench/backfill details can be found on pages 8 and 9; and acceptable backfill materials and compaction requirements on page 7 in this document.
5. Select fill should be placed and compacted to the minimum thickness referenced in the applicable installation detail before transitioning to native or non-select fill material over the pipe or to pavement.
6. Fill above the select fill should be fully compacted.
7. As backfill is placed around the pipe, care should be taken to avoid damage to the pipe.
8. Backfill height differential from one side of pipe to the other shall not exceed 12". Only "hand compaction" equipment is allowed over and around the pipe until minimum construction heights are achieved.

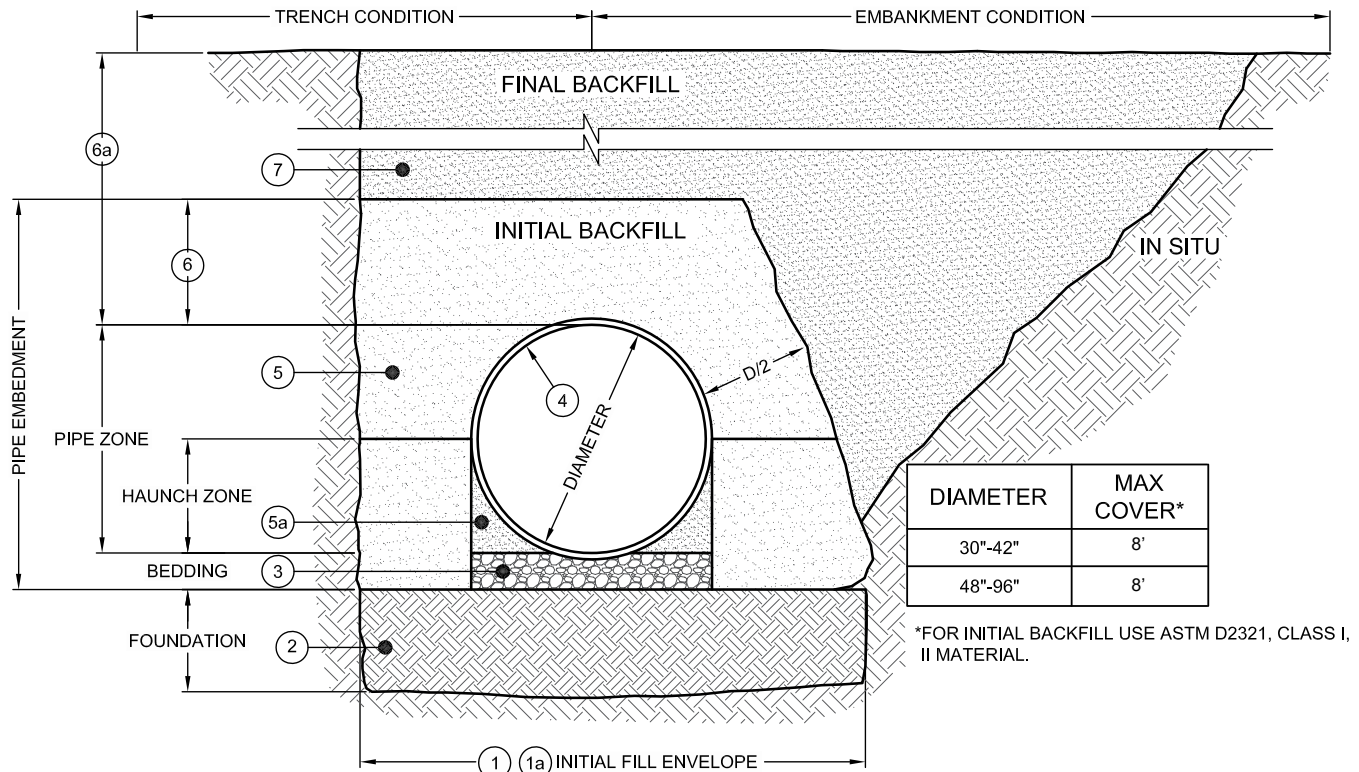


TABLE 3. ACCEPTABLE BACKFILL MATERIALS AND COMPACTION REQUIREMENTS

DESCRIPTION	SOIL CLASSIFICATIONS				MINIMUM STANDARD PROCTOR DENSITY %
	ASTM D2321	ASTM D2487	AASHTO M43	AASHTO M145	
Graded or crushed, crushed stone, gravel	Class I	-	5 56	A-1-a	85%
Well-graded sand, gravels and gravel/ sand mixtures; poorly graded sand, gravels and gravel/sand mixtures; little or no fines	Class II	GW GP SW SP	57 6	A-1-b A-3	85%
Silty or clayey gravels, gravel/sand/ silt or gravel and clay mixtures; silty or clayey sands, sand/clay or sand/silt mixtures	Class III	GM GC SM SC	Gravel and sand (<10% fines)	A-2-4 A-2-5	90%

Use of cementitious or flowable backfills is compatible with DuroMaxx. Proper precautions should be taken to preclude flotation of the pipe. Contact your Contech representative for further guidance.

Backfill Detail for 36" to 96" diameter



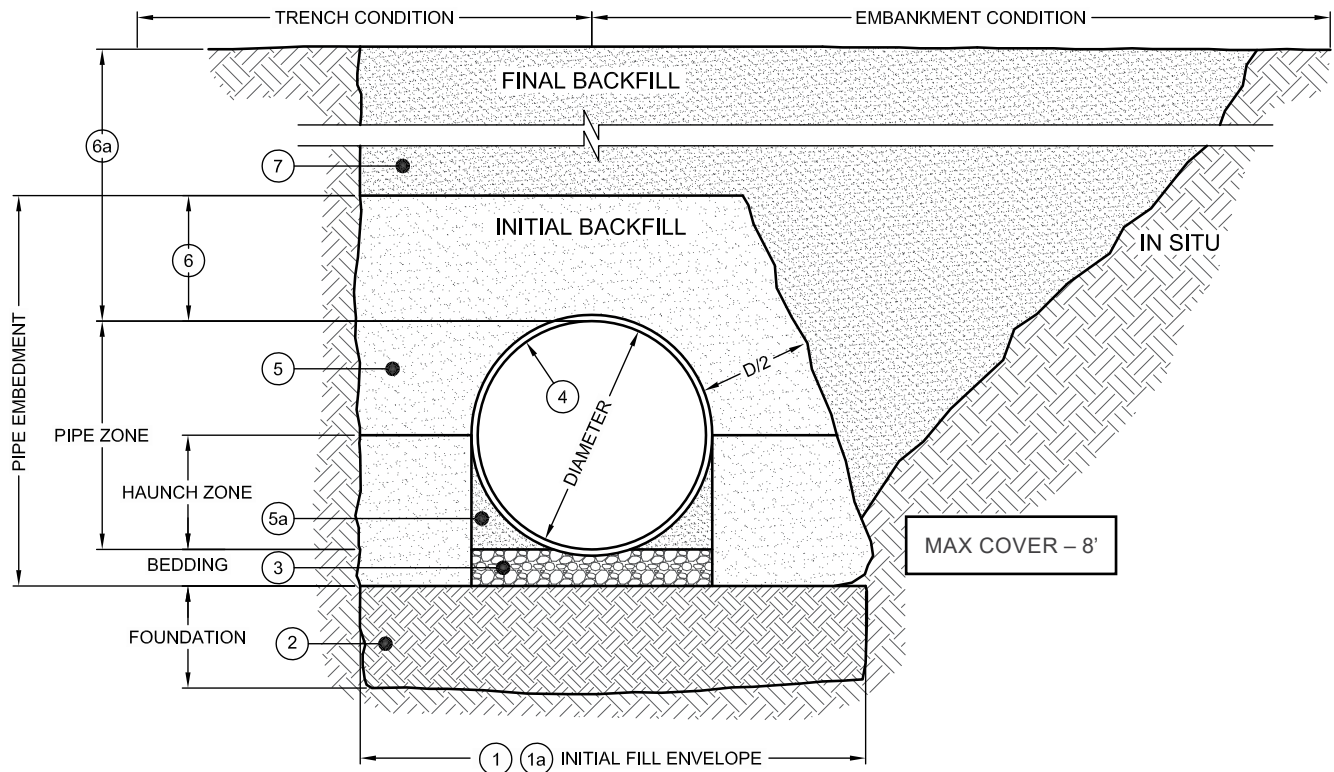
- ① MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER PIPE. MIN. WIDTH = $(1.25 \times \text{DIAMETER}) + 12"$ (FOLLOW ASTM D2321)
- ①a MINIMUM EMBANKMENT WIDTH IS 3 PIPE DIAMETERS BUT NO LESS THAN 2' OUTSIDE OF SPRINGLINE.
- ② FOUNDATION SHALL BE WELL CONSOLIDATED & STABLE.
- ③ BEDDING MATERIAL SHALL BE A RELATIVELY LOOSE MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 4" TO 6" IN DEPTH.
- ④ DUROMAXX STEEL REINFORCED (SRPE) PIPE.
- ⑤ INITIAL BACKFILL FOR PIPE EMBEDMENT MATERIAL TO MEET ASTM D2321 CLASS I, II, III OR APPROVED EQUAL, COMPACTED TO 90% STANDARD PROCTOR (NATIVE MATERIAL CAN BE UTILIZED THAT MEETS ASTM D2321 OR APPROVED EQUAL).
 - ALL LIFTS PLACED IN CONTROLLED MANNER. TO PREVENT UNEVEN LOADING, IT IS RECOMMENDED THAT LIFTS NOT EXCEED 8" UNCOMPACTED LIFT HEIGHTS.
- ⑤a HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION.
- ⑥ INITIAL BACKFILL ABOVE PIPE MAY INCLUDE ROAD BASE MATERIAL AND RIGID PAVEMENT (IF APPLICABLE), MINIMUM COVER STILL APPLIES, OTHERWISE:
 - 6" MINIMUM FOR PIPE DIAMETERS 30" - 60"
 - 12" MINIMUM FOR PIPE DIAMETERS 66" - 96"
- ⑥a HEIGHT OF COMPACTED COVER PER DIAMETER FOR CONVENTIONAL HIGHWAY LOADS (DISTANCE MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT):
 - 12" MINIMUM FOR PIPE DIAMETERS 30" - 60"
 - 18" MINIMUM FOR PIPE DIAMETERS 66" - 72"
 - 24" MINIMUM FOR PIPE DIAMETERS 84" - 96"
- ⑦ FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS PER THE PROJECT PLANS, SPECIFICATIONS. ENGINEER OF RECORD.

NOTES:

- GEOTEXTILE SHALL BE USED AS REQUIRED TO PREVENT SOIL MIGRATION.
- FOR MULTIPLE BARREL INSTALLATION THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE = PIPE DIA./2 OR 3' FOR PIPE DIAMETERS 72" AND LARGER. CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.
- BACKFILL REQUIREMENTS SHALL FOLLOW ASTM D2321. IN THE EVENT OF DISCREPANCIES, ASTM D2321 SHALL SUPERCEDE THIS DETAIL.

1
2
BACKFILL DETAIL
 SCALE: N.T.S.

Backfill Detail for 108" and 120" diameter



- ① MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER PIPE. MIN. WIDTH = $(1.25 \times \text{DIAMETER}) + 12"$ (FOLLOW ASTM D2321)
- ①a MINIMUM EMBANKMENT WIDTH IS 3 PIPE DIAMETERS.
- ② FOUNDATION SHALL BE WELL CONSOLIDATED & STABLE.
- ③ BEDDING MATERIAL SHALL BE A RELATIVELY LOOSE MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 4" TO 6" IN DEPTH.
- ④ DUROMAXX STEEL REINFORCED (SRPE) PIPE.
- ⑤ INITIAL BACKFILL FOR PIPE EMBEDMENT MATERIAL TO MEET ASTM D2321 CLASS I OR APPROVED EQUAL, COMPACTED TO 90% STANDARD PROCTOR (NATIVE MATERIAL CAN BE UTILIZED THAT MEETS ASTM D2321 OR APPROVED EQUAL).
 - ALL LIFTS PLACED IN CONTROLLED MANNER. TO PREVENT UNEVEN LOADING, IT IS RECOMMENDED THAT LIFTS NOT EXCEED 8" UNCOMPACTED LIFT HEIGHTS.
- ⑤a HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION.
- ⑥ INITIAL BACKFILL ABOVE PIPE MAY INCLUDE ROAD BASE MATERIAL AND RIGID PAVEMENT, MINIMUM COVER STILL APPLIES, OTHERWISE: 18" MINIMUM FOR PIPE DIAMETERS 108" - 120"
- ⑥a HEIGHT OF COMPACTED COVER PER DIAMETER FOR CONVENTIONAL HIGHWAY LOADS (DISTANCE MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT):
 - 30" MINIMUM FOR PIPE DIAMETERS 108"
 - 36" MINIMUM FOR PIPE DIAMETERS 120"
- ⑦ FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS PER THE PROJECT PLANS, SPECIFICATIONS. ENGINEER OF RECORD.

NOTES:

- GEOTEXTILE SHALL BE USED AS REQUIRED TO PREVENT SOIL MIGRATION.
- FOR MULTIPLE BARREL INSTALLATION THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE = PIPE DIA./2 OR 3' FOR PIPE DIAMETERS 72" AND LARGER. CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.
- BACKFILL REQUIREMENTS SHALL FOLLOW ASTM D2321. IN THE EVENT OF DISCREPANCIES, ASTM D2321 SHALL SUPERCEDE THIS DETAIL.

1 **BACKFILL DETAIL**
2 **SCALE: N.T.S.**

Flowable Fill

These materials are suitable for use with DuroMaxx at the direction of the Engineer. The contractor must take precautions to preclude the dislocation or flotation of the pipe during placement of the flowable fill. Should these materials be utilized by the contractor, Contech will assist with recommendations for restraint to ensure line and grade can be maintained.

Embankment Conditions

1. DuroMaxx is a superior product that is normally installed in a trench condition. Embankment installations are an acceptable installation application.
2. In general, the backfill type and placement of the backfill immediately around the pipe can be the same as that shown on page 8.
3. The width of the select fill zone around the pipe and the type of material placed outside the zone – adjacent to the select fill zone – are critical and dependent upon the pipe diameter and ultimate amount of fill and loads to be placed over the pipe.
4. In the event of an embankment installation, a backfill design should be prepared for the specific site conditions by the Engineer.
5. Larger diameters may not be allowed or may require additional care in backfilling. Only small walk-behind compaction equipment should be used directly around the pipe.

Cover Limits

Once the backfilling process is completed, the contractor should take care to maintain the minimum allowable cover height over the pipe and should notify all other contractors and subcontractors to avoid removal of fill cover or rutting.

TABLE 4. HEIGHT OF COVER LIMITS H20-25/HS20-25

Pipe Dia. (in)	Min. Cover (ft)	Max. Cover (ft)
30-42	1	8
48-60	1	8
66-72	1.5	8
84-96	2	8
108	2.5	8
120	3	8

NOTES

1. Allowable minimum cover is measured from the top of the pipe to the bottom of a flexible pavement or the top of the pipe to the top of a rigid pavement. Minimum cover in unpaved areas will be greater than for paved areas shown in Table 2 and must be maintained. Contact your local Contech Sales Engineer for more information.
2. All heights of cover are based on trench conditions. If embankment conditions exist, additional care in the placement of fill outside the pipe backfill zone is required. Your Contech representative can provide further guidance for a project in embankment conditions.

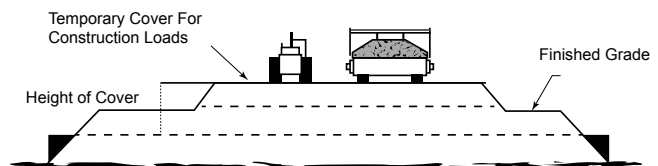
Construction Loads

For temporary construction vehicle loads, an extra amount of compacted cover may be required over the top of the pipe. The height of cover shall meet the minimum requirements shown in Table 5 below. The use of heavy construction equipment necessitates greater protection for the pipe than finished grade cover minimums for normal highway traffic.

Minimum cover may vary depending on local conditions. The contractor must provide the additional cover required to avoid damage to the pipe. Minimum cover is measure from the top of the pipe to the top of the maintained construction roadway surface.

TABLE 5. HEAVY CONSTRUCTION LOADS

Minimum Height of Cover Requirements for Construction Loads. The Minimum Cover should be a COMPACTED Height of Cover Requirement.				
Diameter/Span (in)	Axle Load (Kips)			
	>32≤50	50≤75	75≤100	110≤150
30-42	2.0 ft	2.5 ft	3.0 ft	3.0 ft
48-72	3.0 ft	3.0 ft	3.5 ft	4.0 ft
84-96	3.0 ft	3.5 ft	4.0 ft	4.5 ft
102-120	3.5 ft	4.0 ft	4.5 ft	5.0 ft



Temperature Effects

1. DuroMaxx is a superior product and the pipe's stiffness is not affected by solar absorption or elevated ambient temperatures.
2. If large swings in temperature occur from the location the pipe is stored and the bottom of the trench, then the pipe may require conditioning to avoid contraction of the pipe's length.
3. Operating temperatures are not recommended beyond 120° F (49° C).

Repairs

1. The recommended cutting tool for DuroMaxx pipe is a chop saw and abrasive saw blade. Refer to the Operating Instructions from the saw manufacturer for additional information.
2. Blade thickness should be no less than 1/8" thick and is recommended to be made of 2 ply material that is used to cut ductile iron pipe.
3. Use the leading edge of the blade to cut into the ribs of the pipe.
4. Bury the blade as much as possible into the pipe as you proceed.
5. The alternative cutting tool for DuroMaxx is a handheld reciprocating saw. This process will take about 2 minutes to cut the steel ribs. There are 9 ribs for 24" around the pipe circumference.
6. For large diameters, square cuts can be achieved from the inside.
- Repairs
4. Should damage to the pipe occur at any point during installation, the Engineer should be contacted immediately.
5. For larger damaged sections, cut out damaged areas and cut a length of replacement pipe to fit.
6. Similar to other flexible pipe products, DuroMaxx can be coupled using various industry standard methods and materials (e.g. concrete collars, Fernco® Inc., Mar Mac® or equal).
7. For smaller abrasions or exposed steel, an approved rubberized undercoating spray can be used to cover the steel.

Taps

1. DuroMaxx pipe can be supplied with standard prefabricated taps fittings or components per job plans once pre-fabrication drawings are reviewed by Contech Engineering and approved by the Engineer.
 2. DuroMaxx can be field tapped using Inserta-Tees® for drainage projects. Please contact your Contech Representative for more information.
- Recommendations



Always use safety glasses when cutting DuroMaxx pipe and use protective gloves in case sharp edges are exposed.

Recommended Draining Procedure

The tank can be drained for inspection and maintenance through the manhole access. Tank draining can be accomplished by operating the rainwater harvesting pump to evacuate the water from the tank. A vac truck can be used to evacuate any remaining water. If it is not feasible to operate the rainwater harvesting pump, a vac truck in conjunction with a portable submersible pump placed in the tank can be used.

Tank Corrosion and Chemical Leaching Potential

SRPE tanks are not suitable for potable water storage applications.

Please refer to the "DuroMaxx Technical Bulletin TB1- Durability Considerations for DuroMaxx Sewer Pipe" for tank corrosion and chemical leaching potential.

Acceptable pH Range for RWH Applications

Please refer to the "DuroMaxx Technical Bulletin TB1- Durability Considerations for DuroMaxx Sewer Pipe" for pH range considerations.



Support

Your Primary Contech Contact: _____

Phone: _____

Your Customer Solutions Coordinator (CSC) is: _____

Phone: _____

Project Site Address: _____

NOTES: _____

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater and earth stabilization products. For information on other Contech division offerings, visit www.ContechES.com or call 800-338-1122.

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For more complete information on installing DuroMaxx, refer to ASTM D2321.

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INSTALLATION GUIDE



R-TANK® INSTALLATION

PRE-CONSTRUCTION CHECKLIST

TOOLS YOU'LL NEED

- ☐ Laser or transit
- ☐ Measuring tape (long enough to mark R-Tank® footprint)
- ☐ Hard rakes
- ☐ Marking paint
- ☐ Razor knife
- ☐ Screw driver / nut driver set (for pipe boots)
- ☐ Metal snips to cut steel band clamps
- ☐ String line
- ☐ Reciprocating saw (to cut in inspection & maintenance ports)
- ☐ Drill with 1" drill bit to create vent holes in ports

Additional tools if R-TANK® modules are not preassembled

- ☐ Dead blow mallets
- ☐ Work tables (3/4" plywood placed on R-Tank® modules works well)

MATERIALS YOU'LL NEED

- ☐ R-Tank® modules
- ☐ Geotextile
- ☐ Geogrid (only for load bearing applications)
- ☐ Liner (if required by plans)
- ☐ Base & backfill material (per spec section 2.03)
- ☐ Pipe boot kits
(If not using kits, you'll need duct tape and a stainless steel band clamp for each inlet and outlet pipe, and for each inspection or maintenance port.)
- ☐ Maintenance port kits
(If not using kits, you will need non corrosive rigid anti-scour pad [15" x 15" to fit below maintenance ports.], fabric pipe boot, duct tape, stainless steel band clamp 12" schedule 40 PVC pipe and H2O rated ring and cover.)
- ☐ Metallic tape

EQUIPMENT YOU'LL NEED

- ☐ Forklift and other equipment/tools necessary to unload box truck
- ☐ Pallet jack (to unload material from box truck)
- ☐ Walk-behind trench roller (plate compactor may work for smaller projects)
- ☐ Low ground pressure (LGP) tracked skid steer or dozer (<7.0 psi gross operating pressure)
- ☐ LGP dozer - 10 ton max gross vehicle weight and 7.0 psi max operating pressure
- ☐ Roller - 6 ton max gross vehicle weight

Note: This list does not include equipment or tools needed to excavate or level the floor of the excavation.

**ACF offers an on-site assembly service.
Call to request a quote, 800-448-3636.**



STEP 1 - EXCAVATION

The excavation limits and location of R-Tank® System should be staked out using the drawings. If limits are not shown, add 2' on each side of the R-Tank® system.

- A.** Excavate the designated surveyed area according to plans following all relevant local, state and OSHA guidelines. Typical excavations should include:
 - Two foot perimeter around R-Tank® to allow for proper compaction of backfill
 - Enough depth to accommodate a minimum 3" base (if required) below the R-Tank®
- B.** Level the bottom of the excavation (see Fig. 1) as shown on plans. Most excavations have a flat bottom while some will slope toward the outlet pipe.
- C.** Prepare subgrade according to plans. Base of excavation must be uniform, level and free of debris and soft or yielding subgrade areas. Compact to at least 95% standard proctor density (or as required by Engineer) unless infiltration of stormwater into subgrade is desired. A minimum bearing capacity of 2,000 psf (per spec section 3.02D) must be achieved prior to beginning R-Tank module installation. If the subgrade is pumping or appears excessively soft, the design engineer should be consulted.



Fig. 1 Excavate according to plans, following all governmental regulations.

TIP: Assembling the R-Tank® units (Step 2) during excavation may save time during the installation, but requires additional material handling and space. If time allows consider assembling modules in the completed excavation to reduce labor / material handling costs.

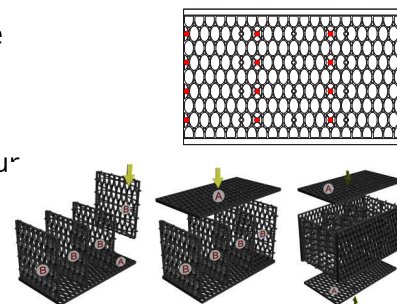
STEP 2 - ASSEMBLE R-TANK® UNITS

If R-Tank units arrive on your project in flat panels, they will need to be assembled. Complete directions are provided for each module type below, and a video is available on YouTube by searching for "R-Tank assembly" or by using this link: <https://www.youtube.com/watch?v=0MTzTVkTq5Q>. The modules should take 2-3 minutes per segment to build, with workers completing the assembly and material handlers assisting. This is a conservative estimate used to approximate total man hours needed for assembly.

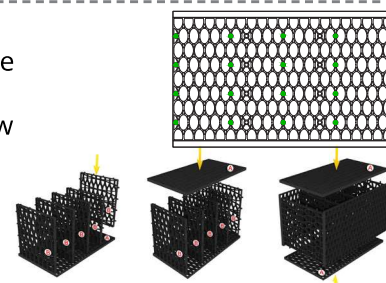


* Begin by connecting four (4) small plates to one large plate, using the connection locations shown in red dots. Next, attach a second large plate opposite the first. Finally, add two large plates to the sides, and the single module is complete. To build a double module (or taller), follow the directions above, using the top of the single module as your first large plate to connect additional small plates.

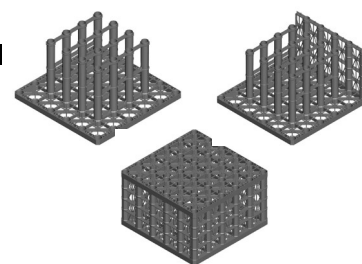
***Warning:** R-Tank® LD modules are only for applications not subjected to traffic loads.



Begin by connecting five (5) small plates to one large plate, using the connection locations shown in green dots. Next, attach a second large plate opposite the first. Finally, add two plates to the sides, and the single module is complete. To build a double module (or taller), follow the directions above, using the top of the single module as your first large plate to connect additional small plates.



UD modules have three (3) different plates: a top/bottom plate, a side plate, and an internal plate. Sides have five columns, while the internal plates only have 4. Begin by connecting four (4) internal plates to the bottom plate. Next, add four side plates, and finish the single module by snapping on the top. To build a double module (or taller), follow the directions above, using the top of the single module as your first bottom plate to connect additional plates.



R-TANK® INSTALLATION

STEP 3 - PREPARE BASE

- A.** If present, remove standing water in the excavation as it will prevent proper base preparation.
- B.** Establish a level working platform. A thin layer (minimum 3") of material is recommended. Check plans to see if geotextile is specified below the base material. Base materials must meet spec section 2.03A.
 - In regions with sandy soils meeting the requirements noted and where the subgrade elevation is above the groundwater table, imported base materials may not be needed. (For more information see specification section 2.03A.)
- C.** Grade and level base as shown on plans with no more than 1/2" variance (+/- 1/4"). Base must be smooth and free of debris and large rocks.



Fig. 2 Base must be smooth to ensure units fit together without gaps

TIP: Creating a smooth, level platform will allow for faster installation of R-Tank® modules, as they will fit together evenly, eliminating detail work that can delay your progress.

STEP 4 - PLACE GEOTEXTILE

- A.** Check the plans to see if geotextile is required to be placed between the base and the R-Tank® units. It is required on most projects, but not all. If it is not required, skip to Step 5.
- B.** Cut strips of geotextile to the proper length, and place them over the base, covering the floor of the excavation. The geotextile should extend at least 2' beyond the edge of the R-Tank® footprint. Adjacent panels of material should be overlapped by 12" or more, as shown on the plans.
- C.** Use pins, staples, sandbags or other ballast to hold the geotextile in place, preventing it from blowing or sliding out of position.
- D.** Patch any holes made in the Geotextile by placing a small patch of fabric over the damaged area. The patch must be large enough to cover the damaged area with at least 12" of overlap on undamaged material.
- E.** If a liner and/or additional geotextile is required per plans, install these now as shown on the project plans.



Fig. 3 Pull wrinkles out of geotextiles so material lays flat



Fig.4 Reduced overlaps don't create significant savings and can create delays

TIP: Some contractors choose to cut the geotextile strips long enough to wrap up the sides and over the top of the R-Tank® in a single piece (see Fig. 3). If space allows and the folded flaps will not interfere with the installation, you may want to consider this option. If a liner is required on your project, this method should be used to protect the liner.

TIP: Many contractors find that it is both easier and less expensive to have specialty contractors install the liner (typically used when building a cistern). If you are installing a liner yourself, handle it VERY CAREFULLY to avoid damage.

****WARNING: GEOTEXTILES CAN BE DAMAGED BY EXTREME HEAT. SMOKING IS NOT PERMISSIBLE ON/NEAR THE SYSTEM, AND TOOLS USING A FLAME TO TACK GEOTEXTILE OVERLAPS, SUCH AS PROPANE TORCHES, ARE PROHIBITED. ****

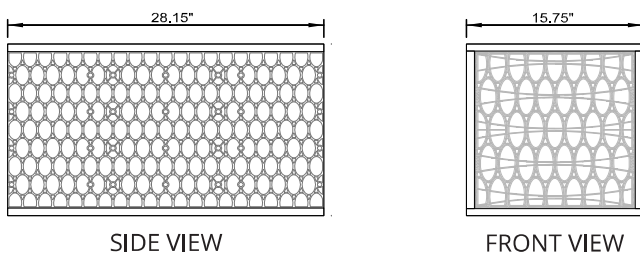
STEP 5 - INSTALL R-TANK® MODULES

- A.** Determine the starting location. It is often helpful to use an inlet or outlet pipe to guide you. Using a string line, establish two adjacent edges of the R-Tank® footprint. Ensure that your corner is square. Mark these two edges with marking paint and remove the string line (see Fig. 5).
- B.** Begin placing R-Tanks® in the corner of the marked area.
 - Do NOT place units on their sides, as this will void the warranty. Check plans to ensure the correct orientation of the R-Tanks® (see Fig. 8).
 - Check the plans to ensure the R-Tanks® are running in the correct direction (North/South vs. East/West) to match the footprint shown on plans (see Fig. 8).
 - R-Tank® units should fit together evenly. Occasional minor gaps between units ($< \frac{1}{2}$ " or variations in the height of the units ($< \frac{1}{2}$ " are acceptable (see Fig. 6), but reasonable efforts should be made to minimize these variations. If gaps or height variations persist through 3 or more adjacent units, remove the modules and pull back the textile to repair base.
 - No lateral connections between adjacent R-Tank® units are required

For LD, HD and SD modules: the large side plate of the tanks should be placed on the perimeter of the system. This will require that two ends of the tank area will have a row of tanks placed perpendicular to all other tanks (see Fig. 7).

- Option 1: End column should cover 75% of the final module.
 Option 2: End column may extend beyond the final row.

LD/ HD/ SD



UD

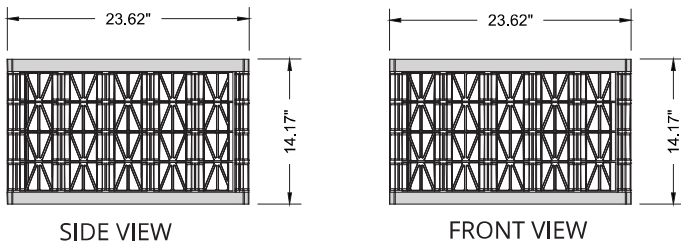


Fig. 5 Use a string line and marking paint to square the system footprint



Fig. 6 Minor variations (less than width of top plate) in tank height are acceptable

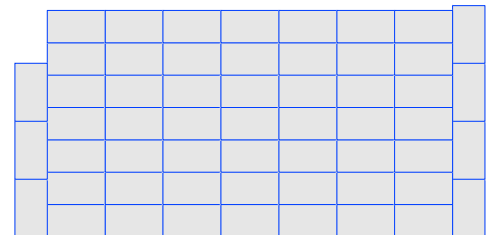


Fig. 7 Plan view showing the end rows turned perpendicular. The corners may not match up perfectly, so two acceptable alternatives are shown. Most plans do not show this configuration. Field adjustments are easily made.

Fig. 8 (To the left) Make sure the tanks are oriented properly in the excavation

IMPORTANT: Anyone walking directly on top of the units should be instructed to keep their weight over the vertical supports of the tank to prevent damaging the units.

R-TANK® INSTALLATION

STEP 6 - INSTALL INSPECTION / MAINTENANCE PORTS

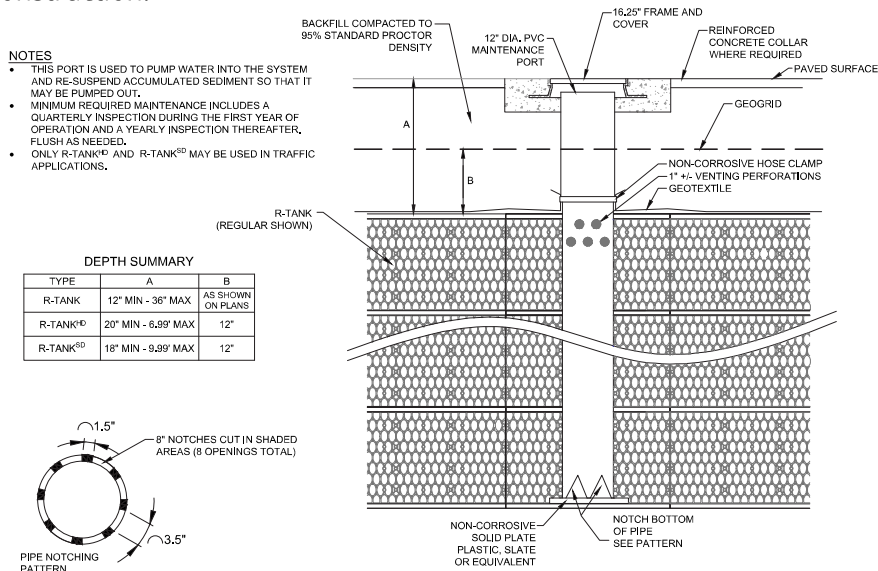
- A.** Check plans for size and type of pipe (usually 10-12" schedule 40 PVC pipe), and cut pipe to length, leaving enough excess to trim the top when final grade is reached. All ports should be made from pipe long enough to extend from the bottom of the R-Tank® to finished grade.
- B.** Drill several 1" diameter holes (air vents) into the pipe right below where the future top of the R-Tank® system and pipe meet when installed. Air vents can also be created with a chop saw or grinder by cutting several 3-5" vertical slots into the pipe at the same location.
- C.** Using a reciprocating saw, cut several 8" triangular notches into the bottom of the pipe as shown on plans (see Fig. 9).
- D.** Identify the location of all ports and remove the R-Tank® from each location.
- E.** All modules will need to be disassembled in order to cut, remove, and/or relocate internal plates. This process will vary based on the module your project is using, as noted on the next page.
- F.** Reassemble the R-Tank® when cutting is completed.
- G.** Insert the non-corrosive anti-scour pad in the bottom of the R-Tank® (should fit directly below the Maintenance Port), and replace the R-Tank® into the proper location.
- H.** If using Prefabricated Pipe Boot Kits, install the boot onto the pipe now, leaving the band clamps loose so that final adjustments may be made in Step 7. Install the pipe into the R-Tank® unit (see Fig. 12) and make sure it is plumb.
- G.** Temporarily seal the opening on top of the pipe with a cap or temporary lid to prevent debris from entering the system during construction.



Fig. 9 Cut 8" notches into the bottom of maintenance port



Fig. 10 Installed maintenance port



TIP: If the location of Maintenance Ports is not shown on your plans, contact the engineer. Ports should be added within 10' of all inlet and outlet pipes (a single Maintenance Port can cover multiple pipe connections), and include additional Maintenance Ports as needed to prevent the distance between ports from exceeding 50'.

IMPORTANT: Do not over-cut the R-Tank® plates. Minimize the gaps between the pipe and the R-Tank® plates. This is particularly important with the top plate.

STEP 6E DETAILS - INSTALL INSPECTION / MAINTENANCE PORTS

LD Modules

To accommodate the maintenance port, remove the two internal plates and reconnect them at the connection points a few inches closer to the edges of the module. This will provide enough room for a 12" pipe. Using your reciprocating saw, cut a circular hole the same size as the pipe in the center of the horizontal R-Tank plates, between the relocated internal plates. All horizontally oriented plates will need to be cut EXCEPT FOR THE BOTTOM PLATE. See Table 1 for the number of horizontal plates that will need to be cut.

HD / SD Modules

To accommodate the maintenance port, remove the center interior small plate (see Fig. 11). Using your reciprocating saw, cut a circular hole the same size as the pipe in the center of the horizontal R-Tank plates, between the internal plates. All horizontally oriented plates will need to be cut EXCEPT FOR THE BOTTOM PLATE. See Table 1 for the number of horizontal plates that will need to be cut for your specific module.

UD Modules

Use a 10" PVC Pipe to create the maintenance port. A 12" pipe will not fit correctly. To accommodate the 10" pipe, remove the two center internal plates. Cut one of the plates in half vertically, so that you are left with two pieces, each with two full columns. Reinsert these pieces into the module on the edges, perpendicular to the full-size internal plates (see Fig. 12). Discard the other internal plate that was removed.

Using your reciprocating saw, cut a circular hole the same size as the 10" pipe in the center of the horizontal R-Tank plates, between the internal columns. All horizontal plates will need to be cut EXCEPT FOR THE BOTTOM PLATE. See Table 1 below for the number of horizontal plates that will need to be cut for your specific module.



Fig. 11 For HD and SD modules, make space for the pipe by removing the center plate

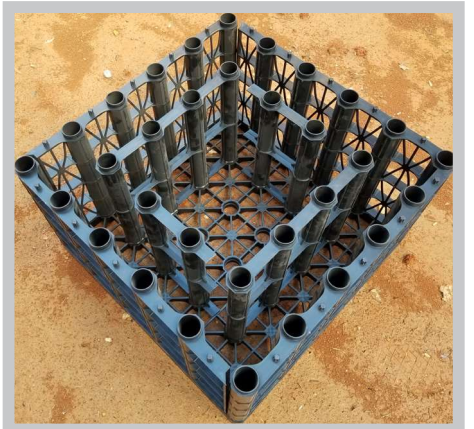
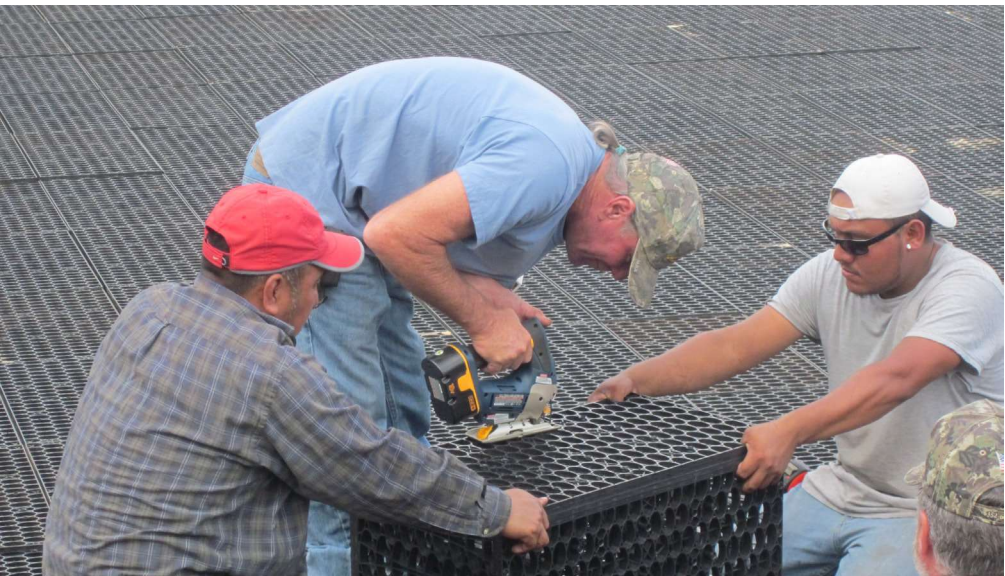


Fig. 12 For UD modules, two internal plates are removed, and two half-pieces are reinserted perpendicular to the other internal pieces.

Unit	Cut
Single	1 Large Plate
Double	2 Large Plates
Triple	3 Large Plates
Quad	4 Large Plates
Pent	5 Large Plates

Table 1



R-TANK® INSTALLATION

STEP 7 - SEAL R-TANK® WITH GEOTEXTILE

- A.** Clean off any debris that may be lying on top of the exposed geotextile around the perimeter of the R-Tank®
- B.** Cut strips of geotextile to fit over the top and down both sides of the R-Tank® with at least 2' of excess material on each side of the system. This 2' flap should overlay the geotextile placed below the R-Tank® units, creating a clean 24" overlap to seal the system. Adjacent strips of geotextile should overlap at least 12" or as shown on plans.
- C.** Use duct tape, sand bags or other ballast to temporarily secure overlaps
- D.** Where the geotextile intersects an Inspection or Maintenance Port, cut an "X" into the geotextile and pull it over the pipe. The flaps of the "X" should point AWAY from the R-Tank® (see Fig. 14). Use a fabric boot and a stainless steel band clamp to seal the flaps to the pipe.
- E.** Fold geotextile for outside corners similar to sheets on a bed, and lay excess material flat against R-Tank® (see Fig. 15). Leave corners loose to avoid creating weak spots in the material. Temporarily secure excess fabric with duct tape.
- F.** Where the inlet and outlet pipes connect to the R-Tank®, cut an "X" into the geotextile so that the pipe makes DIRECT contact with the R-Tank®. Pull the flaps of the "X" over the pipe so that the flaps of the "X" point AWAY from the R-Tank®. Use a stainless steel band clamp to seal the flaps to the pipe.
- G.** If using prefabricated pipe boot kits, install them onto the inlet and outlet pipes (see Fig. 16). Adjust boots so that the fabric lays snug against the R-Tank®. Tighten the band clamps with a screw/nut driver. Use duct tape to secure the boot flap to the outside of the geotextile envelope.
- H.** Walk bottom edge of geotextile along the sides of R-Tank to eliminate gaps between the fabric and the bottom corner of the R-Tank®.



Fig. 13 Encapsulate R-Tanks® with geotextile

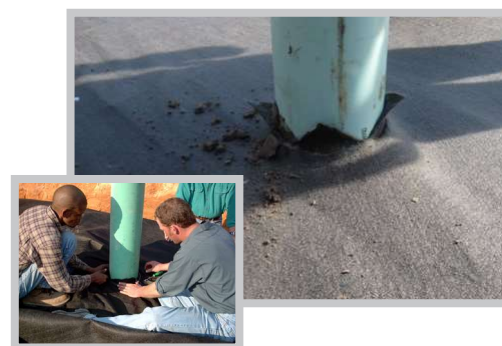


Fig. 14 Cut an "X" into textile to accommodate pipe penetration and seal with a boot



Fig. 15 Finished envelope should lay flat against R-Tank®



Fig. 16 Install boots onto pipes prior to connecting them to the R-Tank, leaving the clamps loose for final adjustment later

IMPORTANT: Take special care with inside corners on the footprint of the system. Cut geotextile as needed to ensure that it lays flat against the R-Tank®. Use additional pieces of geotextile to seal the corner and any cuts that are made (12" overlap).

WARNING: Inlet and outlet pipes must make DIRECT contact with the R-Tank® (per Step 7F), allowing water to flow directly into or out of the R-Tank® without filtering through the geotextile.

Failing to correctly connect pipes will cause the system to malfunction.

****WARNING: GEOTEXTILES CAN BE DAMAGED BY EXTREME HEAT. SMOKING IS NOT PERMISSIBLE ON/NEAR THE SYSTEM, AND TOOLS USING A FLAME TO TACK GEOTEXTILE OVERLAPS, SUCH AS PROPANE TORCHES, ARE PROHIBITED. ****

STEP 8 - BACKFILL SIDES

- Place backfill material (see specification section 2.03 B) around perimeter of the R-Tank®, distributing the material evenly to prevent shoving of the R-Tank® units. All backfill material must meet requirements listed in the specs
- Use a trench roller or plate compactor to compact backfill in 12" lifts (see Fig. 17)
- Continue placing and compacting backfill in 12" lifts until the material reaches the top of the R-Tank® units

IMPORTANT: Vibratory compaction of the side backfill (see Fig. 18) is a critical step that both compacts the backfill and eliminates minor gaps between individual R-Tank® units. While some backfill materials will yield a 95% proctor density without compaction, vibratory compaction of the material must be completed to ensure the stability of the system. **Skipping this step will void the manufacturer's warranty.**



Fig. 17 Vibratory compaction of side backfill is ALWAYS REQUIRED, regardless of what backfill material is used.



Fig. 18 Use an LGP dozer to push backfill over R-Tank® units.

STEP 9 - BACKFILL TOP

- Dump backfill material adjacent to the R-Tank® and, using your LGP Skid Steer or Dozer (see table below), push the material over the R-Tank® system.
 - Backfill must meet requirements listed in specification section 2.03 B
 - If your machine is not listed in the table, and you cannot find its ground pressure, you'll need to find your vehicle's Operating Weight and measure the area where the tracks contact the ground. Take these dimensions and multiply them (Length x Width), then multiply by 2 (since the machine has two tracks), then divide the Operating Weight by the total square inches of contact area to determine the contact pressure of the machine. If the contact pressure is less than 7.0 psi and the operating weight is less than 20,000 lbs, the machine will work with 12" of cover.
- Lightly compact top backfill to 95% standard proctor density (or as shown on plans) using your walk-behind trench roller. Alternately, a roller (maximum gross vehicle weight of 6 tons) may be used. Roller must remain in static mode until a minimum of 24" of cover has been placed over the modules (per spec, section 3.05 A5). Sheep foot rollers should not be used.

Largest Track Dozers that can be used with 12" of cover over R-Tank®

Machine Weight	Operating Dimensions	Track Pressure	Ground
Case 850K LGP	20,700 lbs	28" x 92.6" = 2593 si	4.0 psi
Caterpillar D5K LGP	21,347 lbs	26" x 91" = 2366 si	4.52 psi
John Deere 550J LGP	18,252 lbs	24" x 86" = 2064 si	4.2 psi
Komatsu D39PX-21	19,620 lbs	25" x 93" = 2325 si	4.27 psi
New Holland D95 LGP	20,700 lbs	28" x 93" = 2604 si	4.0 psi

This list is not intended to be all inclusive, but representative.

TIP: When pushing backfill over R-Tank® units, work in the direction of the geotextile overlap to avoid shoving material between the fabric layers.

WARNING: Dump trucks should not drive over or dump material on top of the R-Tank®.

WARNING: Some materials will compact significantly while others may shove excessively as you work. Never allow your lift thickness to compact to less than 12" without adding more material.

WARNING: A minimum of 12" of material must be maintained between the Dozer tracks and top of the R-Tank®. For best results, push at least 14" (or more) of backfill over the units, so that as the material compacts beneath the dozer, a 12" minimum lift is maintained. It is recommended that the dozer drive straight on and back straight off of the system during backfill placement. Turning movements are likely to shove the backfill material, reducing the thickness of the lift and potentially damaging the R-Tank® modules.

R-TANK® INSTALLATION

STEP 10 - PLACE GEOGRID

- A.** Check plans to see if required. Geogrid is required for most load-bearing applications (see Fig. 19), such as systems placed beneath parking lots and roads. It is not required for some UD installations and above systems used in open space where traffic is prohibited, such as sport fields or natural areas.
- B.** Geogrid must be placed 12" above the R-Tank®, or as shown on plans. Overlap adjacent panels by 18" minimum or as specified. Roll out Geogrid over the top of the system, with the edges of the grid extending 5' from R-Tank® footprint or 3' beyond the edge of excavation - or more as show on plans (refer to CAD detail HS20 loads).
- C.** If metallic tape has been specified (used to locate the system), install it now.



Fig. 19 Overlap geogrid 18" or as required by plans.



Fig. 20 Pushing backfill parallel to the Geogrid prevents the grid from shoving.

STEP 11 - PLACE ADDITIONAL COVER AS NEEDED

If additional cover or pavement base is required by the plans, begin placing and compacting material as discussed in Step 9. Push cover material parallel to the geogrid for best results (see Fig. 20). All cover material must meet requirements of specification section 2.03C.

TIP: To achieve proper compaction requirements, it may be beneficial to begin placing material in 6" lifts.

WARNING: Maximum cover for R-Tank^{LD}® systems (4-plate) is 3'. Use R-Tank^{HD}® units for cover depths less than 7', R-Tank^{SD}® units for cover depths up to 10', and R-Tank^{XD}® units for cover depths up to 16'. If you suspect the incorrect module is being used on your project, please contact ACF Environmental at 800-448-3636.

STEP 12 - SECURE THE INSTALLATION

Construction loads are often the heaviest loads that ever drive over the R-Tank® System, and there are many construction vehicles that exceed the HS20 standard that most detention systems are designed to meet. To prevent damage from these vehicles, the installation should be secured to prevent unauthorized traffic from driving over the system once it has been installed.

- A.** Projects nearing completion (within three months) should use warning tape or temporary fencing to secure the installation (see Fig. 21).
- B.** For larger projects with ongoing construction activities, consider a more durable method for preventing unauthorized traffic from accessing the system (see Fig. 22).

Regardless of what method is selected to secure the installation, it must remain in place until construction activity has concluded and no further access of vehicles exceeding the HS20 standard is necessary.



Fig. 21 Secure the installation with temporary fencing



Fig. 22 Secured R-Tank® installation using Jersey barriers



STEP 13 - INSTALL PRE-TREATMENT DEVICES

Install any pre-treatment devices prior to activating the R-Tank® System to prevent debris from entering the system (see Fig. 23).



Fig. 23 Trash Guard Plus prevents contamination of your system

TIP: For more information about pretreatment devices, or R-Tank installations, contact ACF Environmental's Inside Sales team at 800-448-3636





For more information, contact us at
800-448-3636 or visit the R-Tank product page on
our website at: www.acfenvironmental.com

APPENDIX O



PRACTICAL SOLUTIONS. EXCEPTIONAL SERVICE.

GEOTECHNICAL INVESTIGATION
PROPOSED ADDITION TO ORANGETOWN TOWN HALL
ORANGEBURG, NEW YORK

Submitted To:

Lothrop Associates LLP

333 Westchester Ave
White Plains, NY 10604

W.O. 10128.01-REV. 1

March 8, 2021

Submitted By:

**Tectonic Engineering
Consultants, Geologists & Land
Surveyors, D.P.C.**

1279 Route 300, 2nd Floor
Newburgh, NY 12550

(P) 845.567.6656
(F) 845.567.6248

Lothrop Associates, LLP
333 Westchester Avenue
White Plains, NY 10604

Attention: Mr. Bob Gabalski, AIA
(Via Email: bgabalski@lothropassociates.com)

March 8, 2021

RE: W.O. 10128.01-REV.1
GEOTECHNICAL INVESTIGATION
PROPOSED ADDITION TO ORANGETOWN TOWN HALL
ORANGETOWN, NEW YORK

Dear Mr. Gabalski;

Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C. is pleased to submit this geotechnical investigation and engineering evaluation was performed for the proposed addition to the Orangetown Town Hall building complex located at 26 Orangeburg Road, in Orangeburg, New York. The purpose of the investigation was to characterize the subsurface conditions in the area of the proposed addition, and to develop geotechnical design and construction criteria for the proposed building addition.

We appreciate this opportunity to assist you with this project. If you have any questions, please do not hesitate to contact the undersigned.

Sincerely,

TECTONIC ENGINEERING CONSULTANTS, GEOLOGISTS & LAND SURVEYORS, DPC

Mark A. Stier, P.E., PG 076154
Executive Vice President



"G:\Newburgh\Geotechnical\10100\10128.01 Orangetown Town Hall Expansion\Report\REV 1\TEC Cover Letter.docx"

Newburgh Office

1279 Route 300 | Newburgh, NY 12550
845.567.6656 Tel | 845.567.8703 Fax

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GEOTECHNICAL INVESTIGATION
PROPOSED ADDITION TO ORANGETOWN TOWN HALL
ORANGEBURG, NEW YORK

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1.0 INTRODUCTION

A geotechnical investigation and engineering evaluation was performed for the proposed addition to the Orangetown Town Hall building complex located at 26 Orangeburg Road, in Orangeburg, New York. The purpose of the investigation was to characterize the subsurface conditions in the area of the proposed addition, and to develop geotechnical design and construction criteria for the proposed building addition.

The following sections summarize the performed scope of services; provides general descriptions of the existing site conditions and proposed construction; and describe the performed investigation. These are followed by a discussion of the findings and our geotechnical recommendations for the design and construction of the building addition.

2.0 SCOPE OF SERVICES

The following services were performed for Lothrop Associates LLP, herein referred to as Client:

- Drilling, sampling, and logging of nine (9) test borings. Two (2) borings were added as a result of encountering shallow refusal on obstructions.
- Field inspection services by a geotechnical engineer to confirm conformance of the investigation to appropriate standards, collect samples for laboratory testing, and prepare logs of the encountered subsurface conditions.
- Laboratory testing of representative soil samples to assist in the evaluation of the engineering properties of the encountered soils and to check field classifications of soils.
- Performance of geotechnical engineering evaluation of the encountered subsurface conditions as they relate to the proposed building addition.
- Preparation of this report presenting the results of the subsurface investigations, laboratory testing, analyses, and our geotechnical recommendations for the design and construction of the proposed building addition.

3.0 SITE AND PROJECT DESCRIPTIONS

The project site, which is the existing Orangetown Town Hall and police department building complex, is located at 26 Orangeburg Road in Orangeburg, New York. This property is located at the northwest corner of Orangeburg Road and Dutch Hill Road, immediately east of the northbound entrance and exit ramps of the Palisades Parkway. The property has two main connected buildings, and asphalt paved driveways/parking areas located on the west and northeast sides of the buildings. The southeastern corner and far eastern end

of the site, as well as areas immediately adjacent to the buildings and within islands of the west parking lot, are landscaped, containing lawn areas, trees and shrubs. The western end of the site is wooded. The southern of the two buildings is a single-story structure that measures roughly 75 by 150 feet, with the long dimension paralleling Orangeburg Road. The northern building is a two-story structure with a basement that has a plan area of about 80 by 170 feet, with the long dimension paralleling Dutch Hill Road. Surface grades across the site are flat to gently sloping, with grades overall sloping down towards the southeast. Based on **review of the drawing entitled “Grading and Drainage Plan, Orangetown Town Hall Additions and Alterations”** revision dated March 3, 2021, by Tectonic, the existing two-story building has a finish floor elevation of +219.56 feet, and the basement has a floor elevation of approximately +211.23 feet. Grades around the site range from a high of about +222 feet within the wooded area at the west, to a low elevation of about +208 feet at the southeast.

We understand that the proposed project is to consist of the demolition of the existing single-story building and the construction of an addition on the west side of the three-story building, along with the construction of a parking lot within the landscaped area along the east end of the site. Based on the previously referenced grading and drainage plan, existing grades within the area of the proposed addition, which spans from the sidewalk and landscaped areas immediately fronting the building to the paved driveway and parking to the west, generally range from about +217 feet to +219 feet. Based on review of the undated architectural drawings, prepared by Lothrop Associates LLP, we understand that the addition will be a three-story structure having a length of about 220 feet and a width of about 78 feet, with the long dimension adjoining the existing building. The building will not have a basement. The approximate finish floor elevation of the proposed building is reportedly +219.56 feet. Structural loading estimates were not provided at the time of this report.

4.0 SUBSURFACE INVESTIGATION

The subsurface investigation consisted of the performance of nine test borings, with two being added after encountering shallow refusal on apparent cobbles or boulders. The borings were designated as B-1 through B-7, with the added borings, which were located several feet from the original boring, being given a letter suffix. These are borings B-1a and B-5a. The locations of the borings are shown on the attached Boring Location Plan, Figure 1.

The test borings were performed between the dates of August 12 and 14, 2020, by Craig Test Boring Company Inc. using a CME 55LC ATV mounted drill rig equipped with an automatic hammer. The borings were advanced to depths ranging from 4 to 32 feet using a tricone drill bit and mud-rotary drilling techniques. Four-inch nominal driven steel casing was installed to depths ranging from 6 to 20 feet to further stabilize the boring sidewalls. Standard Penetration Testing was typically conducted continuously to a depth of 12 feet and at 5-foot maximum intervals thereafter.

The test borings were performed under the full-time observation of a geotechnical engineer. The engineer observed that the investigation was performed in accordance with the appropriate standards and prepared logs of the encountered subsurface conditions. Logs of the test borings are attached in Appendix I.

5.0 LABORATORY TESTING

Laboratory testing was conducted on selected samples to evaluate field identification of soil samples and assist in identifying the **soil's engineering properties**. The **laboratory testing** consisted of the performance of six gradation analyses performed in accordance with ASTM D6913. The results of the laboratory testing are provided in Appendix II and discussed in Section 6.

6.0 SUBSURFACE CONDITIONS

The encountered subsurface conditions generally consist, in turn, of a thin layer of fill; apparent glacial till soils; and highly decomposed bedrock. It is noted that the soils characterized as glacial till could also be residual soils, those resulting from the complete decomposition of the underlying bedrock. Sedimentary rock of the Brunswick formation can be locally seen in outcrop in the general area.

The fill, which was encountered to depths up to approximately 2 feet at most of the boring locations, commonly consists of brown or gray-brown silty sand with minor amounts of gravel. The fill is overlain by a variable 3 to 6-inch thick layer of asphalt pavement at borings performed within the driveway and parking lots, and a several inch thick layer of topsoil within landscaped areas.

The native soils most commonly consist of silty, red-brown, coarse to fine sand with varying amounts of gravel. The presence of larger materials, such as cobbles and possibly boulders, is indicated by the encountering of casing refusal at borings B-1 and B-5. Occasionally, the native soils consist of silty medium

to fine sand with varying amounts of gravel, or silt with lesser amounts of sand and gravel. SPT N-values within the native soils generally indicate that they are in a medium dense state to depths varying from about 6 to 10 feet, and a dense to very dense state at greater depths, with split-spoon sampler refusal commonly being encountered at depths ranging from about 16.5 to 20 feet. Split-spoon sampler refusal is defined as over 50 blows of the 140-pound hammer with less than 6 inches of sampler penetration, and it is an indicator of transition into highly weathered sandstone bedrock. All of the deeper borings were terminated within these very dense materials.

Due to the introduction of water during mud-rotary drilling and the relatively low permeability of the site soils, groundwater levels could not be reliably measured while and immediately upon completion of drilling. Boring B-6 was left open during the duration of the investigation after having pumped the drilling fluids to a depth of 18.8 feet. Water rose in the hole to an elevation of 11.5 feet over the next day, indicating that this is the likely groundwater depth at the end of the investigation. This corresponds to a groundwater elevation of about +205.5 feet. It is also noted that in general, split-spoon soil samples were generally moist in the 10 to 12-foot sample, and wet in the 12 to 15 feet sample. This generally further suggests that groundwater at the other boring locations was at a similar depth over the duration of the investigation.

It should be noted that groundwater levels will vary with season, weather and other factors. Consequently, groundwater should be anticipated to be encountered at other depths at other times.

7.0 SEISMIC SITE COEFFICIENTS AND LIQUEFACTION POTENTIAL

Based on the results of the test borings, the site falls under Seismic Site Class C. The corresponding maximum spectral response accelerations at short periods (S_{MS}) is equal to 0.388g and at a 1-second period (S_{M1}) is equal to 0.092g.

Due to the dense nature of the site soils below the water table, the site soils is not subject to liquefaction during the design earthquake event.

8.0 DISCUSSION & CONCLUSIONS

The following bulleted items discuss the geotechnical considerations regarding the design and construction of the proposed addition to the town hall building. The discussion is based on the findings of the investigation described in Section 6, and our understanding of the proposed site development described in Section 3.

- The subgrade soils at the anticipated minimum foundation bearing depths are anticipated to range from medium dense to dense glacial till soils suitable for the support of spread footings and continuous wall foundations. Some fill may also be encountered at the proposed foundation subgrades. The existing fill should be removed to suitable native soil materials.
- Since the proposed building does not have a basement, proposed foundations are anticipated to bear approximately 8 feet above the foundations of the existing building. In order to avoid loading the existing foundations, the proposed foundations will need to be gradually stepped up from the basement bearing elevation at a 1H:1V slope, or the basement wall bounding the transition will need to be designed to resist surcharge loads resulting from shallow bearing foundations.
- As groundwater was measured at an elevation of approximately +205.5 feet, and the new building is proposed to be at an elevation +219.5 feet, groundwater is not anticipated to impact both building design and construction.
- The glacial till and highly decomposed sedimentary bedrock should be assumed to contain oversized materials. Apparent cobbles resulted in casing refusal at shallow depths at borings B-1 and B-5.
- Because of their high fines contents, the glacial till soils and underling highly decomposed bedrock are not suitable for use as structural fill. Also, these materials should be considered moderately to highly frost susceptible. Design measures to minimize the frost heave of pavements and slabs should be implemented. This includes extending free draining base fills to greater depths to provide partial frost protection and minimizing access of surface water beneath these structures.
- The on-site soils are not subject to liquefaction during the design earthquake event.

9.0 RECOMMENDATIONS

The following sections provide recommendations for the design of the proposed building foundations. The recommendations are based on the results of the subsurface investigation presented in this report and our experience working in similar site conditions.

9.1 Foundations

The proposed building addition can be supported on continuous wall footings and spread footings bearing on undisturbed medium dense to dense native soils, or compacted structural fill placed over these materials. We recommend that all foundations be designed for a net allowable bearing pressure of 2 tons per square foot. Based on the anticipated building loads, this bearing pressure is anticipated to result in reasonably sized foundations. Subgrade preparation recommendations are provided in Section 10.

Continuous wall footings be designed with a minimum width of 2 feet and spread footings should have a minimal width of 3 feet. Exterior footings should bear at least 3.5 feet below the adjacent outside grade for frost protection. Interior foundations should bear at least 1.5 feet below the finished floor slab elevation within heated sections of the building. Stepped foundations should be stepped such that the rise over run does not exceed 1H:1V. Using the above design criteria, total settlement is estimated to be less than 1.0 inch and differential settlements are estimated to be less than 0.5 inches. The differential settlement is estimated over a distance of about 30 feet along continuous footings, or between adjacent column footings.

9.2 Building and Temporary Retaining Walls

Building and retaining walls should be backfilled with non-expansive, free draining soil. Imported structural fill, as defined in Section 10, should be used within these zones. Foundation and temporary retaining walls can be designed in accordance with the following criteria:

<u>Soil Parameter</u>	<u>Select Fill Backfill & Medium Dense Native Soil⁴</u>	<u>Dense to Very Dense Native Soil/Decomposed Bedrock⁴</u>
Angle of internal Friction	34°	38°
Active earth pressure Coefficient (K_a) ⁽¹⁾	0.28	0.24
At rest earth pressure Coefficient (K_o) ⁽²⁾ (restrained wall)	0.44	0.38
Passive earth pressure Coefficient (K_p) ⁽³⁾	3.54	4.2
Total unit weight of soil (pounds per cubic foot)	125	130

- 1) Use for free standing walls where movement of up to $0.0025 \times$ height of wall is both possible and tolerable. Otherwise, use at-rest coefficient.
- 2) Use for walls restrained against outward lateral movement.
- 3) Passive resistance should be within the zone of frost penetration (3.5 feet).
- 4) Medium dense soils can be taken as those having SPT N-values between 10 and 30 blows per foot (bpf), while dense to very dense soils can be taken as those having SPT N-values greater than 30 bpf.

Concrete foundations cast directly against the native on-site soils or fill can be assumed to have a coefficient of sliding resistance of 0.34.

Additional loading due to temporary and permanent surcharges, such as earthquake, automobiles and construction traffic, and building foundations falling in close proximity to the basement walls should be added to the lateral loading exerted by the backfill. Loads due to supported structures should be applied in appropriate combinations with the lateral loads.

Damproofing should be provided for all foundation walls where the outside grade is higher than the slab elevation. All retaining walls and any foundation walls where the slab resides at a lower elevation than the outside grade should include foundation drainage consisting of a minimum 12-inch wide drainage layer of crushed stone or clean gravel placed against the full-height of the wall with a collector pipe at the footing bottom draining by gravity to a suitable outlet. The gradation specification for the drainage material is provided in Section 10 as **“free draining crushed stone.”** The stone or gravel should be completely separated from the soil backfill by a permeable geotextile having an apparent opening size (AOS) of U.S. Sieve Nos. 70 to 100, **such as TenCate’s Mirafi 140N.** Grading of the surface of the backfill and the surrounding topography and pavements should provide positive drainage away from the walls. Roof drains should be positively drained to areas away from the building.

9.3 Slabs-on-Grade

Slab-on-grade floors should be supported on a minimum 6-inch thick layer of free draining $\frac{1}{2}$ to $\frac{3}{4}$ inch crushed stone placed over a proof-rolled and approved subgrade consisting of native soil, or a structural fill subgrade. Remedial removals of unsuitable materials such as topsoil, or loose upper

soils will likely be required within the footprint of the proposed building. Subgrade preparation and structural fill material and placement recommendations are provided in Section 10 of this report.

A vapor barrier consisting of a polyethylene membrane at least 20 mils thick, such as Stego® Wrap Vapor Barrier, should be placed beneath all moisture-sensitive floor slabs. A coefficient of friction of 0.3 should be used between the slab and the vapor barrier. If concrete is cast directly against compacted structural fill, a coefficient of friction of 0.45 can be used.

For design of slab-on-grade floors with a 6 inch crushed stone base, a modulus of subgrade reaction of 150 pounds per cubic inch (pci) is recommended when bearing on fill, native soils, or compacted structural fill. The modulus of subgrade reaction is suitable for estimating distributions of bearing pressure beneath the slab and for estimating bending moments and shears within the slab. It is not intended for the purpose of calculating total or differential settlements.

10.0 CONSTRUCTION RECOMMENDATIONS

The following sections provide our general site and building construction recommendations.

10.1 General Site Preparation

Topsoil, stumps, roots greater than 1/2-inch in diameter, pavement, sidewalks, catch basins, drain pipes and other structures should be removed. Topsoil removed from the stripping operation may be stockpiled and **processed (if necessary) to meet the site civil engineer's and/or landscape architect's** specifications for topsoil to be placed around the site. All debris and unsuitable materials removed from the site should be disposed of at a legal disposal facility. Existing utilities within the project limits, if any, should be re-routed or protected from damage by construction equipment. Site clearing should extend a minimum 10 feet **beyond the proposed building's footprint.**

10.2 Subgrade Preparations

The subgrades should consist of undisturbed, firm, and stable fill or glacial till, or imported structural fill placed over an undisturbed native subgrade.

Foundation subgrades should be prepared by removing all soil loosened by machine excavation. Fill, floor and pavement subgrades may be prepared by recompactng loosened materials. The foundation subgrades, slab-on-grade subgrades, pavement subgrades, and any areas to receive fill should be proofrolled under the observation of the geotechnical engineer. Proofrolling in confined areas should be performed with a double-drum vibratory roller having a minimum static weight of 1.5 tons. Proofrolling in open areas should be performed with a static roller having a minimum weight of 10 tons, or by a fully-loaded 10-wheeled dump truck. Soils not meeting the recommended requirements for suitable bearing materials, all existing fill, or areas found to be soft and yielding during proofrolling, should be removed. The area of removal should be within the zone of influence of the foundations, which is defined as zone contained within imaginary planes sloping downward and outward from the bottom edges of the foundation at a slope of 1 horizontal to 1 vertical. When unsuitable material is encountered beneath slabs or pavement, the area of removal should span the entire soft, yielding area beneath the slab or pavement. Over-excavated areas should be re-established with compacted fill.

10.3 Protection of Subgrades and Temporary Dewatering

The glacial till soils at the site will become readily disturbed when exposed to moisture. Subgrades should be protected from the effects of frost, construction traffic, groundwater, and surface water. The necessary protection should be provided immediately subsequent to excavation and be maintained until placing fill or concrete. Temporary surface drainage measures are recommended to divert runoff away from the proposed construction limits.

If maintaining subgrade stabilization during periods of wet weather is a concern, crushed stone may be placed on footing subgrades after excavation, proofrolling and subgrade approved by the geotechnical engineer. The crushed stone should be clean 3/4-inch gravel and not exceed 6 inches in thickness. The crushed stone should be compacted after placement to create a level bearing **surface and to “seal” the subgrade.**

It is not expected that significant dewatering will be required at this site, but if necessary, it should be performed in a manner that will prevent loosening or migration of the subgrade soils and performed to maintain the water level at least 1-foot below the deepest excavation. Given the dense nature and high

finer content of the on-site soils, it is anticipated that sump pits and pumps may be suitable for dewatering. The operation of sumps directly in the footing excavations should not be allowed. Sump pits should be placed at least 1-foot outside of foundation excavations for every foot below the foundation subgrade elevation that they are excavated. The dewatering system should be designed by a New York State Licensed Professional Engineer, and it should be designed to ensure that dewatering does not result in any loss of soil.

10.4 General Excavation

All excavations should conform to the latest OSHA requirement regarding worker safety. The soils will vary from having OSHA designation Class B and C soils.

The results of our subsurface investigation indicate that the required on-site excavations should be feasible with normal heavy-duty earthmoving equipment in good working order. However, larger boulders may be encountered that require excavator mounted hydraulic hammer to fracture. Also, and as noted, weathered bedrock requiring excavator mounted hydraulic hammers to fracture may also be encountered in deeper excavations.

10.5 Fill and Backfill Materials

Structural fill shall consist of sand, gravel, crushed stone, crushed gravel, or a mixture of these, it shall contain no organic matter, and it shall conform to the following gradation:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
3 inch	100
¾ inch	30-70
No. 40	5-40
No. 200	0-10

Based on the results of our subsurface investigation and laboratory testing, the majority of the on-site soils are not suitable for use as structural fill as all but isolated layers have excessive fines (soil passing the No. 200 sieve).

All fill and backfill should be compacted to at least 95 percent of the maximum dry density, within 2 percent of the optimum moisture content, as determined by ASTM D1557. The lift thickness for the fill soils will vary depending on the type of compaction equipment used. Fills should generally be placed in uniform horizontal lifts not exceeding 12 inches in loose thickness. In confined areas, the loose lift thickness should be 6 inches or less and each lift should be compacted with sufficient passes of hand operated vibratory or impact compaction equipment. A geotechnical engineer with appropriate field and laboratory support should inspect all footing subgrades, approve materials for use as fill, and test backfill materials for compliance with the recommended compaction.

Free draining crushed stone placed below slabs and as drainage materials behind foundation and retaining walls, and within curtain drains and underdrains should meet the specification for Underdrain Filter Type I materials, as specified in the NYSDOT Standard Specifications (Item 733.2001), as follows:

<u>Sieve Size</u>	<u>Percent Finer by Weight</u>
1 inch	100
½ inch	30-100
¼ inch	0 – 30
No. 10	0 – 10
No. 20	0 – 5

In some cases, it may be preferable to place flowable fill as backfill within utility trenches or as a substitute for compacted fill to restore the grade when undercutting unsuitable materials from beneath buildings or other structures. In that case, the flowable fill should have a minimum 28-day unconfined compressive strength of 150 psi and should meet the requirements for Controlled Low Strength Material (CLSM), as specified in Section 733-01 – “**Flowable Fill**” of the NYSDOT Standard Specifications.

11.0 CONSTRUCTION MONITORING

A geotechnical engineer familiar with the existing subsurface conditions and having the appropriate laboratory and field-testing support should be engaged by the owner to observe that all earthwork is performed in accordance with the specifications, the Code, and the design criteria provided in this report.

The following work should be performed under the observation of the geotechnical engineer:

- Placement and compaction of fill
- Foundation subgrade preparation
- Proofrolling of floor, pavement and foundation subgrades
- Temporary dewatering activities

All materials proposed for use as soil fill should be tested and approved prior to delivery or use on-site. All fill materials should be tested as they are being placed to verify that the required compaction is being achieved.

12.0 LIMITATIONS

Our professional services have been performed using the degree of care and skill ordinarily exercised under similar circumstances by reputable geotechnical engineers and geologists practicing in this or similar situations. The interpretation of the field data is based on good judgment and experience. However, no matter how qualified the geotechnical engineer or detailed the investigation, subsurface conditions cannot always be predicted between the points of actual sampling and testing. No other warranty, expressed or implied, is made as to professional advice included in this report.

The recommendations and data contained in this report are intended for design purposes only. The use of this report as a construction document is neither intended nor authorized by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C. (Tectonic). Contractors and others involved in the construction of this project are advised to make an independent assessment of the subsurface conditions for establishing quantities, schedules, and construction techniques.

This report has been prepared for the exclusive use of the Lothrop Associates LLP and their designees for the specific application to the proposed construction described in this report. In the event that any changes in nature, design or location of proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions modified or verified in writing by Tectonic. It is recommended that Tectonic be retained to review the plans and specifications prior to bidding and to provide construction monitoring and inspection services to ensure proper implementation of the recommendations contained herein, which would otherwise limit our professional liability.

FIGURE I



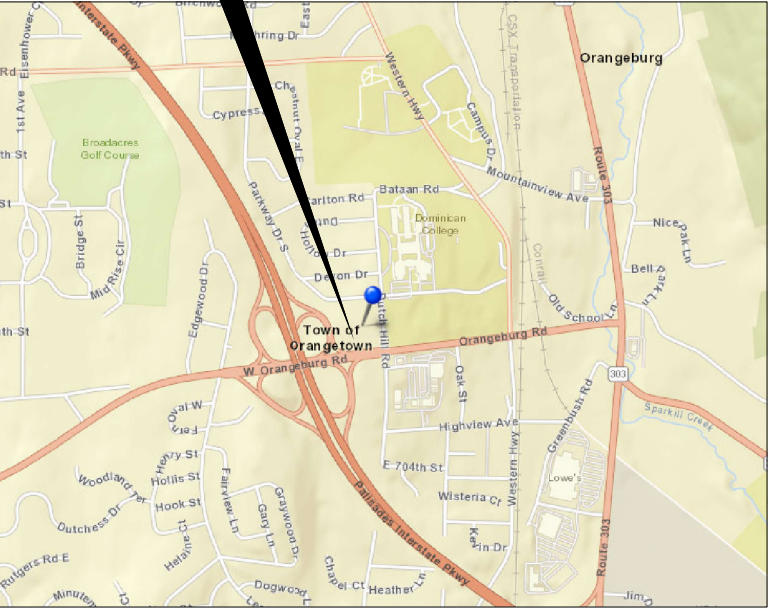
LEGEND

 B-1 APPROXIMATE BORING LOCATION

NOTES

- 1. PLAN BASED ON A SURVEY BY THE TECTONIC.
- 2. BORING LOCATIONS ARE APPROXIMATE.

SITE



TECTONIC

- PLANNING
- ENGINEERING
- SURVEYING
- CONSTRUCTION MANAGEMENT

TECTONIC Engineering & Surveying Consultants P.C. Phone: (845) 567-6656
1279 Route 300 Fax: (845) 567-6248
Newburgh, NY 12550 www.tectonicengineering.com

BORING LOCATION PLAN

ORANGETOWN TOWN HALL EXPANSION
26 ORANGEBURG ROAD
ORANGEBURG, NY 10962

Date	7/30/20	Work Order	10128.01	Drawing No.	1	Rev	0
Scale	1"=30'						

APPENDIX I

PROJECT No. **10128.01**
 PROJECT: **Orangetown Hall Expansion**
 LOCATION: **Orangetown, NY**

BORING No. B-1

SHEET No. 1 of 1

CLIENT: Lothrop Associates LLP			GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory		
CONTRACTOR: Craig Test Borings Co., Inc.							DRILLER: Mark Kier		
METHOD OF ADVANCING BORING	DIA.	DEPTH					SURFACE ELEVATION: 218.0		
POWER AUGER:		TO		MON. WELL	<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO	DATUM: See Remarks		
ROT. DRILL:	3 7/8"	0 TO 4'	SCREEN DEPTH: --- TO ---			DATE START: 8/14/20			
CASING:	4"	0 TO 6'	WEATHER: Clear TEMP: 80° F			DATE FINISH: 8/14/20			
DIAMOND CORE:		TO	DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH (TONS/FT)			
CME 55LC Rubber Track Rig with Automatic Hammer			*CHANGES IN STRATA ARE INFERRED			1 2 3 4 5			

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	STANDARD PENETRATION (BLOWS/FT.)			ELEVATION (FT.)										
			SAMPLE NUMBER	RECOV.		MOISTURE				PLASTIC LIMIT %	WATER CONTENT %	LIQUID LIMIT %											
				LENGTH (IN.)	RQD (%)					✕	⊗	△											
										10	20	30	40	50									
1	42	4	S-1	14		M	SP-SM	0.25' Topsoil like material Bwn m-f SAND, little f Gravel, trace Silt (FILL)															
2		17																					
3	44	12	S-2	18		M	SM									Rd-bwn c-f SAND, some Silt, little c-f Gravel							
4		19																					
5	17	6	S-3	12		M	SM	Rd-bwn c-f SAND, and Silt, trace f Gravel							213.0								
6		8																					
7	33	9	S-4	16		M	SM									Rd-bwn m-f SAND, some Silt, little f Gravel Casing refusal @ 6'							
8		11																					
9		18						End of Boring at 8'															
10		17																					
11		25																					
12		41																					
13																							
14																							
15																							
16																							
17																							
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22																							
23																							
24																							
25																							

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.



PROJECT No. **10128.01**
PROJECT: **Orangetown Hall Expansion**
LOCATION: **Orangetown, NY**

BORING No. B-1A

SHEET No. 1 of 2

CLIENT: Lothrop Associates LLP				GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory			
CONTRACTOR: Craig Test Borings Co., Inc.								DRILLER: Mark Kier			
METHOD OF ADVANCING BORING	DIA.	DEPTH						SURFACE ELEVATION: 218.0			
POWER AUGER:		TO			MON. WELL	<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		DATUM: See Remarks			
ROT. DRILL:	3 7/8"	0	TO 30'	SCREEN DEPTH: --- TO ---			DATE START: 8/14/20				
CASING:	4"	0	TO 8'	WEATHER: Clear TEMP: 80° F			DATE FINISH: 8/14/20				
DIAMOND CORE:		TO		DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH ● (TONS/FT)				PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % STANDARD PENETRATION (BLOWS/FT.)
CME 55LC Rubber Track Rig with Automatic Hammer				*CHANGES IN STRATA ARE INFERRED			1	2	3	4	

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES			UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	PLASTIC LIMIT %			WATER CONTENT %			LIQUID LIMIT %			ELEVATION (FT.)
			SAMPLE NUMBER	RECOV.					MOISTURE	X	10	20	30	X	40	50	△	
				LENGTH (IN.)	RQD (%)													
STANDARD PENETRATION (BLOWS/FT.)																		
10 20 30 40 50																		
1							Advanced boring to 8' - No sampling											
2																		
3																		
4																		
5																		213.0
6																		
7																		
8																		
9	33	15 16 17	S-1	0		M	SM	No Recovery, 3" Spoon advanced Rd-bwn c-f SAND, and Silt, little c-f Gravel										
10		14																208.0
11	50+	35 50/4	S-2	10		M	SM	Same										
12																		
13																		
14																		
15																	203.0	
16	17	10 9 8 9	S-3	8		W	SM	Rd-bwn c-f SAND, some f Gravel, some Silt										
17																		
18																		
19																		
20																	198.0	
21	49	10 22 27 20	S-4	10		W	GM	Rd-bwn c-f GRAVEL, some m-f Sand, some Silt										
22																		
23																		
24																		
25																	193.0	

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.

CLIENT: **Lothrop Associates LLP**

CONTRACTOR: **Craig Test Borings Co., Inc.**

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	UNCONFINED COMPRESS. STRENGTH (TONS/FT.)					ELEVATION (FT.)
			SAMPLE NUMBER	RECOV.		MOISTURE				PLASTIC LIMIT %	WATER CONTENT %	LIQUID LIMIT %			
				LENGTH (IN.)	RQD (%)										
26	82	33 42 40 50/5	S-5	18		W	SM	Rd-bwn c-f SAND, some Silt, little f Gravel				82			
27															
28															
29															
30													188.0		
31	100+	50 50 50/1	S-6	20		W	SM	Same					100		
32															
33								End of Boring at 32'							
34															
35													183.0		
36															
37															
38															
39															
40													178.0		
41															
42															
43															
44															
45													173.0		
46															
47															
48															
49															
50													168.0		
51															
52															
53															
54															
55													163.0		

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.

CLIENT: Lothrop Associates LLP				GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory				
CONTRACTOR: Craig Test Borings Co., Inc.								DRILLER: Mark Kier				
METHOD OF ADVANCING BORING		DIA.	DEPTH					SURFACE ELEVATION: 218.0				
POWER AUGER:			TO		MON. WELL <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			DATUM: See Remarks				
ROT. DRILL:		3 7/8"	0	TO	30'	SCREEN DEPTH: --- TO ---			DATE START: 8/14/20			
CASING:		4"	0	TO	8'	WEATHER: Overcast TEMP: 75° F			DATE FINISH: 8/14/20			
DIAMOND CORE:			TO		DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH ● (TONS/FT)				PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % STANDARD PENETRATION (BLOWS/FT.)
CME 55LC Rubber Track Rig with Automatic Hammer					*CHANGES IN STRATA ARE INFERRED			1	2	3	4	

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BLU/6 IN.)	SAMPLES			UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	ELEVATION (FT.)		
			SAMPLE NUMBER	RECOV. LENGTH (IN.)	RQD (%)						
1	19	4	S-1	12		M	GM				
2		9									
3	18	10	S-2	16		M	SM				
4		12									
5	18	13	S-3	11		M	SM				
6		9									
7	40	9	S-4	17		M	SM				
8		8									
9	10	8	S-5	7		M	SM				
10		10									
11	68	14	S-6	13		M	SM				
12		17									
13		23	S-7	8		M	SM				
14		14									
15		3	S-8	10		W	SM				
16	100+	4									
17		6									
18		7									
19		12									
20		20									
21	65+	48									
22		35									
23		30									
24		50									
25		50/5									

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.



PROJECT No. **10128.01**
PROJECT: **Orangetown Hall Expansion**
LOCATION: **Orangetown, NY**

BORING No. B-2

SHEET No. 2 of 2

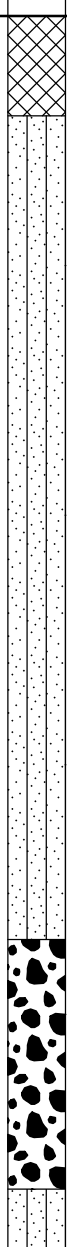
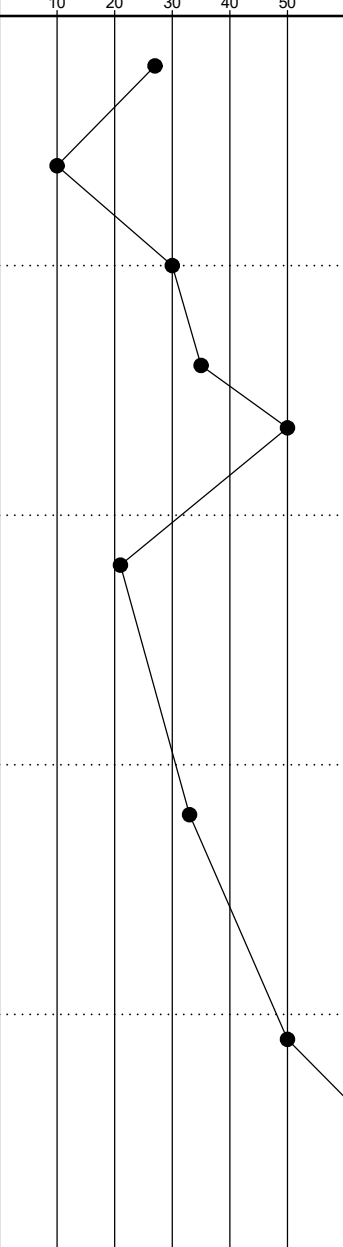
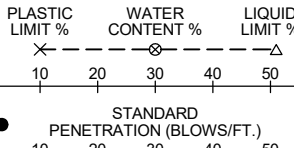
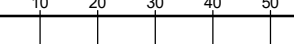
CLIENT: **Lothrop Associates LLP**

CONTRACTOR: **Craig Test Borings Co., Inc.**

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	UNCONFINED COMPRESS. STRENGTH (TONS/FT.)					ELEVATION (FT.)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.


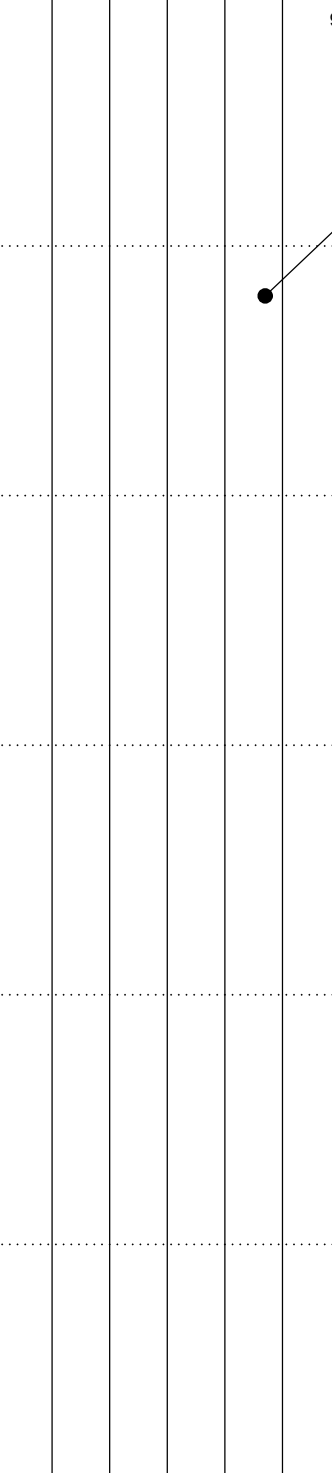

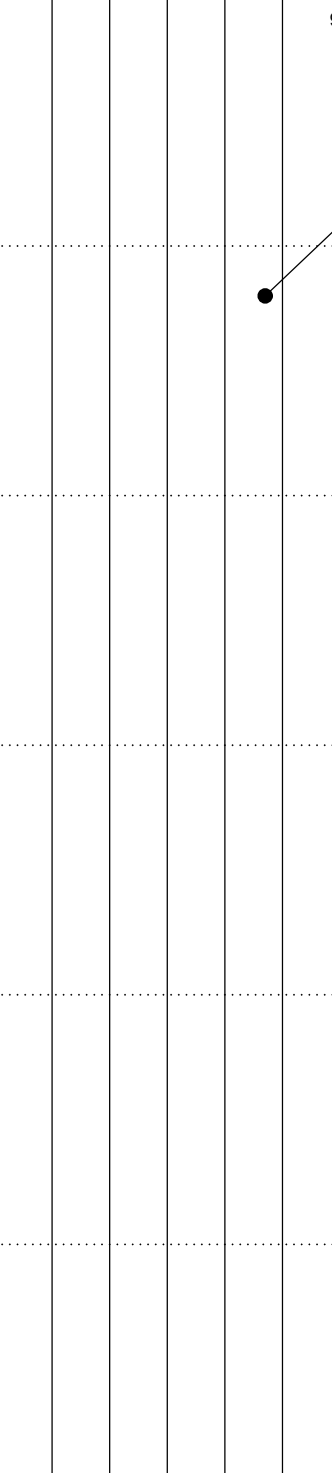
CLIENT: Lothrop Associates LLP				GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory				
CONTRACTOR: Craig Test Borings Co., Inc.								DRILLER: Mark Kier				
METHOD OF ADVANCING BORING		DIA.	DEPTH					SURFACE ELEVATION: 218.5				
POWER AUGER:			TO		MON. WELL <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			DATUM: See Remarks				
ROT. DRILL:		3 7/8"	0	TO 30'		SCREEN DEPTH: --- TO ---			DATE START: 8/13/20			
CASING:		4"	0	TO 8'		WEATHER: Overcast TEMP: 80° F			DATE FINISH: 8/13/20			
DIAMOND CORE:			TO		DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH ● (TONS/FT)				
CME 55LC Rubber Track Rig with Automatic Hammer					*CHANGES IN STRATA ARE INFERRED			1 2 3 4 5				

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BLU/6 IN.)	SAMPLES			UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	ELEVATION (FT.)		
			SAMPLE NUMBER	RECOV. LENGTH (IN.)	RQD (%)						
1	27	9 15 12	S-1	14		M	SM				
2		8									
3	10	5 5 5	S-2	12		M	SM				
4		7									
5	30	11 12 18 19	S-3	8		M	SM				
6											
7	35	23 15 20 22	S-4	12		M	SM				
8	50+	50/5	S-5	6		M	SM				
9											
10											
11	21	24 11 10 10	S-6	6		M	SM				
12											
13											
14											
15											
16	33	8 13 20 29	S-7	18		W	SM				
17											
18											
19											
20											
21	50+	37 50/4	S-8	2		W	GP				
22											
23											
24											
25											

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.

CLIENT: **Lothrop Associates LLP**

CONTRACTOR: **Craig Test Borings Co., Inc.**

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	UNCONFINED COMPRESS. STRENGTH (TONS/FT.)			ELEVATION (FT.)
			SAMPLE NUMBER	RECOV.		MOISTURE				PLASTIC LIMIT %	WATER CONTENT %	LIQUID LIMIT %	
				LENGTH (IN.)	RQD (%)								
26	95+	34 45 50/3	S-9	18		W	SM			95			
27													
28													
29													
30										188.5			
31	47	24 23 24 32	S-10	20		W	ML						
32													
33													
34													
35											183.5		
36													
37													
38													
39													
40											178.5		
41													
42													
43													
44													
45											173.5		
46													
47													
48													
49													
50											168.5		
51													
52													
53													
54													
55										163.5			

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.



PROJECT No. **10128.01**
PROJECT: **Orangetown Hall Expansion**
LOCATION: **Orangetown, NY**

BORING No. B-4

SHEET No. 1 of 2


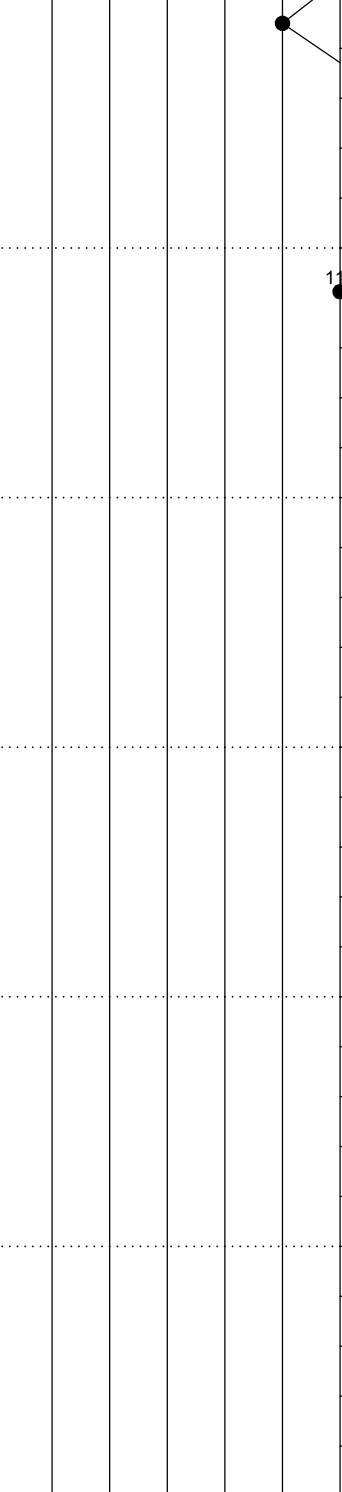
CLIENT: Lothrop Associates LLP				GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory				
CONTRACTOR: Craig Test Borings Co., Inc.								DRILLER: Mark Kier				
METHOD OF ADVANCING BORING		DIA.	DEPTH					SURFACE ELEVATION: 218.5				
POWER AUGER:			TO		MON. WELL <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			DATUM: See Remarks				
ROT. DRILL:		3 7/8"	0	TO	30'	SCREEN DEPTH: --- TO ---			DATE START: 8/13/20			
CASING:		4"	0	TO	8'	WEATHER: Overcast TEMP: 80° F			DATE FINISH: 8/13/20			
DIAMOND CORE:			TO		DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH ● (TONS/FT)				PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % STANDARD PENETRATION (BLOWS/FT.)
CME 55LC Rubber Track Rig with Automatic Hammer					*CHANGES IN STRATA ARE INFERRED			1	2	3	4	

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BLU/6 IN.)	SAMPLES			UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	ELEVATION (FT.)		
			SAMPLE NUMBER	RECOV. LENGTH (IN.)	RQD (%)						
1	23	29	S-1	10		M	SM				
2		11									
3	20	18	S-2	12		M	SM				
4		20									
5	31	11	S-3	8		M	SM				
6		9									
7	24	15	S-4	6		M	SM				
8		8									
9	32	12	S-5	16		M	SM				
10		19									
11	69	26	S-6	12		M	SM				
12		30									
13		34									
14		43									
15		26									
16	60	26									
17		15	S-7	18		W	SM				
18		27									
19		33									
20		50/4									
21	103+	15	S-8	12		W	SM				
22		53									
23		50/3									
24											
25											

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.

CLIENT: **Lothrop Associates LLP**

CONTRACTOR: **Craig Test Borings Co., Inc.**

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	UNCONFINED COMPRESS. STRENGTH (TONS/FT.)			ELEVATION (FT.)
			SAMPLE NUMBER	RECOV.		PLASTIC LIMIT %				WATER CONTENT %	LIQUID LIMIT %		
				LENGTH (IN.)	RQD (%)								
26	50+	60 50/3	S-9	8		W	SM						
27													
28													
29													
30											188.5		
31	118	44 56 62 50/3	S-10	8		W	GM				118		
32													
33													
34													
35											183.5		
36													
37													
38													
39													
40											178.5		
41													
42													
43													
44													
45											173.5		
46													
47													
48													
49													
50											168.5		
51													
52													
53													
54													
55											163.5		

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.



PROJECT No. **10128.01**
PROJECT: **Orangetown Hall Expansion**
LOCATION: **Orangetown, NY**

BORING No. B-5

SHEET No. 1 of 1

CLIENT: Lothrop Associates LLP			GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory	
CONTRACTOR: Craig Test Borings Co., Inc.							DRILLER: Mark Kier	
METHOD OF ADVANCING BORING	DIA.	DEPTH					SURFACE ELEVATION: 218.0	
POWER AUGER:		TO		MON. WELL <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			DATUM: See Remarks	
ROT. DRILL:	3 7/8"	0 TO	SCREEN DEPTH: --- TO ---			DATE START: 8/12/20		
CASING:	4"	0 TO 4'	WEATHER: Overcast TEMP: 80° F			DATE FINISH: 8/12/20		
DIAMOND CORE:		TO	DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH ● (TONS/FT)		ELEVATION (FT.)
CME 55LC Rubber Track Rig with Automatic Hammer			*CHANGES IN STRATA ARE INFERRED			1 2 3 4 5		

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BLU/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	STANDARD PENETRATION (BLOWS/FT.)					ELEVATION (FT.)
			SAMPLE NUMBER	RECOV. LENGTH (IN.)	RQD (%)	MOISTURE									
1	12	8	S-1	12		M	SM	0.5' Asphalt Rd-bwn m-f SAND, some f Gravel, some Silt (FILL)		●					
2		4													
3	11	4													
4		7	S-2	3		M	SM	Rd-bwn m-f SAND, and Silt, some c-f Gravel		●					
		10													
5								End of Boring at 4'							213.0
6															
7															
8															
9															
10															208.0
11															
12															
13															
14															
15															203.0
16															
17															
18															
19															
20															198.0
21															
22															
23															
24															
25															193.0

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.



PROJECT No. **10128.01**
PROJECT: **Orangetown Hall Expansion**
LOCATION: **Orangetown, NY**

BORING No. B-5A

SHEET No. 1 of 2

CLIENT: Lothrop Associates LLP				GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory			
CONTRACTOR: Craig Test Borings Co., Inc.								DRILLER: Mark Kier			
METHOD OF ADVANCING BORING	DIA.	DEPTH						SURFACE ELEVATION: 218.0			
POWER AUGER:		TO			MON. WELL <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			DATUM: See Remarks			
ROT. DRILL:	3 7/8"	0	TO 30'	SCREEN DEPTH: --- TO ---			DATE START: 8/12/20				
CASING:	4"	0	TO 20'	WEATHER: Overcast TEMP: 80° F			DATE FINISH: 8/12/20				
DIAMOND CORE:		TO		DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH (TONS/FT)				
CME 55LC Rubber Track Rig with Automatic Hammer				*CHANGES IN STRATA ARE INFERRED			1 2 3 4 5				

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES			UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	<div>UNCONFINED COMPRESS. STRENGTH (TONS/FT) ● 1 2 3 4 5 PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % X --- ⊗ --- Δ 10 20 30 40 50 STANDARD PENETRATION (BLOWS/FT.) ● 10 20 30 40 50</div>					ELEVATION (FT.)
			SAMPLE NUMBER	RECOV. LENGTH (IN.)	RQD (%)									
1							No Sampling to 4'							
2														
3														
4														
5	16	10 7 9	S-1	12		M	Rd-bwn c-f SAND, some Silt, little f Gravel							213.0
6		8 12 16 19	S-2	29		M	Rd-bwn c-f SAND, some Silt, little c-f Gravel							
7	28													
8		15 25 33 40	S-3	18		M	Rd-bwn c-f SAND, some Silt, little f Gravel							
9	58													
10		60 45 50/4	S-4	16		M	Same							208.0
11	95+													95
12														
13														
14														
15														203.0
16	76+	16 26 50/5	S-5	12		W	Rd-bwn SILT, some c-f Sand, trace f Gravel							76
17														
18														
19														
20														
21	50+	42 50/2	S-6	4		W	Rd-bwn m-f SAND, some Silt, little c-f Gravel							198.0
22														
23														
24														
25														193.0

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.



PROJECT No. **10128.01**
PROJECT: **Orangetown Hall Expansion**
LOCATION: **Orangetown, NY**

BORING No. B-6

SHEET No. 1 of 2

CLIENT: Lothrop Associates LLP				GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory				
CONTRACTOR: Craig Test Borings Co., Inc.					8/13/20	11:30 AM	18.8'	DRILLER: Mark Kier				
METHOD OF ADVANCING BORING		DIA.	DEPTH		8/14/20	10:30 AM	11.5'	SURFACE ELEVATION: 217.0				
POWER AUGER:			TO		MON. WELL <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			DATUM: See Remarks				
ROT. DRILL:		3 7/8"	0	TO 30'	SCREEN DEPTH: --- TO ---			DATE START: 8/12/20				
CASING:		4"	0	TO 20'	WEATHER: Overcast TEMP: 80° F			DATE FINISH: 8/12/20				
DIAMOND CORE:			TO		DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH ● (TONS/FT)			F.T.)	
CME 55LC Rubber Track Rig with Automatic Hammer					*CHANGES IN STRATA ARE INFERRED			1	2	3		4

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	PLASTIC LIMIT %	WATER CONTENT %	LIQUID LIMIT %	ELEVATION (FT.)	
			SAMPLE NUMBER	RECOV.		MOISTURE				×	⊗	△		
				LENGTH (IN.)	RQD (%)					10	20	30		40
											STANDARD PENETRATION (BLOWS/FT.)			
										●				
1	15	269	S-1	16		M	SM	3" Topsoil Bwn m-f SAND, some Silt, trace f Gravel (FILL)		15	25	45		
2		148								18	28	48		
3	18	899	S-2	18		M	SM	Rd-bwn c-f SAND, and Silt, little c-f Gravel		20	30	50		
4		176								22	32	52		
5	14	868	S-3	18		M	SM	Rd-bwn m-f SAND, and Silt, little f Gravel		25	35	55	212.0	
6		468								28	38	58		
7	16	610	S-4	12		M	SM	Rd-bwn c-f SAND, some c-f Gravel, some Silt		30	40	60		
8		1610								35	45	65		
9	43	1014	S-5	10		M	SM	Rd-bwn m-f SAND, and Silt, little c-f Gravel		40	50	70	207.0	
10		1729								45	55	75		
11	44	2222	S-6	16		M	SM	Rd-bwn c-f SAND, some c-f Gravel, some Silt		50	60	80		
12		48								55	65	85		
13										60	70	90		
14										65	75	95		
15										70	80	100	202.0	
16	40	2212	S-7	14		W	SM	Rd-bwn c-f SAND, and Silt, little f Gravel		75	85	105		
17		2830								80	90	110		
18										85	95	115		
19										90	100	120		
20										95	105	125	197.0	
21	50+	3750/5	S-8	12		W	SM	Rd-bwn m-f SAND, and Silt, little f Gravel		100	110	130		
22										105	115	135		
23										110	120	140		
24										115	125	145		
25										120	130	150	192.0	

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic.



PROJECT No. **10128.01**
PROJECT: **Orangetown Hall Expansion**
LOCATION: **Orangetown, NY**

BORING No. B-6

SHEET No. 2 of 2

CLIENT: **Lothrop Associates LLP**

CONTRACTOR: **Craig Test Borings Co., Inc.**

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	UNCONFINED COMPRESS. STRENGTH (TONS/FT.)					ELEVATION (FT.)
			SAMPLE NUMBER	RECOV.		MOISTURE				PLASTIC LIMIT %	WATER CONTENT %	LIQUID LIMIT %			
				LENGTH (IN.)	RQD (%)										
26	50+	48 50/4	S-9	10		W	SM	Same							
27															
28															
29															
30	50+	50/5	S-10	6		W	SM	Rd-bwn c-f SAND, and Silt, some f Gravel						187.0	
31								End of Boring at 32'							
32															
33															
34															
35															
36															
37															
38															
39															
40															
41															
42															
43															
44															
45															
46															
47															
48															
49															
50															
51															
52															
53															
54															
55															

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic.

CLIENT: Lothrop Associates LLP				GROUND WATER	DATE	TIME	DEPTH	INSPECTOR: Paul Gregory				
CONTRACTOR: Craig Test Borings Co., Inc.								DRILLER: Mark Kier				
METHOD OF ADVANCING BORING		DIA.	DEPTH					SURFACE ELEVATION: 218.0				
POWER AUGER:			TO		MON. WELL <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO			DATUM: See Remarks				
ROT. DRILL:		3 7/8"	0	TO	30'	SCREEN DEPTH: --- TO ---			DATE START: 8/12/20			
CASING:		4"	0	TO	20'	WEATHER: Overcast TEMP: 80° F			DATE FINISH: 8/12/20			
DIAMOND CORE:			TO		DEPTH TO ROCK: Not Encountered'			UNCONFINED COMPRESS. STRENGTH ● (TONS/FT)				PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT %
CME 55LC Rubber Track Rig with Automatic Hammer					*CHANGES IN STRATA ARE INFERRED			1	2	3	4	

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	STANDARD PENETRATION (BLOWS/FT.)			ELEVATION (FT.)		
			SAMPLE NUMBER	RECOV.		MOISTURE				PLASTIC LIMIT %	WATER CONTENT %	LIQUID LIMIT %			
				LENGTH (IN.)	RQD (%)					X	⊗	△			
										10	20	30	40	50	
1	13	5	S-1	12		M	SM	6" Asphalt Rd-bwn m-f SAND, some c-f Gravel, some Silt (apparent FILL)							
2		5													
3	24	10	S-2	12		M	SM	Same							
4		12													
5	18	7	S-3	18		M	SM	Rd-bwn c-f SAND, and Silt, little c-f Gravel							213.0
6		8													
7	29	10	S-4	18		M	SM	Same							
8		10													
9	48	11	S-5	18		M	SM	Rd-bwn c-f SAND, and Silt, little f Gravel							
10		13													
11	87+	16	S-6	18		M	SM	Rd-bwn c-f SAND, some Silt, some c-f Gravel							87
12		14													
13		21													
14		27													
15		37	S-7	14		M	ML	Rd-bwn SILT, some f Sand, little c-f Gravel							203.0
16	54	50													
17		50/5													
18															
19															
20															
21	50+	42	S-8	10		W	SM	Rd-bwn c-f SAND, and Silt, some f Gravel							198.0
22		50/5													
23															
24															
25															193.0

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.

CLIENT: **Lothrop Associates LLP**

CONTRACTOR: **Craig Test Borings Co., Inc.**

DEPTH (FT.)	N OR MIN./FT.	PENETRATION RESISTANCE (BL/6 IN.)	SAMPLES				UNIFIED SOIL CLASS.	DESCRIPTION OF MATERIAL	LITHOLOGY*	UNCONFINED COMPRESS. STRENGTH (TONS/FT)			ELEVATION (FT.)				
			SAMPLE NUMBER	RECOV.		MOISTURE				PLASTIC LIMIT %	WATER CONTENT %	LIQUID LIMIT %					
				LENGTH (IN.)	RQD (%)												
26	50+	50 50/5	S-9	8		W	SM	Rd-bwn m-f SAND, and Silt, some f Gravel									
27																	
28																	
29																	
30																	
31	50+	37 50/2	S-10	8		W	SM	Rd-bwn m-f SAND, and Silt, little f Gravel					188.0				
32																	
33								End of Boring at 32'									
34																	
35													183.0				
36																	
37																	
38																	
39																	
40													178.0				
41																	
42																	
43																	
44																	
45													173.0				
46																	
47																	
48																	
49																	
50													168.0				
51																	
52																	
53																	
54																	
55													163.0				

REMARKS: Surface elevation estimated from spot elevations & elevation contours on drawing "Grading & Drainage Plan, Orangetown Town Hall Additions & Alterations", Revision date May 1, 2020 by Tectonic. See B-6 for groundwater observations.

LEGEND FOR SOIL DESCRIPTION

<u>COARSE GRAINED SOIL</u> (Coarser than No. 200 Sieve)						
<u>DESCRIPTIVE TERM & GRAIN SIZE</u>						
<u>TERM</u>		<u>SAND</u>			<u>GRAVEL</u>	
coarse - c		No.	4	Sieve to No.	10	Sieve 3" to 3/4"
medium - m		No.	10	Sieve to No.	40	Sieve 3/4" to 3/16"
fine - f		No.	40	Sieve to No.	200	Sieve
<u>COBBLES</u> 3" to 10"		<u>BOULDERS</u>			10" +	
<u>GRADATION DESIGNATIONS</u>				<u>PROPORTIONS OF COMPONENT</u>		
fine, f				Less than 10% coarse to medium		
medium to fine, m-f				Less than 10% coarse		
medium, m				Less than 10% coarse and fine		
coarse to medium, c-m				Less than 10% fine		
coarse, c				Less than 10% medium and fine		
coarse to fine, c-f				All greater than 10%		

<u>FINE GRAINED SOIL</u> (Finer than No. 200 Sieve)		
<u>DESCRIPTION</u>	<u>PLASTICITY INDEX</u>	<u>PLASTICITY</u>
Silt	0 - 1	none
Clayey Silt	2 - 5	slight
Silt & Clay	6 - 10	low
Clay & Silt	11 - 20	medium
Silty Clay	21 - 40	high
Clay	greater than 40	very high

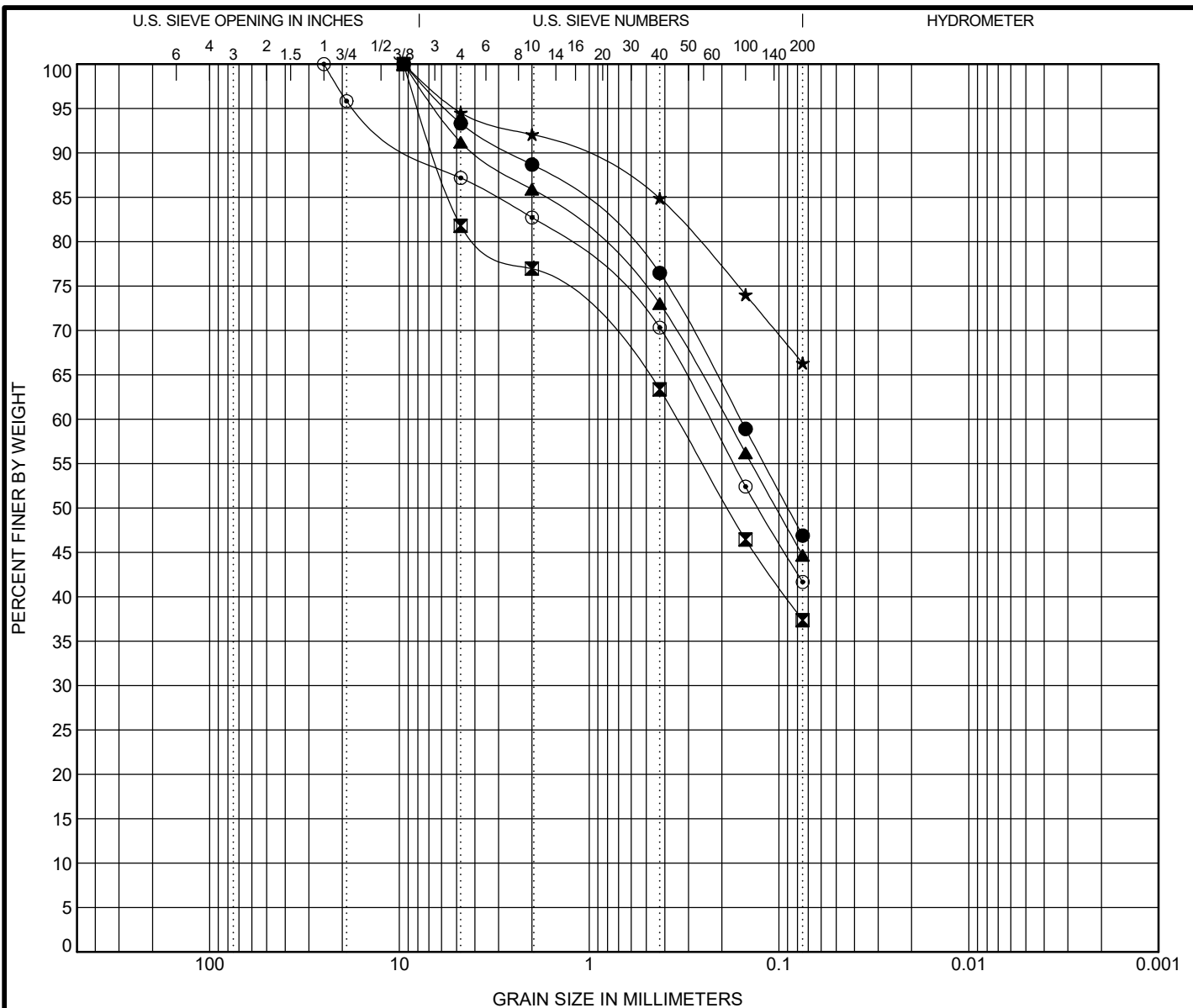
<u>PROPORTION</u>	
<u>DESCRIPTIVE TERM</u>	<u>PERCENT OF SAMPLE WEIGHT</u>
trace	1 - 10
little	10 - 20
some	20 - 35
and	35 - 50
The primary component is fully capitalized	

<u>COLOR</u>		
Blue - blue	Gy - gray	Wh - white
Blk - black	Or - orange	Yl - yellow
Bwn - brown	Rd - red	Lgt - light
Gn - green	Tn - tan	Dk - dark

<u>SAMPLE NOTATION</u>	
S - Split Spoon Soil Sample	WOC - Weight of Casing
U - Undisturbed Tube Sample	WOR - Weight of Rods
C - Core Sample	WOH - Weight of Hammer
B - Bulk Soil Sample	PPR - Compressive Strength based on Pocket Penetrometer
NR - No Recovery of Sample	TV - Shear Strength (tsf) based on Torvane

<u>ADDITIONAL CLASSIFICATIONS</u>	
New York City Building Code soil classifications are given in parentheses at the end of each description of material, if applicable. See sections 1804.2 of the 2008 Building Code for further details.	

APPENDIX II



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Sample Identification				Classification				WC%	LL	PL	PI	Cc	Cu
●	B-1	4.0	S-3	Rd-Bwn c-f SAND, and Silt, trace f Gravel				15.9					
⊠	B-2	15.0	S-7	Rd-Bwn c-f Sand, and Silt, little f Gravel				11.2					
▲	B-3	2.0	S-2	Rd-Bwn c-f Sand, and Silt, trace f Gravel				13.9					
★	B-5A	15.0	S-5	Rd-Bwn SILT, some c-f Sand, trace f Gravel				15.0					
⊙	B-7	4.0	S-3	Rd-Bwn c-f Sand, and Silt, little c-f Gravel				13.2					
Sample Identification				D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay	Source of Material	
●	B-1	4.0	S-3	9.5	0.16			6.7	46.4	46.9		Boring	
⊠	B-2	15.0	S-7	9.5	0.346			18.2	44.4	37.4		Boring	
▲	B-3	2.0	S-2	9.5	0.19			8.8	46.5	44.7		Boring	
★	B-5A	15.0	S-5	9.5				5.5	28.2	66.3		Boring	
⊙	B-7	4.0	S-3	25	0.233			12.8	45.5	41.7		Boring	

Tectonic

280 Little Britain Road Bldg 2
Newburgh, NY 12550
Telephone: 845.563.9081

Fax: 845.563.9085

GRAIN SIZE DISTRIBUTION

Project No: 10128.01

Date: 8/31/20

Project: Orangeburg Town Hall Addition

Location: Orangeburg, NY

Our Story

For the past 30 years, Tectonic has delivered quality professional services in a timely and cost effective manner by pooling its talented staff into project teams that think, act, and perform as one integral unit. By carefully listening and collaborating with its clients, the firm is able to identify the key issues and assure stakeholder objectives are met in the final deliverables. Through innovating and adopting technological advances, the firm is able to generate unique solutions to improve our nation's deteriorating infrastructure and build safe sustainable communities.

As the world evolves, and its challenges grow more complex, Tectonic continues to innovate and provide the practical solutions and exceptional customer service its clients have trusted since its founding.

END ATTACHMENT TO SECTION 31 25 00

SWPPP

SECTION 31 31 00 – SOIL MANAGEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This specification describes requirements for soil management as specified herein, including segregation and storage, field organic vapor monitoring, sampling and analysis, transportation and disposal, and reuse of soils.
- B. The Contractor shall provide all labor, materials, tools, and equipment to perform all operations necessary to characterize, classify and determine the requirements for handling, disposal, and/or reuse of all materials to be excavated.

1.2 GENERAL INFORMATION AND REQUIREMENTS

- A. The Contractor is responsible for assuring compliance with all applicable Federal and State regulations and policies in place at the time of construction. This includes, but is not limited to, any Federal or State modifications to sampling or analytical methods, standards, or policies specified herein.
- B. Soil contaminants may potentially include:
 - 1. Petroleum products, which may include, but are not limited to: gasoline, heating oils, diesel fuel, kerosene, lubricating oils, motor oils, greases, and other fractions of crude oil;
 - 2. Other contamination by organic constituents including volatile organic compounds;
 - 3. Metal(s) such as lead, chromium, and/or other heavy metals; and/or
 - 4. Any other constituents that require specialty disposal of the soil.

Additional information regarding contaminated soil is available in a Field Sampling Summary Report drafted in September 2020, as detailed under Specification Item 1.6: Existing Soil Conditions.

- C. Segregation and Storage
 - 1. This work shall consist of segregating contaminated soil from non-contaminated soil during excavation, and the temporary storage and management of contaminated soil (pending sampling, analysis and ultimate disposition) in accordance with an accepted Contaminated Material Handling Plan.
- D. Field Organic Vapor Monitoring

NOT USED

E. Sampling and Analysis

1. This work shall consist of collecting soil samples and arranging for samples to be analyzed at a laboratory in accordance with an accepted Field Sampling Plan. The laboratory shall be accredited for the specified parameters by the New York State Department of Health (NYSDOH) under the Environmental Laboratory Approval Program (ELAP). The results of the laboratory analysis will determine or confirm the final regulatory classification of the soil for appropriate handling, transportation, treatment and disposal/reuse methods and requirements.

F. Transportation and Disposal

1. This work shall consist of transporting and disposing of soil that is not otherwise reused on site, and completing any other related activities, in accordance with an accepted Disposal Plan. For shipping and disposal purposes, the regulatory classification of the soil (as either contaminated non-hazardous waste or RCRA regulated hazardous waste) will be based on investigations conducted prior to award or based on the results of laboratory analysis included in this Specification Section.

G. Reuse of Soils

1. This work shall consist of the reuse of soil within the contract limits as embankment, fill or other appropriate on-site use (unless gross contamination is discovered). Soil areas and reuse locations, if provided, are indicated in the contract documents or shall be determined and approved by the Engineer. The reuse of soil must be compliant with applicable sections of 6 NYCRR Part 360.12 and Part 350.13 as deemed appropriate based upon the following a) an investigation conducted prior to the contract award and/or sampling and analysis conducted during project construction and the qualification of the soil placement as a generic beneficial use determination (BUD) or b) as a site-specific BUD obtained from the New York State Department of Conservation (NYSDEC). The material must and can be considered suitable material as per the Geotechnical Investigation Report, as detailed under Specification Item 1.6: Existing Soil Conditions.

1.3 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving: Section 31 20 00.

1.4 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

- C. Field Sampling Summary Report: Preliminary Soil Waste Characterization – Orangetown Town Hall Expansion, prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C., dated September 4, 2020.
- D. Geotechnical Investigation Report – Proposed Addition to Orangetown Town Hall, prepared by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C., dated March 8, 2021.

1.5 DEFINITIONS

- A. NYSDOH: New York State Department of Health
- B. ELAP: Environmental Laboratory Approval Program
- C. RCRA: Resource Conservation and Recovery Act
- D. BUD: Beneficial Use Determination
- E. NYSDEC: New York State Department of Environmental Conservation
- F. PID: Photoionization Detector
- G. PPM: Parts Per Million
- H. FID: Flame Ionization Detector
- I. PPC: Personal Protective Clothing
- J. PPE: Personal Protective Equipment
- K. OSHA: Occupational Safety and Health Administration
- L. EPA: United States Environmental Protection Agency
- M. USDOT: United States Department of Transportation

1.6 EXISTING SOIL CONDITIONS

- A. A preliminary soil waste characterization field study was conducted by Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C. (Tectonic) between August 12 – 14, 2020. Full details of this preliminary investigation are available a Field Sampling Summary Report prepared by Tectonic and drafted in September 2020. Relevant conclusions and recommendations of the preliminary waste characterization studies are as follows:
 - 1. The soils sampled and analyzed would be classified as non-hazardous regulated material by the State on New York. Material scheduled for excavation and off-site disposal should be disposed of at an appropriate, permitted facility that can accept the waste. Material considered for on-site reuse would be regulated as follows:

- a. As per the NYSDEC Pre-determined BUD Part 360.12(c)(1)(ii), “fill material generated outside of New York City with no evidence of historical impacts such as reported spill events, or visual or other indications (odors, etc.) of chemical or physical contamination,” may be re-used on Site. In the event that visual or other indications of contamination are observed during soil disturbance activities, NYSDEC Part 360.13(c) states, “fill material used as backfill for the excavation from which the fill material was taken, or as fill in areas of similar physical characteristics on the project property is exempt from regulation under this Part [360]”.
- b. If fill material exhibits historical or visual evidence of contamination (including odors), and will be used in an area with public access, the relocated fill material must be covered with a minimum of 12 inches of soil or fill material that meets the criteria for general fill as defined in this Part [360]. General fill is defined in in Table 2 of Part 360 as:

TABLE 2: Fill Material Beneficial Use

Fill Material Type	Fill Material End Use	Physical Criteria	Maximum Concentration Levels
General Fill	Any setting where the fill material meets the engineering criteria, for use, except: 1. Undeveloped land; and 2. Agricultural crop land. General Fill may also be used in the same manner as Restricted-Use Fill and Limited-Use Fill.	Only soil, sand, gravel or rock; no non-soil constituents.	Lower of Protection of Public Health-Residential Land Use and Protection of Groundwater in Table 375-6.8(b) of this Title.

1.7 SUBMITTALS

- A. Contaminated Material Handling Plan
- B. Field Sampling Plan
- C. Field Sampling Summary Report
- D. Disposal Plan

PART 2 - MATERIALS

2.1 GENERAL

- A. As per the Contaminated Material Handling Plan, (Item 3.2 (C) (1))

2.2 SEGREGATION AND STORAGE

- A. A minimum of 10-mil or two (2) layers of 6-mil polyethylene sheeting shall be used as soil stockpile(s) liner(s) and cover(s).
- B. A partial containment berm made up of hay bales, silt fences, or timbers shall be utilized around stockpiled soils to direct runoff and minimize erosion.

2.3 FIELD ORGANIC VAPOR MONITORING

NOT USED

2.4 SAMPLING AND ANALYSIS

- A. All reusable sample collection devices, such as shovels or hand trowels, shall be stainless steel. All devices shall be decontaminated before and after collection of each sample. All methods necessary to decontaminate the sampling equipment shall be used. Contractor shall be responsible for proper handling and disposal of all decontamination materials and fluids.
- B. All disposable sampling devices shall be constructed of inert materials such as polyethylene, silicon, or Teflon. All disposable sampling devices shall be used only once and properly disposed.

2.5 TRANSPORTATION AND DISPOSAL

- A. The Contractor must assure that the waste transporter's appropriate choice of vehicles and operating practices are fitted to prevent spillage or leakage of contaminated material during transportation.

2.6 REUSE OF SOILS

- A. As per the NYSDEC Pre-determined BUD Part 360.12(c)(ii), "fill material generated outside of New York City with no evidence of historical impacts such as reported spill events, or visual or other indications (odors, etc.) of chemical or physical contamination," may be re-used on Site. In the event that visual or other indications of contamination are observed during soil disturbance activities, NYSDEC Part 360.13(c) states, "fill material used as backfill for the excavation from which the fill material was taken, or as fill in areas of similar physical characteristics on the project property is exempt from regulation under this Part [360]".
- B. If fill material exhibits historical or visual evidence of contamination (including odors), and will be used in an area with public access, the relocated fill material must be covered with a minimum of 12 inches of soil or fill material that meets the criteria for general fill as defined in this Part [360]. General fill is defined in in Table 2 of Part 360 as:

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General Fill	Any setting where the fill material meets the engineering criteria, for use, except: 1. Undeveloped land; and 2. Agricultural crop land. General Fill may also be used in the same manner as Restricted-Use Fill and Limited-Use Fill.	Only soil, sand, gravel or rock; no non-soil constituents.	Lower of Protection of Public Health-Residential Land Use and Protection of Groundwater in Table 375-6.8(b) of this Title.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Specification Section 31 20 00 "Earth Moving."

3.2 GENERAL

- A. Work activities shall be performed in accordance with the contract documents and with applicable Contaminated Material Handling Plan, Field Sampling Plan and Disposal Plan. The Contractor shall initiate any measures necessary to protect the safety and health of workers and the general public based on the potential hazards associated with potentially contaminated soil.
- B. **Regulatory Compliance:** The Contractor shall conduct all tasks in accordance with all applicable Federal, State, County, and local regulations including, but not necessarily limited to:
- 29 CFR 1910.120 and 29 CFR 1926.65 - Hazardous Waste Operations and Emergency Response.
 - 6 NYCRR 360 - Solid Waste Management Facilities.
 - 6 NYCRR 364 - Waste Transporter Permits.
 - 6 NYCRR 371 - Identification and Listing of Hazardous Wastes (Defines Resource Conservation and Recovery Act (RCRA) defined hazardous wastes.
 - 6 NYCRR 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (applicable to soils regulated as hazardous wastes only).
 - 6 NYCRR 373 - Hazardous Waste Management Facilities.
 - 6 NYCRR Part 375 - Environmental Remediation Program.
 - 6 NYCRR Part 376 - Land Disposal Restrictions.
 - 49 CFR 100 to 180 - USDOT Hazardous Materials Transport and Manifest System Requirements (applicable to soils regulated as hazardous wastes only).
 - Local restrictions on transportation of waste/debris.
 - 40 CFR 260 to 272 - Hazardous Waste Management (RCRA).
 - Posted weight limitations on roads and bridges.

13. Resource Conservation and Recovery Act (RCRA).
14. NYSDEC Program Policy DER-10: Technical Guidance for Site Investigation and Remediation (DER-10).
15. NYSDEC Policy CP-51: Soil Cleanup Guidance.

C. ***Preparation of Plans / Reports:*** The Contractor shall be required to prepare the plans and reports described below. Two (2) copies of each applicable plan shall be submitted to the Engineer for acceptance at least thirty (30) calendar days prior to commencing work.

Plans and reports shall be prepared based on the type(s) of contamination and locations identified in the contract documents. If a different type of contamination is encountered during work, and additional plans must be written, the thirty (30) calendar day lead time for submittals may be modified by the Engineer as appropriate.

1. ***Contaminated Material Handling Plan (CMHP):*** The CMHP shall describe the procedures to be used to segregate contaminated soil during excavation, soil storage/stockpile procedures, and safety and health issues. The following information shall be included in the CMHP:
 - a. Name and address of the plan preparer;
 - b. Contract name, contract number and description;
 - c. Describe procedures to be used to segregate contaminated soil during excavation;
 - d. Location of intended soil stockpile, trucks, roll-off container and other storage areas;
 - e. Describe how contaminated soil will be moved to soil storage locations;
 - f. Describe how soil storage/stockpile locations will be prepared and managed;
 - g. Describe how potential air quality impacts such creation of dust particulates and vapors will be minimized to protect air quality within, adjacent to or downwind from the project;
 - h. Describe air monitoring procedures to be used during work, define action levels, and explain the response if action levels are exceeded; The protocol and procedures shall consider action levels for both work personnel and also perimeter/community action levels based on the nature of the contamination and activities conducted;
 - i. Hazardous substance evaluation - types of chemicals associated with the waste to be generated,
 - j. Hazard assessment - physical and toxic effects associated with the waste to be generated; Personal protective clothing (PPC) and personal protective equipment (PPE) to be used or available on-site;
 - k. Names of key personnel, emergency contacts and phone numbers;
 - l. List the OSHA training each worker has received. At least one worker must have completed supervisor training per 29 CFR 1910.120(E)(4);
 - m. General and site-specific safety rules, with emergency response procedures and directions to the nearest hospital (with map);
 - n. Decontamination procedures for personnel and equipment; and
 - o. Disposal of contaminated PPC and PPE;

2. **Field Sampling Plan:** A Field Sampling Plan (FSP) must be prepared and submitted to the Engineer for approval prior to mobilization for any sampling activities. The FSP shall include protocols for the collection and analysis of samples that represent all soils to be excavated and stockpiled. The Engineer will approve the FSP only if it clearly provides the information to allow for classification of all material proposed for excavation. No sampling shall be conducted until the Engineer has reviewed and formally approved the FSP in writing. At a minimum, the following information shall be included in the FSP:
 - a. Name and address of the plan preparer;
 - b. Name, telephone number, and ELAP certification number of the proposed NYSDOH ELAP accredited laboratory;
 - c. Name, address, experience and qualifications of each individual who will collect soil samples. Each individual shall be thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements;
 - d. For materials destined for offsite disposal at a permitted facility, the FSP shall include a detailed outline of the disposal facility requirements for sampling, testing and analysis including specific number and types of samples per unit volume of soil to be excavated;
 - e. For all materials to be disposed, the sampling frequency shall be, at a minimum, in accordance with NYSDEC DER-10 Table 5.4(e)10, unless otherwise specified by the disposal facility:

Table 5.4(e)10			
Recommended Number of Soil Samples for Soil Imported To or Exported From a Site			
Contaminant	VOCs	SVOCs, Inorganics & PCBs/Pesticides	
Soil Quantity (cubic yards)	Discrete Samples	Composite	Discrete Samples/Composite
0-50	1	1	3-5 discrete samples from different locations in the fill being provided will comprise a composite sample for analysis
50-100	2	1	
100-200	3	1	
200-300	4	1	
300-400	4	2	
400-500	5	2	
500-800	6	2	
800-1000	7	2	
➤ 1000	Add an additional 2 VOC and 1 composite for each additional 1000 Cubic yards or consult with DER		

- f. Description of QA/QC samples required by the reuse or disposal facilities;
- g. Description of additional reuse or disposal facility requirements;
- h. A scaled map of the site showing existing fixed landmarks and the proposed excavation limits. The map shall contain specific sampling locations that will conform to the applicable sampling frequency requirements;
- i. Proposed sampling, handling, preservation, and storage of equipment and procedures, including transfer procedures, and sampling equipment decontamination procedures;
- j. Analytical Methods: proposed analytical methods shall be in accordance with EPA SW-846, latest edition;
- k. Data Quality Objectives: Procedures for assessing precision, accuracy, degree of representation, comparability and completeness of samples and data, including performance audits and proposed protocols for corrective

- measures where problems are identified shall be defined and meet standards set forth in this Specification;
- l. Schedule of field inspections;
 - m. Planned preparation of daily and project summary quality control reports; and
 - n. Manufacturer, catalog data and calibration records of all analytical equipment to be used on-site.
3. ***Field Sampling Summary Report:*** The field sampling summary report (FSSR) shall contain all laboratory analytical results obtained from the field sampling event(s). A detailed account of any field procedures used which deviated from those established in the FSP shall be included, as well as a complete set of field notes. The Contractor shall submit hard copies of the FSSR which shall include a Summary Table listing the analytical results with highlighted exceedances of RCRA Characteristics, BUD, or applicable parameters of 6NYCRR Part 375 and all disposal facility limits, including any alternate acceptance criteria. Detailed field notes shall be maintained by the Contractor during sampling to allow identification of sample analysis results with the respective areas / volumes of soil that the data represent, and to verify quantities of materials to be beneficially reused or disposed of as regulated solid waste. The field notes shall be made available to the Engineer during the sampling program and included in the FSSR and shall consist of:
- a. Boring and/or test pit logs from each sampling location containing a continuous stratigraphic description of all material encountered. Descriptions of material shall include, but not be limited to, color, odor, staining, field screening measurement, relative grain size distribution, material composition, moisture content, and cohesive properties;
 - b. The location of each sampling point on a scaled map;
 - c. Depth intervals for each sample, whether a grab or composite, and any special notes, which are included on the laboratory chain-of-custody forms; and
 - d. Copies of all laboratory chain-of-custody forms for samples that are collected for analysis.
4. ***Disposal Plan:*** The following information shall be included in the Disposal Plan:
- a. Name and address of plan preparer;
 - b. Name of disposal/treatment facility, address, telephone number and contact person;
 - c. Copy of applicable permits and/or licenses held by the disposal/treatment facility;
 - d. EPA Identification Number and/or State Facility Identification Number issued to the disposal/treatment facility;
 - e. Method(s) of disposal/treatment that will be used;
 - f. Signed letter from the disposal/treatment facility stating it is authorized under law to accept the type of waste being generated, their intent to accept the waste generated by this contract, and a list of the laboratory tests required by the facility;
 - g. Name of waste transporter, address, telephone number and contact person;

- h. EPA Identification Number and/or State Transporter Identification Number issued to waste transporter; and
- i. Copies of all waste transporter permits and/or license plate numbers for vehicles that will be used for transport of waste from the site to the intended disposal/treatment facility;

3.3 SEGREGATION AND STORAGE

- A. The Contractor shall have an accepted CMHP prior to commencing work within potentially contaminated soil areas. Soil determined to be contaminated (by PID/FID screening or observation) shall be segregated from non-contaminated soil and stored pending sampling, analysis and disposal. For the purposes of this project, contaminated versus non-contaminated soils are defined as follows:

- 1. ***Non-Contaminated Soil:*** Soil with PID/FID head space readings less than 25 ppm and exhibiting no other evidence of contamination (visual or olfactory evidence) shall be considered non-contaminated. Unless further analysis is performed for confirmation of the non-contaminated soil, this soil will be considered uncontaminated.
- 2. ***Contaminated Soil:*** Soil with PID/FID head space readings equal to or greater than 25 ppm and/or soil exhibiting other evidence of contamination (visual or olfactory evidence) shall be considered contaminated. This soil shall be segregated from non-contaminated soil and placed in stockpiles or containers. The results of laboratory analysis will be used to determine its regulatory classification. If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil.

If feasible, soil with significantly higher PID/FID head space readings and soil exhibiting unusual visual or odor characteristics shall be segregated from other contaminated soil. The Contractor shall notify the Engineer immediately if soil is discovered that appears to contain unknown contaminants or soil that varies significantly from the type of contamination identified in the contract documents. The Engineer will determine the preliminary regulatory classification of the suspect soil and will determine how the soil is to be managed.

- B. The Contractor shall not store contaminated soil for more than forty (40) calendar days, with this time limit beginning on the first day soil is placed in a stockpile, truck-bed or roll-off container. If the Engineer approves additional storage time for soil determined to be contaminated non-hazardous waste, the Contractor shall also request approval from NYSDEC for any storage greater than sixty (60) calendar days. If the Engineer approves additional storage time for soil determined to be RCRA regulated hazardous waste, the Contractor shall also obtain approval from NYSDEC for any storage greater than ninety (90) calendar days. Contaminated soil may be placed in stockpiles, trucks or roll-off containers as follows:

1. ***Stockpiles:*** The Contractor shall prepare and maintain stockpiles as follows:

a. ***Preparation of Stockpile Areas***

- 1) The area shall be graded to provide positive drainage away from intended stockpile locations;
- 2) All stones, roots, debris and other objects that may puncture polyethylene ground protection shall be removed;
- 3) The ground surface where soil will be stockpiled shall be covered with a minimum of 10-mil or two (2) layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants; and
- 4) Stockpile locations shall be accepted by the Engineer prior to use.

b. ***Stockpile Protection***

- 1) At the end of each work day, contaminated soil stockpiles shall be completely covered with a minimum of 10-mil or two (2) layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
- 2) Stockpile covers shall be weighted or secured by appropriate means to prevent tearing or removal by weather conditions.
- 3) Stockpiles shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.
- 4) A partial containment berm made up of hay bales, silt fences, or timbers shall be utilized around stockpiled soils to direct runoff and minimize erosion.

c. ***Maintenance***

- 1) Stockpile covers, site grading, signing and security measures shall be properly maintained for the duration of storage.
- 2) Damaged covers and other protections shall be repaired or replaced by the Contractor within 24-hours after notification. If this work is not satisfactorily completed within 24-hours, no further stockpiling shall be allowed until such work is completed.

2. ***Trucks or Roll-off Containers:*** The Contractor shall prepare and maintain trucks and roll-off containers as follows:

- a. The interior of truck-beds and roll-off containers shall be lined with 10-mil or two (2) layers of 6-mil polyethylene sheeting, or an equivalent material. All seams shall be overlapped and sealed to prevent the leaching of contaminants.
- b. At the end of each work day, trucks and roll-off containers storing soil shall be completely covered with waterproof tarpaulins. Tarpaulins shall be placed over the top of the truck bed or container (rather than over the soil inside) and shall extend over the sides to prevent water accumulation and the evaporation of contaminants.

- c. Tarpaulins shall be weighted or secured by appropriate means to prevent tearing or removal by climatic conditions.
- d. Trucks and roll-off containers shall be labeled, signed, fenced or otherwise secured (as needed) at the end of each work day.
- e. Trucks, roll-off containers and tarpaulins shall be properly maintained for the duration of soil storage.
- f. Damaged tarpaulins and protections shall be repaired or replaced by the Contractor within 24-hours after notification. If this work is not satisfactorily completed within 24-hours, no further soil storage shall be allowed until such work is completed.
- g. Trucks and roll-off containers storing contaminated soil shall be located as described in CMHP.

3.4 FIELD ORGANIC VAPOR MONITORING

NOT USED

3.5 SAMPLING AND ANALYSIS

- A. The Contractor shall have an accepted FSP prior to commencing work. Sampling shall be conducted by individuals thoroughly trained in sampling protocols, handling and chain of custody procedures, and laboratory requirements. Accepted sampling practices shall be used to obtain representative composite sample(s) and/or grab sample(s) as required for the specific analyses to be completed. Representative samples shall be collected from stored soil as soon as possible after excavation. Soil shall be taken from a depth greater than one (1) foot within the stockpile. Each composite sample shall include a minimum of three (3) to five (5) sample points. Grab samples shall be collected in a manner so as to best characterize the extent of contamination of the soil in question and best characterize the extent of contamination of the stockpile. If any soil areas are present with field indications of contamination discretely different than the other areas (i.e., significantly elevated PID/FID readings, staining, etc.), the area may require a separate sample and the Engineer shall be alerted to approve additional sample and analysis. Analyses shall be completed at a NYSDOH ELAP accredited laboratory that is certified to perform the required tests. Analyses shall be completed within ten (10) work days of sample collection. The Contractor shall provide the Engineer with a copy of all reports within two (2) work days of their receipt from the laboratory.
- B. All material shall be sampled and analyzed in accordance with the disposal facility requirements or as required by a site-specific NYSDEC or applicable Out-of-State Regulatory Agency BUD.
- C. Soil shall not be added to any stockpile, truck or roll-off container after its contents have been sampled. If soil is added after sampling, or sampled soil is otherwise tampered with, the Contractor shall re-sample the soil at no additional cost to the Town.
- D. All sampling equipment shall be certified clean or precleaned prior to the collection of each sample, by the following method:

1. Wash all sampling equipment and secondary containers with non-phosphate laboratory grade detergent and distilled water.
 2. Triple rinse with distilled water.
 3. Rinse with isopropyl alcohol, or if samples are visibly contaminated with petroleum use a solvent, such as hexane or other alternate approved by the Engineer.
 4. Triple rinse with analyte free water.
- E. All samples shall be identified with a sample label in addition to an entry on a chain-of-custody record. The label shall be identified upon receipt by the laboratory and cross-referenced to the chain-of-custody record. Any inconsistencies shall be noted on the custody record. Laboratory personnel shall notify the Contractor's sampling and analysis representative immediately if any inconsistencies exist in the paperwork associated with the samples, and the Contractor shall be responsible for collecting new samples to replace those with inconsistencies that cannot be rectified.
- F. Custody of samples shall be maintained through the shipment of samples to the selected laboratory(ies). All samples shall be packaged and shipped daily to ensure that no sample is held at the site for more than 24-hours. Samples shall be delivered directly to the laboratory.
- G. Conduct specified analyses as follows:
1. ***Petroleum Contamination Parameter Analysis:*** Samples shall be analyzed for petroleum contamination constituents (total constituent analysis) in accordance with CP – 51/Soil Cleanup Guidance, Gasoline and Fuel oil, Tables 2 and 3 using USEPA Method 8260 for volatile organics and methyl t-butyl ether (MTBE) and USEPA Method 8270 for base/neutrals.
 2. ***Hazardous Waste RCRA Toxicity Characteristic Analysis:*** Samples shall be analyzed for Hazardous Waste RCRA Toxicity Characteristics Leaching Procedure (TCLP) constituents. Analysis shall be for full TCLP constituents on the sample extract as prepared by USEPA Method 1311.
 3. ***Ignitability of Solids Analysis:*** Samples shall be analyzed for ignitability by USEPA Method 1030.
 4. ***pH of Soil and Waste:*** Samples shall be analyzed for pH measurement by USEPA Method 9045.
 5. ***Polychlorinated Biphenyls (PCB) Analysis:*** Samples shall be analyzed for PCBs by USEPA Method 8082.
 6. ***Total Petroleum Hydrocarbons (TPH) Analysis:*** Samples shall be analyzed for petroleum hydrocarbons, USEPA Method 8015, gasoline range organics (GROs) and/or diesel range organics (DROs).

3.6 TRANSPORTATION AND DISPOSAL

- A. The Contractor shall have an accepted Disposal Plan prior to the transportation and disposal of soils. Soils shall not be transported until all sampling and analysis, as required by the Engineer or by the Disposal facility, have been performed and laboratory reports have been provided and accepted by the Engineer and/or Town.
- B. Disposal Facility Selection Requirements
 - 1. The Contractor shall submit the name(s) of the selected offsite soil disposal facilities and their location(s) to the Engineer for approval. Note that some companies may have multiple disposal facilities, each possessing differing requirements regarding the types of materials accepted, the specific analytical testing parameters that must be performed for each material, and the frequency of sampling required for each material. It is the Contractor's responsibility to determine the specific waste acceptance criteria and testing requirements for each of its proposed facilities. If the Contractor chooses to use a facility that has not previously been approved by the Engineer or the Town, the Contractor must seek approval from the Engineer to use the facility, and all additional sampling and testing procedures associated with the facility shall be provided at no additional expense to the Town.
 - a. The Contractor shall confirm the permit status, types of materials accepted, as well as check for outstanding violations and enforcement actions at each selected disposal facility. The Engineer shall verify the information provided by the Contractor for each facility prior to approval.
 - b. The Contractor shall verify the location(s) of the selected disposal facility(ies), as well as the types of materials accepted, the specific analytical testing parameters that must be performed for each material, and the frequency of sampling required for each material, at each of the selected facilities. The analytical testing parameters and the frequency of sampling required for each material are subject to change. It shall be the Contractor's responsibility to confirm and comply with all requirements of the selected facility(ies) prior to submittal to the Engineer for review and approval.
 - c. If an approved facility is not available during construction, the Contractor shall be fully responsible for procuring alternate approved facilities at no additional expense to the Town. Any additional sampling and analysis required and labor involved in selecting new facilities after the initial reuse or disposal facilities are accepted shall be the responsibility of the Contractor.
- C. Transportation Off Site
 - 1. For the duration of transportation, roll-off containers and truck beds shall be completely covered with secured waterproof tarpaulins to prevent water infiltration, evaporation of contaminants and spillage of soil.
 - 2. The Contractor shall take immediate action to remedy any situation involving a release of soil during loading or while in transit.

3. Soil shall not be combined with material from any other source.
4. Soil shall be transported in vehicles with valid Waste Transporter permits for New York State (and other required permits/licenses from any other states as applicable). The Contractor shall provide a copy to the Engineer of the waste transporter permit documenting that the transporter is authorized to transport waste to the intended disposal/treatment facility. The Contractor shall complete any required shipping papers, labeling, placarding, and weighing/load measurements and shall provide copies of required documentation to the Engineer.
5. Soil that is determined to be a regulated hazardous waste per the criteria of 6 NYCRR Part 371 shall be shipped with a hazardous waste manifest to a treatment/disposal facility permitted to accept the waste. The Contractor shall complete all required manifests, labeling, placarding, land disposal restriction notifications, and other requirements for shipping and tracking hazardous wastes and shall provide copies of required documentation to the Engineer. The Engineer will provide the Contractor with the EPA Identification Number(s) issued to the Town as the hazardous waste generator and will sign the generator certification statements.

D. Disposal / Treatment

1. Soil shall be disposed of by the methods and procedures described in the accepted Disposal Plan. Soil characterization information, field identification and confirmation laboratory analyses will be used to determine appropriate classification and category of soil for disposal. Each category of surplus or waste soil shall be handled and disposed of based upon its characterization in accordance with applicable regulatory requirements.
2. Soil shall be transported to a disposal/treatment facility within forty (40) calendar days from the start of storage. The Contractor shall complete under this item any soil sampling and analysis required by the disposal/treatment facility that is not specifically included in the contract.

E. Documentation

1. The Contractor shall provide the Engineer with copies of all receipts from the disposal/treatment facility which indicate the actual quantity of waste received within two (2) work days of receipt from the facility. For soil determined to be RCRA regulated hazardous waste, the Contractor shall also provide the Engineer with the appropriate copies of each signed manifest within two (2) work days of receipt. Any manifest discrepancies, including the need for exception reporting, shall be reported immediately to the Engineer and shall be resolved by the Contractor.

3.7 REUSE OF SOILS

- A. The Contractor shall place soil as embankment, fill or other appropriate on-site use as determined and approved by the Engineer and/or Town, and in accordance with the contract documents. Only appropriate soils placed in appropriate locations as included in the contract documents shall be reused.

- B. The material must be considered suitable material as per the Geotechnical Investigation Report, as detailed under Specification Item 1.6: Existing Soil Conditions.
- C. If fill material exhibits historical or visual evidence of contamination (including odors), and will be used in an area with public access, the relocated fill material must be covered with a minimum of 12 inches of soil or fill material that meets the criteria for general fill as defined in this Part [360]. General fill is defined in in Table 2 of Part 360 as:

TABLE 2: Fill Material Beneficial Use

Fill Material Type	Fill Material End Use	Physical Criteria	Maximum Concentration Levels
General Fill	Any setting where the fill material meets the engineering criteria, for use, except: 1. Undeveloped land; and 2. Agricultural crop land. General Fill may also be used in the same manner as Restricted-Use Fill and Limited-Use Fill.	Only soil, sand, gravel or rock; no non-soil constituents.	Lower of Protection of Public Health-Residential Land Use and Protection of Groundwater in Table 375-6.8(b) of this Title.

1. A demarcation layer will be installed for soil covers. Material meeting the criteria for general fill as defined above will be placed over a demarcation layer (i.e., an identifiable barrier between reused soils and the soil cap). Where existing soil meets the applicable soil cleanup objectives (SCOs) and where no reused soil exists, there will not be a need to install a demarcation layer

END OF SECTION 31 31 00

SECTION 321200 - FLEXIBLE PAVING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:

1. Fine grading of pavement sub-grade
2. Milling of existing asphalt pavement.
3. Sawing of existing asphalt pavement.
4. Installation of full-depth hot mix asphalt pavement.
5. Installation of hot mix asphalt patching.
6. Installation of hot mix asphalt overlays.
7. Pavement reconstruction.
8. Trench repair with hot mix asphalt.
9. Temporary pavement.
10. Installation of bituminous surface treatment.

B. RELATED WORK SPECIFIED ELSEWHERE

- | | |
|-----------------------|-----------------|
| 1. Earth Moving: | Section 312000. |
| 2. Curbs and Gutters: | Section 321600 |

1.2 SUBMITTALS

- A. Product Data: Manufacturer's name, specifications, and installation instructions, for each item specified.
- B. Quality Control Submittals:
1. Plant name and location of hot mix asphalt supplier.

1.3 PROJECT CONDITIONS

- A. Environmental Requirements:
1. Discontinue paving when surface temperatures fall below requirements listed in NYS DOT Table 402-2.
 2. Do not place asphalt concrete on wet surfaces, or when weather conditions otherwise prevent the proper handling or finishing of bituminous mixtures as determined by the Owner's Representative.

1.4 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance. Firm shall be a registered and approved paving mix manufacturer with authorities having jurisdiction or with the DOT of the state in which Project is located.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Hot Mix Asphalt Paving: Conform to NYS DOT Section 400 Bituminous Pavements.
 - 1. Top Course: NYS DOT, Type F2, Item 402.128204, or as indicated on the plans.
 - 2. Binder Course: NYS DOT Type F9, Item 402.198904, or as indicated on the plans.
 - 3. Diluted Tack Coat: NYS DOT 407.0102
 - 4. Joint Sealant: ASTM D6690 Type II Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase to satisfaction of the Owner's Representative using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Remediate unsatisfactory conditions. Do not begin paving installation until these conditions have been corrected to the satisfaction of the Owner's Representative.

3.2 COLD MILLING

- A. Clean existing paving surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement, including hot-mix asphalt and, as necessary,

unbound-aggregate base course, by cold milling to grades and cross sections indicated. Repair or replace curbs, manholes, and other construction damaged during cold milling.

3.3 PATCHING, REPAIRS, AND INTERFACE WITH PREVIOUSLY PLACED PAVEMENTS

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Recompact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
 - 1. Tack coat faces of excavation and allow to cure before paving.
 - 2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
 - 3. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.
- B. Crack and Joint Filling: Remove existing filler material from cracks or joints to a depth of 1/4 inch. Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.
- C. Tack Coat: Apply uniformly to existing surfaces of previously constructed asphalt or portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. of surface.
 - 1. Allow tack coat to cure undisturbed before paving.
 - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT MIX ASPHALT PAVING

- A. Construct hot mix asphalt pavement in accordance with NYSDOT, Section 402.

3.5 TEMPORARY PAVEMENT

- A. The Contractor will provide temporary pavement at areas indicated on the plans or as directed by the Owner's Representative to ensure safe, stable site access during the various stages of project construction.
- B. Temporary pavement will comply with the requirements and standards of this specification. However, temporary pavement shall exclude the provision of a surface-wearing course.
- C. All costs associated with the provision of temporary pavement shall be included in the price bid for the project.

3.6 INSTALLATION TOLERANCES

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Binder Course: Plus or minus 1/2 inch (13 mm).
 - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Binder Course: 1/4 inch (6 mm).
 - 2. Surface Course: 1/8 inch (3 mm).
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/8 inch (3 mm).

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent testing agency at his expense to perform field inspections and tests and to prepare test reports. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements. All reporting demonstration compliance with the standards described herein shall be provided to the Owner's Representative at the Contractor's expense.
- B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density: Field density of in-place compacted pavement shall be determined by nuclear method according to ASTM D 2950.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321200

SECTION 321300 - RIGID PAVING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Installation of concrete walkways.
 - 2. Installation of concrete pads.
 - 3. Installation of concrete footings for incidental site construction.
 - 4. Placement of miscellaneous concrete during the course of construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving: Section 312000.
- B. Curbs and Gutters: Section 321600

1.03 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. Except as shown or specified otherwise, the Work of this Section shall conform to the requirements of Specifications for Structural Concrete for Buildings ACI 301-05 of the American Concrete Institute.

1.04 DEFINITIONS (Amendments to ACI 301, Chapter 1):

- A. Exposed Construction: Exposed to view.
- B. Architectural Concrete: Concrete which is exposed to view as an interior or exterior surface in the completed structure.

1.05 SUBMITTALS

- A. Submittals Package: Submit product data for design mix(es) and materials for concrete specified below at the same time as a package.

- B. Shop Drawings: Placing drawings for bar reinforcement.
- C. Product Data:
 - 1. Concrete design mix(es) with name and location of batching plant.
 - 2. Portland Cement: Brand and manufacturer's name.
 - 3. Fly Ash: Name and location of source, and NYS DOT test numbers.
 - 4. Air-entraining Admixture: Brand and manufacturer's name.
 - 5. Water-reducing Admixture: Brand and manufacturer's name.
 - 6. Aggregates: Name and location of source, and NYS DOT test numbers.
 - 7. Lightweight Coarse Aggregate: Brand and manufacturer's name
 - 8. Chemical Curing and Anti-Spalling Compound: Brand and manufacturer's name, and application instructions.
 - 9. Bonding Agent (Adhesive): Brand and manufacturer's name, and preparation and application instructions.
 - 10. Expansion Joint Filler: Brand and manufacturer's name.
 - 11. Emery Aggregate: Brand and manufacturer's name, and application instructions.
- D. Quality Control Submittals:
 - 1. Certificates: Affidavit required under Quality Assurance Article.

1.06 QUALITY ASSURANCE

- A. Concrete batching plant shall be currently approved as a concrete supplier by the New York State Department of Transportation.
- B. Fly ash supplier shall be currently approved as a fly ash supplier by the New York State Department of Transportation.
- C. Certifications: Affidavit by the bar reinforcement manufacturer certifying that bar material meets the contract requirements.
- D. Source Quality Control: the Owner's Representative reserves the right to inspect and approve the following items, at his own discretion, either with his own forces or with a designated inspection agency:
 - 1. Batching and mixing facilities and equipment.
 - 2. Sources of materials.

1.07 FIELD CONDITIONS

- A. Weather limitations: The provisions of NYSDOT Section 502-3.02 shall apply.

1.08 STORAGE

- A. Store materials to insure the preservation of their quality and fitness for the Work. Materials, even though accepted prior to storage, are subject to inspection and shall meet the requirements of the Contract before their use in the Work.

PART 2 - PRODUCTS

2.01 MATERIALS (Amendments to ACI 301, Chapter 2):

- A. Water-reducing Admixture: ASTM C 494, Type A, and on the New York State Department of Transportation's current "Approved List".
- B. Fly Ash: ASTM C 618, including Table 1A (except for footnote A), Class F except that loss on ignition shall not exceed 4.0 percent.
- C. Chemical Curing and Anti-Spalling Compound: ASTM C-309, Type 1D, Class B, with a minimum 18 percent total solids content. No thinning of material allowed.
 - 1. SureCure Emulsion, Kaufman Products, Inc. 3811 Curtis Avenue, Baltimore, MD 21226, (800) 637-6372.
 - 2. Cure & Seal by Symons Corp., 200 East Touhy Ave., PO Box 5018, Des Plaines, IL 60017-5018, (847) 298-3200.
 - 3. "Kure N Seal W" by Sonneborn Building Products, Chemrex, Inc., 889 Valley Park Dr., Shakopee, MN 55379, (800) 433-9517.
 - 4. Day-Chem Cure & Seal 26 percent (J-22) by Dayton Superior Corp., 721 Richard St., Miamisburg, OH 45342, (800) 745-3700.
 - 5. Acrylseal HS by Master Builders, Inc., 23700 Chagrin Blvd., Cleveland, OH 44122, (800) 628-9990
- D. Type 1 Expansion Joint Filler: Preformed, resilient, non-extruding cork units; ASTM D 1752, Type II.
- E. Chamfer Strips: Wood, metal, PVC or rubber; one inch chamfer.
- F. Epoxy Bonding Agent (Adhesive): 100 percent solids epoxy-resin-base bonding compound, complying with ASTM C 881, Types I, II, IV and V, Grade 2 (horizontal areas) or Grade 3 (overhead/vertical areas), and Class B (40-60 degrees Fahrenheit) or Class C (60 degree Fahrenheit and above).
 - 1. SurePoxy HM Series by Kaufman Products, Inc., 3811 Curtis Avenue, Baltimore, MD 21226, (800) 637-6372.
 - 2. Sikadur Hi-Mod 32 by Sika Corporation, 201 Polito Avenue, Lyndhurst, NJ 07071, (800) 933-7452.
 - 3. Epogrip by Sonneborn-Chemrex, 889 Valley Park Drive, Shakopee, MN 55379, (800) 433-9517.

2.02 SUBBASE

- A. Subbase material: Crushed stone in accordance with NYSDOT 304.12 Subbase Course, Type 2

2.03 PROPORTIONING (Amendments to ACI 301, Chapter 3):

- A. Compressive Strength: Minimum 4000 psi, unless shown or specified otherwise.

1. Minimum 4000 psi for subsurface concrete, footings, poured inverts, stairs, and sidewalks.
 - B. Weight: Normal:
 - C. Durability: Concrete shall be air-entrained. Design air content shall be 6 percent by volume, with an allowable tolerance of plus or minus 1.5 percent for total air content. Entrained air shall be provided by use of an approved air-entraining admixture. Air-entrained cement shall not be used.
 - D. Slump:
 1. 3000 psi Normal Weight Concrete: Between 2 inches and 4 inches.
 2. 4000 psi Normal Weight Concrete: Between 2 inches and 3 inches.
 3. Lightweight Concrete: Between 1 inch and 4 inches.
 - E. Admixtures: Do not use admixtures in concrete unless specified or approved in writing by the owner's representative.
 - F. Selection of Proportions: Concrete proportions shall be established on the basis of previous field experience or laboratory trial batches, unless otherwise approved in writing by the Owner's Representative. Proportion mix with a minimum cement content of 564 pounds per cubic yard for 3000 psi concrete and 611 pounds per cubic yard for 4000 psi concrete.
 1. Optional Material: Fly ash may be substituted for (Portland) cement in normal weight concrete up to a maximum of 15 percent by weight of the required minimum (Portland) cement. If fly ash is incorporated in a concrete design mix, make necessary adjustments to the design mix to compensate for the use of fly ash as a partial replacement for (Portland) cement.
 - a. Adjustments shall include the required increase in air-entraining admixture to provide the specified air content.
 - b. Lower early strength of the concrete shall be considered in deciding when to remove formwork.
- 2.04 REINFORCEMENT (Amendments to ACI 301, Chapter 5):
- A. Bar Reinforcement: ASTM A 615, Grade 60, deformed steel bars.
 - B. Fabric Reinforcement: ASTM A 185, welded wire fabric, fabricated into flat sheets unless otherwise indicated.
 - C. Bar Supports: Galvanized steel or AISI Type 430 stainless steel, and without plastic tips.
 - D. Tie Wire: Black annealed wire, 16-1/2 gage or heavier.
- 2.05 JOINTS AND EMBEDDED ITEMS (Amendments to ACI 301, Chapter 6):
- A. Obtain bond at construction joints by the use of bonding agent (adhesive) or the use of cement grout.
- 2.06 PRODUCTION (Amendments to ACI 301, Chapter 7):

- A. Provide ready-mixed concrete, either central-mixed or truck-mixed.

2.07 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves of a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Do not use items of aluminum for mixing, chuting, conveying, forming or finishing concrete, except magnesium alloy tools may be used for finishing.
- B. Keep excavations free of water. Do not deposit concrete in water.
- C. Hardened concrete, reinforcement, forms, and earth which will be in contact with fresh concrete shall be free from frost at the time of concrete placement.
- D. Prior to placement of concrete, remove all hardened concrete spillage and foreign materials from the space to be occupied by the concrete.

3.02 FORMWORK (Amendments to ACI 301, Chapter 4):

- A. Chamfer all exposed external corners of concrete.

3.03 PLACING REINFORCEMENT (Amendments to ACI 301, Chapter 5):

- A. At the time concrete is placed, reinforcement shall be free of mud, oil, loose rust, loose mill scale, and other materials or coatings that may adversely affect or reduce the bond.

3.04 PLACING CONCRETE (Amendments to ACI 301, Chapter 8):

- A. Operation of truck mixers and agitators and discharge limitations shall conform to the requirements of ASTM C 94.
- B. Do not allow concrete to free fall more than 4 feet.
- C. Protect concrete from exposure to salts for sixty (60) days.

3.05 FINISHING FORMED SURFACES (Amendments to ACI 301, Chapter 10):

- A. Finish Schedule: Except where indicated otherwise on the Drawings, provide the finishes below:
- B. Rough Form Finish for concrete surfaces not exposed to view.
- C. Smooth Form Finish for concrete surfaces exposed to view.

3.06 FINISHING SLABS (Amendments to ACI 301, Chapter 11):

- A. Slabs On Grade: Provide key type joints unless otherwise shown. Tool exposed joints.
- B. Finish Schedule: Except where indicated otherwise on the Drawings, provide the finishes below:
 - 1. Floated Finish for:
 - a. Treads and platforms of exterior steps and stairs.
 - b. Slabs and fill over which waterproofing, roofing, vapor barrier, or insulation is required.
 - 2. Broom or Belt Finish for:
 - a. Exterior slabs. Texture, as approved by the Owner's Representative.
- C. Finishing, General: Provide monolithic finishes on concrete floors and slabs without the addition of mortar or other filler material. Finish surfaces in true planes, true to line, with particular care taken during screeding to maintain an excess of concrete in front of the screed so as to prevent low spots. Screed and darby concrete to true planes while plastic and before free water rises to the surface. Do not perform finishing operations during the time free water (bleeding) is on the surface.

3.07 JOINTS

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
 - 1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
- C. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- D. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 20 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-half of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces. Radius shall be 1/4 inch.
2. Sawn Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces. Radius shall be 1/4 inch.

3.08 CURING AND PROTECTION (Amendments to ACI 301, Chapter 12):

A. Maintain concrete surfaces in a moist condition for at least 7 days after placing, except where otherwise indicated. Do not use curing compound.

1. For surfaces of exterior slabs (on grade), apply chemical curing and anti-spalling compound in accordance with the recommendations of the manufacturer.

3.09 FIELD QUALITY CONTROL (Amendments to ACI 301, Chapter 16):

A. Make available to the Owner's Representative whatever test samples are required to make tests. Furnish shipping boxes for compression test cylinders. Provide field cure box as required.

3.10 TOLLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch
3. Surface: Gap below 10 foot long, unlevelled straightedge not to exceed 1/4 inch.

4. Joint Spacing: 3 inches.
5. Contraction Joint Depth: Plus ¼ inch, no minus.
6. Joint Width: Plus 1/8 inch, no minus.

3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete that is broken, damaged, or defective, or does not meet requirements in this Section. Reasons for rejection of concrete include the following:
 1. Staining or discoloration of pavement.
 2. Expansion joints are not perpendicular to roadway.
 3. Joints and surfaces are improperly finished.
 4. Expansion joints protrude from pavement.
 5. Cracks, chips, or other damage occur in construction of maintenance period.
 6. Improper vibration of concrete.
 7. Vandalism during initial setup of concrete.
 8. Pavement is out of alignment by more than 0.2 feet.
 9. Pavement is off grade by more than 0.1 feet.
 10. Settlement of pavement.
 11. Inspection of formwork not asked for by Contractor prior to pouring of pavement.
- B. Drill test cores where directed by the Owner's Representative when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321300

SECTION 321600 - CURBS AND GUTTERS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Installation of concrete vertical/mountable curbing.
 - 2. Installation of stone, precast, block, or granite vertical/mountable curbing with concrete foundations.
 - 3. Installation of concrete gutters.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. Except as shown or specified otherwise, the Work of this Section shall conform to the requirements of Specifications for Structural Concrete for Buildings ACI 301-05 of the American Concrete Institute.

1.3 DEFINITIONS (Amendments to ACI 301, Chapter 1):

- A. Exposed Construction: Exposed to view.
- B. Architectural Concrete: Concrete which is exposed to view as an interior or exterior surface in the completed structure.

1.4 SUBMITTALS

- A. Submittals Package: Submit product data for design mix(es) and materials for concrete specified below at the same time as a package.
- B. Shop Drawings: Placing drawings for bar reinforcement.
- C. Product Data:
 - 1. Concrete design mix(es) with name and location of batching plant.
 - 2. Portland Cement: Brand and manufacturer's name.
 - 3. Fly Ash: Name and location of source, and NYS DOT test numbers.
 - 4. Air-entraining Admixture: Brand and manufacturer's name.

5. Water-reducing Admixture: Brand and manufacturer's name.
6. Aggregates: Name and location of source, and NYS DOT test numbers.
7. Lightweight Coarse Aggregate: Brand and manufacturer's name
8. Chemical Curing and Anti-Spalling Compound: Brand and manufacturer's name, and application instructions.
9. Bonding Agent (Adhesive): Brand and manufacturer's name, and preparation and application instructions.
10. Expansion Joint Filler: Brand and manufacturer's name.
11. Emery Aggregate: Brand and manufacturer's name, and application instructions.

D. Quality Control Submittals:

1. Certificates: Affidavit required under Quality Assurance Article.

1.5 QUALITY ASSURANCE

- A. Concrete batching plant shall be currently approved as a concrete supplier by the New York State Department of Transportation.
- B. Fly ash supplier shall be currently approved as a fly ash supplier by the New York State Department of Transportation.
- C. Certifications: Affidavit by the bar reinforcement manufacturer certifying that bar material meets the contract requirements.
- D. Source Quality Control: the Owner's Representative reserves the right to inspect and approve the following items, at his own discretion, either with his own forces or with a designated inspection agency:
 1. Batching and mixing facilities and equipment.
 2. Sources of materials.

1.6 FIELD CONDITIONS

- A. Weather limitations: The provisions of NYSDOT Section 502-3.02 shall apply.

1.7 STORAGE

- A. Store materials to insure the preservation of their quality and fitness for the Work. Materials, even though accepted prior to storage, are subject to inspection and shall meet the requirements of the Contract before their use in the Work.

1.8 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving: Section 312000.

PART 2 - PRODUCTS

2.1 MATERIALS (Amendments to ACI 301, Chapter 2):

- A. Water-reducing Admixture: ASTM C 494, Type A, and on the New York State Department of Transportation's current "Approved List".
- B. Fly Ash: ASTM C 618, including Table 1A (except for footnote A), Class F except that loss on ignition shall not exceed 4.0 percent.
- C. Chemical Curing and Anti-Spalling Compound: ASTM C-309, Type 1D, Class B, with a minimum 18 percent total solids content. No thinning of material allowed.
 - 1. SureCure Emulsion, Kaufman Products, Inc. 3811 Curtis Avenue, Baltimore, MD 21226, (800) 637-6372.
 - 2. Cure & Seal by Symons Corp., 200 East Touhy Ave., PO Box 5018, Des Plaines, IL 60017-5018, (847) 298-3200.
 - 3. "Kure N Seal W" by Sonneborn Building Products, Chemrex, Inc., 889 Valley Park Dr., Shakopee, MN 55379, (800) 433-9517.
 - 4. Day-Chem Cure & Seal 26 percent (J-22) by Dayton Superior Corp., 721 Richard St., Miamisburg, OH 45342, (800) 745-3700.
 - 5. Acrylseal HS by Master Builders, Inc., 23700 Chagrin Blvd., Cleveland, OH 44122, (800) 628-9990.
- D. Type 1 Expansion Joint Filler: Preformed, resilient, non-extruding cork units; ASTM D 1752, Type II.
- E. Chamfer Strips: Wood, metal, PVC or rubber; one inch chamfer.
- F. Epoxy Bonding Agent (Adhesive): 100 percent solids epoxy-resin-base bonding compound, complying with ASTM C 881, Types I, II, IV and V, Grade 2 (horizontal areas) or Grade 3 (overhead/vertical areas), and Class B (40-60 degrees Fahrenheit) or Class C (60 degree Fahrenheit and above).
 - 1. SurePoxy HM Series by Kaufman Products, Inc., 3811 Curtis Avenue, Baltimore, MD 21226, (800) 637-6372.
 - 2. Sikadur Hi-Mod 32 by Sika Corporation, 201 Polito Avenue, Lyndhurst, NJ 07071, (800) 933-7452.
 - 3. Epogrip by Sonneborn-Chemrex, 889 Valley Park Drive, Shakopee, MN 55379, (800) 433-9517.
- G. Stone Curb: The requirements of NYSDOT Section 714-01 shall apply with the exception of all references to "bluestone", which are disallowed. Belgian block shall also comply with the requirements of ASTM C 615.

2.2 PROPORTIONING (Amendments to ACI 301, Chapter 3):

- A. Compressive Strength: Minimum 4000 psi, unless shown or specified otherwise.
 - 1. Minimum 4000 psi
- B. Weight: Normal:

- C. Durability: Concrete shall be air-entrained. Design air content shall be 6 percent by volume, with an allowable tolerance of plus or minus 1.5 percent for total air content. Entrained air shall be provided by use of an approved air-entraining admixture. Air-entrained cement shall not be used.
- D. Slump:
 - 1. 4000 psi Normal Weight Concrete: Between 2 inches and 3 inches.
- E. Admixtures: Do not use admixtures in concrete unless specified or approved in writing by the owner's representative.
- F. Selection of Proportions: Concrete proportions shall be established on the basis of previous field experience or laboratory trial batches, unless otherwise approved in writing by the owner's representative. Proportion mix with a minimum cement content of 611 pounds per cubic yard for 4000 psi concrete.
 - 1. Optional Material: Fly ash may be substituted for (Portland) cement in normal weight concrete up to a maximum of 15 percent by weight of the required minimum (Portland) cement. If fly ash is incorporated in a concrete design mix, make necessary adjustments to the design mix to compensate for the use of fly ash as a partial replacement for (Portland) cement.
 - a. Adjustments shall include the required increase in air-entraining admixture to provide the specified air content.
 - b. Lower early strength of the concrete shall be considered in deciding when to remove formwork.

2.3 REINFORCEMENT (Amendments to ACI 301, Chapter 5):

- A. Bar Reinforcement: ASTM A 615, Grade 60, deformed steel bars.
- B. Fabric Reinforcement: ASTM A 185, welded wire fabric, fabricated into flat sheets unless otherwise indicated.
- C. Bar Supports: Galvanized steel or AISI Type 430 stainless steel, and without plastic tips.
- D. Tie Wire: Black annealed wire, 16-1/2 gage or heavier.

2.4 JOINTS AND EMBEDDED ITEMS (Amendments to ACI 301, Chapter 6):

- A. Obtain bond at construction joints by the use of bonding agent (adhesive) or the use of cement grout.

2.5 PRODUCTION (Amendments to ACI 301, Chapter 7):

- A. Provide ready-mixed concrete, either central-mixed or truck-mixed.

2.6 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Use flexible or curved forms for curves of a radius 100 feet or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Do not use items of aluminum for mixing, chuting, conveying, forming or finishing concrete, except magnesium alloy tools may be used for finishing.
- B. Keep excavations free of water. Do not deposit concrete in water.
- C. Hardened concrete, reinforcement, forms, and earth which will be in contact with fresh concrete shall be free from frost at the time of concrete placement.
- D. Prior to placement of concrete, remove all hardened concrete spillage and foreign materials from the space to be occupied by the concrete.

3.2 FORMWORK (Amendments to ACI 301, Chapter 4):

- A. Chamfer all exposed external corners of concrete.

3.3 PLACING REINFORCEMENT (Amendments to ACI 301, Chapter 5):

- A. At the time concrete is placed, reinforcement shall be free of mud, oil, loose rust, loose mill scale, and other materials or coatings that may adversely affect or reduce the bond.

3.4 PLACING CONCRETE (Amendments to ACI 301, Chapter 8):

- A. Operation of truck mixers and agitators and discharge limitations shall conform to the requirements of ASTM C 94.
- B. Do not allow concrete to free fall more than 4 feet.
- C. Protect concrete from exposure to salts for sixty (60) days.

3.5 FINISHING FORMED SURFACES (Amendments to ACI 301, Chapter 10):

- A. Finish Schedule: Except where indicated otherwise on the Drawings, provide the finishes below:
 - 1. Rough Form Finish for concrete surfaces not exposed to view.
 - 2. Smooth Form Finish for vertical concrete surfaces exposed to view.
 - 3. Broom Finish for gutters and horizontal surfaces exposed to view.
- B. Finishing, General: Provide monolithic finishes on concrete without the addition of mortar or other filler material. Finish surfaces in true planes, true to line, with particular care taken during screeding to maintain an excess of concrete in front of the screed so as to prevent low spots. Screed and darby concrete to true planes while plastic and before free water rises to the surface. Do not perform finishing operations during the time free water (bleeding) is on the surface.

3.6 JOINTS

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
 - 1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
- C. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- D. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 20 feet, unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- E. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-half of the concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces. Radius shall be $\frac{1}{4}$ inch.
 - 2. Sawn Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut $\frac{1}{8}$ -inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
- F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces. Radius shall be $\frac{1}{4}$ inch.

3.7 CURING AND PROTECTION (Amendments to ACI 301, Chapter 12):

- A. Maintain concrete surfaces in a moist condition for at least 7 days after placing, except where otherwise indicated. Do not use curing compound.
 - 1. For surfaces of exterior concrete, apply chemical curing and anti-spalling compound in accordance with the recommendations of the manufacturer.

3.8 FIELD QUALITY CONTROL (Amendments to ACI 301, Chapter 16):

- A. Make available to the Owner's Representative whatever test samples are required to make tests. Furnish shipping boxes for compression test cylinders. Provide field cure box as required.

3.9 TOLLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
 - 1. Elevation: $\frac{1}{4}$ inch.
 - 2. Thickness: Plus $\frac{3}{8}$ inch, minus $\frac{1}{4}$ inch
 - 3. Surface: Gap below 10 foot long, unlevelled straightedge not to exceed $\frac{1}{4}$ inch.
 - 4. Joint Spacing: 3 inches.
 - 5. Contraction Joint Depth: Plus $\frac{1}{4}$ inch, no minus.
 - 6. Joint Width: Plus $\frac{1}{8}$ inch, no minus.

3.10 REPAIRS AND PROTECTION

- A. Remove and replace concrete that is broken, damaged, or defective, or does not meet requirements in this Section. Reasons for rejection of concrete include the following:
 - 1. Staining or discoloration of curb or gutter.

2. Curb is out of horizontal alignment more than 0.20'.
 3. Curb is out of vertical alignment more than 0.10'.
 4. Expansion joints are not perpendicular to roadway.
 5. Joints and surfaces are improperly finished.
 6. Expansion joints protrude from curb or gutter.
 7. Cracks, chips, or other damage occur in construction of maintenance period.
 8. Settlement of curb.
 9. Improper vibration of concrete.
 10. Vandalism during initial setup of concrete.
 11. Inspection of formwork not asked for by Contractor prior to pouring of curb, sidewalk or driveways.
- B. Drill test cores where directed by the Owner's Representative when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321600

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Applying white, yellow or blue pavement stripes or markings to hot mix asphalt or Portland cement concrete surfaces.
 - 2. Removal of traffic stripes and markings consists of removing all stripes or solid areas, letters, arrows and other symbols (regardless of color) from hot mix asphalt and Portland cement concrete surfaces.
 - 3. The replacement of pavement stripes and markings damaged or impacted during construction.
 - 4. The provision, maintenance and removal of temporary striping and markings as required or as directed by the Owner's Representative.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications and Standard Sheets, as currently amended through the bid date for this project.
- C. FHWA MUTCD, latest revision, with the New York State Supplement, latest revision.

1.3 SUBMITTALS

- A. Written record of existing striping condition as outlined under Section 3.1A below.
- B. Quality Control Submittals:
 - 1. Certificates: Affidavit required under Quality Assurance Article.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Chapter III of Title 6 of the official compilation of Codes, Rules and Regulations of the State of New York (Title 6 NYCRR), Part 205 Architectural Surface Coatings.

- B. Certification: Affidavit by the paint applicator, certifying that the materials comply with the current regulatory requirements in effect at the time products were delivered and applied.

1.5 PROJECT CONDITIONS

- A. Perform the painting operations after working hours, on weekends or at such time so as not to interfere with the flow of traffic. Provide temporary barriers to prevent vehicles from driving over newly painted areas.
- B. Apply paint on dry pavement surface when the air temperature is above 40 degrees F and rising.

1.6 RELATED WORK SPECIFIED ELSEWHERE

- A. Flexible Paving: Section 321200.
- B. Rigid Paving: Section 321300.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Paint: NYS DOT Section 640-2, blue longitudinal striping and hatching, as indicated, or if not indicated, as directed. Delete all references to reflectorization and glass beads.
- B. Epoxy: NYS DOT Section 727-03, white or yellow longitudinal striping, as indicated, or if not indicated, as directed. Delete all references to reflectorization and glass beads.
- C. Thermoplastic: NYS DOT Section 727-01, white or yellow markings, lettering, symbols, and hatching, as indicated, or if not indicated, as directed. Delete all references to reflectorization and glass beads.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Photograph, measure, dimension, and record in writing the existing configuration and characteristics of all striping within the project area. Submit a copy of the recorded configuration to the Owner's Representative for concurrence before proceeding.
- B. Completely remove prior striping or markings by surficial grinding. Obliteration is not permitted.
- C. Remove dust, dirt, and other foreign material detrimental to paint adhesion.

- D. Mark layout of stripes and lines with chalk or paint.

3.2 APPLYING PAVEMENT MARKINGS

- A. Apply paint in accordance with NYS DOT Section 640-3, except as follows:
 - 1. Delete references to reflectorization or glass beads.
- B. Apply epoxy in accordance with NYS DOT Section 685-3, except as follows:
 - 1. Delete references to reflectorization or glass beads.
- C. Apply thermoplastic in accordance with NYS DOT Section 687-3, except as follows:
 - 1. Delete references to reflectorization or glass beads.
- D. Allow markings to cure before removing traffic control and opening to traffic. Any damage to the installation shall be repaired by Contractor by grinding the damaged striping or markings and reapplying the striping or markings in accordance with the requirements provided above.

END OF SECTION 321723

SECTION 323113 - CHAIN LINK FENCES & GATES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Installation of fencing consisting of PVC coated hot-dipped galvanized steel chain link fabric and hot-dipped galvanized steel framework.
 - 2. Installation of gates consisting of PVC coated hot-dipped galvanized steel chain link fabric and hot-dipped galvanized steel framework at the locations shown on the plans.
- B. RELATED WORK SPECIFIED ELSEWHERE:
 - 1. Earth Moving: Section 312000.

1.2 RELATED DOCUMENTS

- A. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

1.3 SUBMITTALS

- A. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence and gateposts, fabric, gates and accessories.
- B. Shop drawings showing location of fence, gates, each post, and details of post installation, extension arms, gate swing, hardware, and accessories. A licensed New York Professional Engineer shall prepare a structurally sound gate design and shop drawing. These materials shall be provided for review.

1.4 QUALITY ASSURANCE

- A. Chain Link Materials
 - 1. Installer Qualifications: Engage an experienced Installer who has at least three years experience and has completed at least five chain link fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.
 - 2. Single-Source Responsibility: Obtain chain link fences and gates, including accessories, fittings, and fastenings, from a single source.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for fences and gates shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 FABRIC

- A. Selvage: Knuckled on both selvages.
- B. Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 12 feet and less in height to comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" and with requirements indicated below:
1. Mesh and Wire Size:
Chain Link Fence: 2-inch mesh, 0.148-inch diameter (9 gauge).
Tennis Chain Link Fence: 1 ¾ inch mesh, 0.120" diameter (11 gauge).
 2. Coating: Hot-dipped galvanized, PVC Coating, Color shall be black

2.2 FRAMING

- A. Round member sizes are given in actual outside diameter (OD) to the nearest thousandth of inches. Round fence posts and rails are often referred to in ASTM standard specifications by nominal pipe sizes (NPS) or the equivalent trade sizes in inches. The following indicates these equivalents all measured in inches:

Actual OD	NPS Size	Trade Size
1.315	1	1⅜
1.660	1¼	1⅝
1.900	1½	2
2.375	2	2½
2.875	2½	3
3.500	3	3½
4.000	3½	4
6.625	6	6⅝
8.625	8	8⅝

- B. Fence: Galvanized-steel tubing posts and rails conforming to ASTM F 761 with a minimum outside protective coating of 0.6 oz. of zinc per sq. ft., a chromate conversion coating, and a clear polymer overcoat. Provide inside protective coating of 0.6 oz. of zinc per sq. ft. or 81 percent, 0.3-mil-thick zinc pigmented coating. Provide the following sizes of framing members with round galvanized-steel gate posts conforming to ASTM F 654.

1. Top Rail: 1-5/8" trade size.

2. Fence posts for fabric up to 6 feet high.
 - a. Line Posts: 2-1/2" trade size.
 - b. Terminal and Corner Posts: 3" trade size.
- C. Type I Round Posts: Standard weight (schedule 40) galvanized-steel pipe conforming to ASTM F 1083, according to heavy industrial requirements of ASTM F 669, Group IA, with minimum yield strength of 25,000 psi, not less than 1.8 oz. of zinc per sq. ft. Type A coating inside and outside according to ASTM F 1234, as determined by ASTM A 90, and weights per foot as follows:

Actual OD (lb/ft)		Weight Size	NPS
1.315	1.68	1	
1.660	2.27	1¼	
1.900	2.72	1½	
2.375	3.65	2	
2.875	5.79	2½	
3.500	7.58	3	
4.000	9.11	3½	
6.625	8.97	6	
8.625	28.55	8	

- D. Top Rail: Manufacturer's longest lengths (17 to 21 feet) with wedged-end or expansion-type coupling, approximately 6 inches long for joining. Provide rail ends or other means for attaching top rail securely to each gate corner, pull, and end post.

Round Steel: 1-5/8" trade size Type I steel pipe.

- E. Steel posts for fabric heights up to 6 feet:
 1. Round Line or Intermediate Posts: 2-1/2" trade size Type I steel pipe.
 2. Round End, Corner, and Pull Posts: 3" trade size Type I steel pipe.
- F. Coating:
 1. All framing shall be PVC-coated.
 2. Color shall be black.

2.3 FITTINGS AND ACCESSORIES

- A. Material: Comply with ASTM F 626. Galvanized steel to suit manufacturer's standards.
 1. Steel: Unless specified otherwise, hot-dip galvanize pressed steel fence, fittings and accessories with at least 1.2 oz. zinc per sq. ft. as determined by ASTM A 90.
- B. Post and Line Caps: Provide weathertight closure cap for each post. Provide line post caps with loop to receive tension wire or top rail.

- C. Post Brace Assembly: Manufacturer's standard adjustable brace. Use material specified below for brace, and truss to line posts with 3/8-inch-diameter rod and adjustable tightener. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.
 - 1. Round Steel: 1-5/8" trade size Type I steel pipe.
- D. Bottom and Center Rail: Same material as top rail. Provide manufacturer's standard galvanized-steel, cast-iron or cast-aluminum cap for each end.
- E. Tension or Stretcher Bars: Hot-dip galvanized steel with a minimum length 2 inches less than the full height of fabric, a minimum cross section of 1/4 inch by 3/4 inch, and a minimum of 1.2 oz. of zinc coating per sq. ft. Provide one bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into the post.
- F. Tension and Brace Bands: 3/4-inch-wide minimum hot-dip galvanized steel with a minimum of 1.2 oz. of zinc coating per sq. ft.
 - 1. Tension Bands: 0.074 inch thick (14 gage) minimum.
 - 2. Brace Bands: 0.105 inch thick (12 gage) minimum.
- G. Tension Wire: 0.177-inch-diameter metallic-coated steel marcelled tension wire conforming to ASTM A 824 with finish to match fabric.
 - 1. Coating Type I aluminum with a minimum coating weight of 0.40 oz. per sq. ft. as determined by ASTM A 428.
 - 2. Coating Type II zinc in the following class as determined by ASTM A 90.
 - a. Class 1, with a minimum coating weight of 0.80 oz. per sq. ft. of uncoated wire surface.
 - b. Class 2, with a minimum coating weight of 1.20 oz. per sq. ft. of uncoated wire surface.
 - c. Class 3, with a minimum coating weight of 2.00 oz. per sq. ft. of uncoated wire surface.
- H. Tie Wires: 0.106-inch-diameter (12-gage) galvanized steel with a minimum of 0.80 oz. per sq. ft. of zinc coating according to ASTM A 641, Class 3 or 0.148-inch-diameter (9-gage) aluminum wire alloy 1350-H19 or equal, to match fabric wire. Select and edit, if required, one of four subparagraphs below to suit Project. Verify local availability before selecting species and grade.
- I. Coating:
 - 1. All Fittings and accessories shall be PVC-coated.
 - 2. The color shall be black.

2.5 CONCRETE

- A. Concrete: Provide concrete consisting of portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain 4000 psi concrete. Use at

least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.

2.6 GATES

- A. Residential Fences: Fabricate gates according to ASTM F 654.
- B. Fabricate perimeter frames of gates from same material and finish as fence framework. Assemble gate frames by welding. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members maximum of 8 feet apart unless otherwise indicated.
 - 1. Fabric: Same as for fence unless otherwise indicated. Secure fabric at vertical edges with tension bars and bands and to top and bottom of frame with tie wires.
 - 2. Bracing: Install diagonal cross-bracing consisting of 5/16-inch-diameter adjustable-length truss rods on gates to ensure frame rigidity without sag or twist.
- C. Swing Gates: Comply with ASTM F 900.
 - 1. Steel: Gates up to 8 feet wide:
 - a. Up to 6 Feet High: Fabricate perimeter frames of 1.660-inch minimum OD Type I steel pipe.
 - 2. Gate Hardware: Provide galvanized hardware and accessories for each gate according to the following:
 - a. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180-degree gate opening. Provide 1-1/2 pair of hinges for each leaf over 6-foot nominal height.
 - b. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as an integral part of latch.
 - c. Keeper: Provide a keeper for vehicle gates that automatically engages gate leaf and holds it in the open position until manually released.
 - d. Gate Stops: Provide gate stops for double gates consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage a center drop rod or plunger bar. Include a locking device and padlock eyes as an integral part of the latch, permitting both gate leaves to be locked with a single padlock.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install fence to comply with ASTM F 567. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
- B. Apply fabric to outside of framework.
- C. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.

1. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
 2. Unless otherwise indicated, excavate hole depths approximately 6 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.
- D. Setting Posts: Center and align posts in holes 6 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
1. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations.
 2. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to a crown to shed water.
- E. Top Rails: Run rail continuously through line post caps, bending to radius for curved runs and at other posts terminating into rail end attached to posts or post caps fabricated to receive rail. Provide expansion couplings as recommended by fencing manufacturer.
- F. Center Rails: Install center rails in one piece between posts and flush with post on fabric side, using rail ends and special offset fittings where necessary.
- G. Brace Assemblies: Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail. Install so posts are plumb when diagonal rod is under proper tension.
- H. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric before stretching fabric and tie to each post with not less than same gage and type of wire. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.
- I. Top Tension Wire: Install tension wire through post cap loops before stretching fabric. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter (11-gage) hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c.
- J. Fabric: Leave approximately 2 inches between finish grade and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains under tension after pulling force is released.
- K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not over 15 inches o.c.
- L. Tie Wires: Use wire of proper length to secure fabric firmly to posts and rails. Bend ends of wire to minimize hazard to persons or clothing.
1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to rails and braces 24 inches o.c.

- M. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

3.3 GATE INSTALLATION

- A. Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary. Install gates according to manufacturer's instructions, plumb, level, and secure.

END OF SECTION 323113

SECTION 323199 - ORNAMENTAL FENCES & GATES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Installation of fencing consisting of fence, posts, framework, hardware, anchorage, fasteners, footings, and accessories.
 - 2. Installation of gates consisting of gates, posts, framework, hardware, anchorage, fasteners, footings, and accessories.
- B. RELATED WORK SPECIFIED ELSEWHERE:
 - 1. Earth Moving: Section 312000.
 - 2. Segmental Retaining Walls: Section 323223.
 - 3. Cast-in-Place Concrete: Section 033000.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Section, apply to this section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. ASTM International (ASTM):
 - 1. ASTM B117 - Operating Salt Spray (Fog) Apparatus.
 - 2. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM B221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 4. ASTM D822 - Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
 - 5. ASTM D2794 - Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - 6. ASTM D3363 - Test Method for Film Hardness by Pencil Test.

1.3 SUBMITTALS

- A. Product data in the form of manufacturer's technical data, specifications, and installation instructions for fence, fabric, components, and accessories.

1.4 Shop drawings showing location of fence, layout, dimensions, profiles, each post, and details of post installation, extension arms, hardware, anchorage details, and accessories. A licensed New York Professional Engineer shall prepare the retaining wall fence design including fall protection and shop drawing. These materials shall be provided for review.

- A. Provide 20-year warranty for factory finish against cracking, peeling, and blistering under normal use, acceptable to the Owner's Representative.

1.5 QUALITY ASSURANCE

A. Fence Materials

1. **Installer Qualifications:** Engage an experienced Installer who has at least three years' experience and has completed at least five fence projects with same material and of similar scope to that indicated for this Project with a successful construction record of in-service performance.
2. **Single-Source Responsibility:** Obtain fences, including accessories, fittings, and fastenings, from a single source where possible and as described in the Section 2 Products of this specification.

1.6 PROJECT CONDITIONS

- A. **Field Measurements:** Verify layout information for fences shown on the Drawings in relation to the property survey and existing structures. Verify dimensions by field measurements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Fence at police department parking lot fence and above retaining wall: Ametco Manufacturing Corporation, 4326 Hamann Parkway, P.O. Box 1210, Willoughby, Ohio 44096; 800-362-1360, models Galaxy and Sedona, as shown on plans.
- B. Fence at North property line: Illusions Vinyl Fence, manufactured and nationally distributed by Eastern Wholesale Fence, LLC, 266 Middle Island Road, Medford, NY 11763, model V300 Solid Vinyl Privacy Style fence system with Sweep 1 Rail Taper, as shown on the plans.

- C. Requests to use equivalent products of other manufacturers shall be submitted and must meet all requirements of this specification and must be acceptable to the Owner's Representative.

2.2 MATERIALS

- A. Extruded aluminum: ASTM B221, Alloy 6063, Temper T-6.
- B. Sheet aluminum: ASTM B209, Alloy 6063, Temper T-6.
- C. Vinyl Fence: Compliance with ASTM F964-13
- D. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing additives.

2.3 FENCE SYSTEM

- A. Ametco Galaxy Fence System: 1/2 by 4-inch extruded aluminum tubular blades spaced vertically 3-1/2 inches on center. Fence weighs 1.75 psf.
 - 1. Type: System of extruded aluminum vertical blades with extruded aluminum frame to be field attached to aluminum posts; Galaxy Aluminum Fencing as manufactured by Ametco Manufacturing Corporation.
 - 2. Blades: Ridged, tubular aluminum sections equally spaced on 3-1/2 inch centers.
 - a. Size: 1/2 by 2 inch
 - b. Material thickness: 0.09 inch
 - 3. Fence height: as indicated on Drawings.
- B. Ametco Sedona Fence System: 1/2 by 2 inch and 1/2 by 4-inch extruded aluminum tubular alternating blades spaced either vertically or horizontally. Opening between blades can range from 1 to 4 inches. Fence weight with 1 inch opening space is 2 psf.
 - 1. Blades: Two widths of rigid, tubular aluminum section installed horizontally or vertically as directed by the Owner's Representative in an alternating pattern:
 - a. Size: 1/2 by 2 inch and 1/2 by 4 inch.
 - b. Material thickness: 0.09 inch.
 - 2. Fence height: as indicated on Drawings.
- C. V300 Solid Vinyl Privacy Style Fence System:
 - 1. Top Rail Size: 1-1/2 by 5-1/2 inch

2. Bottom Rail Size: 1-1/2 by 5-1/2 inch reinforced with a galvanized steel channel.
3. Picket Size: 7/8 by 6 inch tongue and groove.
4. Fence height: as indicated on Drawings.

2.4 GATES

- A. Provide gates of type and size indicated on Drawings. Equip gates with manufacturer's standard hardware as required for complete functional operation.
- B. Hinged swinging single man gate shall be installed as shown on the plans.
 1. Construction: Welded frame fabricated from extruded aluminum tubing with aluminum tubing with aluminum fixed blade panels to match fencing design and material.
 2. Nominal Size: 3' wide
 3. Hardware:
 - a. Hinges: Size and type shall be as determined by the manufacturer. Provide 2 hinges for each leaf up to 6 feet high and 1 additional hinge for each additional 24 inches in height above 6 feet.
 - b. Latch: 3/4 inch diameter slide bolt to accommodate padlock.

2.5 ACCESSORIES

- A. Fasteners: Stainless steel bolts of type, size, and spacing as recommended by fence manufacturer for specific condition.
- B. End caps: Provide aluminum caps for exposed open extruded aluminum sections and for attachment of components to posts.
- C. For exposed locations, provide anti-intruder bolts consisting of cup-head bolt and nut with clamping hexagon such that tightening shears hexagon and render bolt impossible to release.

2.6 FACTORY FINISH

- A. Color for fencing by Ametco shall be: Black or Dark Bronze for the Galaxy Fence System and custom color selected by Owner's Representative for the Sedona Fence System, as shown on the plans.
- B. Color for fencing by Illusions shall be as directed by the Owner's Representative.

2.7 CONCRETE

- A. Concrete: Provide concrete consisting of Portland cement per ASTM C 150, aggregates per ASTM C 33, and potable water. Mix materials to obtain 4000 psi concrete. Use at least four sacks of cement per cu. yd., 1-inch maximum size aggregate, 3-inch maximum slump.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to fabrication, field verify required dimensions.

3.2 INSTALLATION

- A. Install fencing in accordance with manufacturer's installation instructions, approved shop drawings, and approved ASTM sections in Section 1.2, subsection C of this specification. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
- B. Install fence posts plumb and level in accordance with manufacturer's installation instructions. Temporarily brace fence posts with wood supports until concrete and grout is set.
 - 1. Excavation: Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
 - a. If not indicated on Drawings, excavate holes for each post to minimum diameter recommended by fence manufacturer, but not less than four times the largest cross section of post.
 - b. Unless otherwise indicated, excavate hole depths approximately 6 inches lower than post bottom, with bottom of posts set not less than 36 inches below finish grade surface.
 - 2. Setting Posts: Center and align posts in holes 6 inches above bottom of excavation. Space a maximum of 10 feet o.c., unless otherwise indicated.
 - a. Protect portion of posts above ground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
 - b. Unless otherwise indicated, extend concrete footings 2 inches above grade and trowel to a crown to shed water.
- C. Do not install bent, bowed, or otherwise damaged components. Remove damaged components from site and replace.
- D. Secure fence panels and rails with standard stainless steel bolts to fence posts after posts have been set in footings.

- E. Install gates and adjust hardware for smooth operation. After installation, test gate. Open and close a minimum of five times. Correct deficiencies and adjust.
- F. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.
- G. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts for added security.

END OF SECTION 323113

SECTION 323223 - SEGMENTAL RETAINING WALLS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. This Section uses the term Architect. Change this term as necessary to match the actual term used to identify the design professional as defined in the General and Supplementary Conditions. GENERAL
- B. Work shall consist of furnishing and construction of a segmental retaining wall system in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.
- C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings.
- D. This section is to be in conformance with all requirements discussed in the New York State Department of Transportation's Standard Specifications, latest edition.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- 1. Section 312000 "Earth Moving"

1.3 RELATED DOCUMENTS

- A. Engineering Design
 - 1. NCMA Design Manual for Segmental Retaining Walls, Second Edition.
 - 2. NCMA TEK 2-4 – Specifications for Segmental Retaining Wall Units.
 - 3. NCMA SRWU-1 – Determination of Connection Strength between Geosynthetics and Segmental Concrete Units.
 - 4. NCMA SRWU-2 – Determination of Shear Strength between Segmental Concrete Units.
- B. Segmental Retaining Wall Units
 - 1. ASTM C 140 – Sampling and Testing Concrete Masonry Units.
 - 2. ASTM C 1262 – Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.
 - 3. ASTM C 33 – Specification for Concrete Aggregates.
 - 4. ASTM C 90 – Standard Specification for Load-Bearing Concrete masonry Units.
 - 5. ASTM C 150 – Specification for Portland Cement.
 - 6. ASTM C 595 – Specification for Blended Hydraulic Cements.

- C. Work includes preparing foundation soil, furnishing, and installing leveling base pad, drainage soil and retained soil to the lines and grades shown on the construction drawings.
- D. Geotextile Filter
 - 1. ASTM D 4751 – Standard Test Method for Apparent Opening Size
- E. Geosynthetic Reinforcement
 - 1. ASTM D 4595 – Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - 2. ASTM D 5262 – Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics.
 - 3. GRI GG-1: Single Rib Geogrid Tensile Strength
 - 4. GRI GG-5: Geogrid Pullout
 - 5. GRI GG-6: Geotextile Pullout
- F. Soils
 - 1. ASTM D 1557 – Moisture Density Relationship for Soils, Modified Method
 - 2. ASTM D 422 – Gradation of Soils
 - 3. ASTM D 424 – Atterburg Limits of Soils
 - 4. ASTM D G51 – Soil pH
 - 5. ASTM D 3034 – Specification for Polyvinyl Chloride (PVC) Plastic Pipe
 - 6. ASTM D 1248 – Specification for Corrugated Plastic Pipe
- G. Where specification and reference documents conflict, the Owner's Representative shall make the final determination of applicable document.

1.4 SUBMITTALS/CERTIFICATION

- A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.
- B. Contractor shall submit construction drawings and design calculations for retaining wall systems greater than 2 ½ feet of exposed height prepared and stamped by a Professional Engineer registered in the state of New York. The segmental retaining wall shall be designed in accordance with recommendations of the NCMA Design Manual for Segmental Retaining Walls, Second Edition. The Contractor shall submit four (4) original copies of all shop drawings for review (Two (2) copies for the Owner's representative and two (2) copies to be returned to the Contractor upon execution). Fax submissions of shop drawings for review and approval shall not be accepted.
 - 1. The following is a summary of the minimum factors of safety for the various modes of failure evaluated in the proposed design.
 - a. External Stability

- 1) Base Sliding 1.5
 - 2) Overturning 2.0
 - 3) Bearing Capacity 2.0
 - 4) Global Stability 1.3
- b. Internal Stability
 - 1) Tensile Overstress 1.0
 - 2) Pullout 1.5
 - 3) Internal Sliding 1.5
- c. Local Stability
 - 1) Facing Shear 1.5
 - 2) Connection 1.5
2. Slopes above and below all sections of the segmental retaining wall are detailed in the site grading plan.
3. The minimum wall embedment shall be the greater of:
 - a. The height of a SRW unit,
 - b. 150 mm (0.5 ft) or,
 - c. The minimum embedment required because of the slope below the wall:
 - d.

Slope Below Wall	Minimum Embedment
Level	H/10
3 : 1 (18.4 deg)	H/10
2 : 1 (26.5 deg)	H/7
4. The following surcharge shall be applied to the top of each design cross section based on the following proposed use above the wall.

Use Above Wall	Minimum Surcharge
Light Duty	4.8 kPa (100 lb/sq.ft)
5. State of Stress
 - a. The lateral earth pressure to be resisted by the reinforcement at each reinforcement layer shall be calculated using Coulomb coefficient of earth pressure, K_a , times the vertical stress at each reinforcement layer.
 - b. The vertical soil stress at each reinforcement layer shall be taken equal to the unit weight of the soil times the depth to the reinforcement layer below the finished grade behind the facing units. A coefficient of active earth pressure, K_a , shall be used from the top to the bottom of the wall. The coefficient of active earth pressure, K_a , shall be assumed independent of all external loads except sloping fills. For sloping fills,

the coefficient of active earth pressure, K_a , appropriate for the sloping condition, using Coulomb earth pressure shall be used in the analysis.

6. Inclination of Failure Surface

- a. A coulomb failure surface passing through the base of the wall at the back of the reinforced zone up to the ground surface at or above the top of the wall shall be assumed in design of walls.

7. Geosynthetic Reinforcement

- a. The allowable reinforcement tension shall be determined in accordance with the method outlined in the NCMA Design Manual for Segmental retaining Walls, Second Edition. This method calculates the Long Term Design Strength (LTDS.) of the geosynthetic reinforcement by considering the time-temperature creep characteristics of the reinforcement, environmental degradation, construction induced damage and an overall factor of safety.

8. Geogrid Length

- a. The minimum soil reinforcement length shall be as required to achieve a minimum width of structure, B, measured from the front face of the wall to the end of the soil reinforcements. B must be greater than or equal to 60 percent of the total height, H. The length of the reinforcements at the top of the wall may be increased beyond the minimum length required to increase pullout resistance.

9. Global Stability

- a. The shop drawing submittal shall ensure adequate global/overall slope stability.

- C. Contractor shall submit a test report documenting strength of specific modular concrete unit and geogrid reinforcement connection. The maximum design tensile load of the geogrid shall be equal to the laboratory tested ultimate strength of geogrid / facing unit connection at a maximum normal force limited by the "Hinge Height" of the structure divided by a safety factor of 1.5. The connection strength evaluation shall be performed in accordance with NCMA test method SRWU-1.

1.5 QUALITY ASSURANCE

- A. Contractor shall submit certification, prior to start of work, that the retaining wall system (modular concrete units and specific geogrid):
 1. has been successfully utilized on a minimum of five (5) similar projects, i.e., height, soil fill types, erection tolerances, etc.; and
- B. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been

constructed successfully. Contact names and telephone numbers shall be listed for each project.

- C. Contractor shall provide evidence that the design engineer has a minimum of five years of documentable experience in the design for reinforced soil structures.
- D. Soil testing and quality assurance inspection during earthwork and wall construction operations shall be provided in accordance with the requirements of Division 01. Owner's quality assurance program does not relieve the Contractor of responsibility for wall performance.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.
- B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

1.7 DEFINITIONS

- A. Modular Concrete Retaining Wall Units – dry-cast solid concrete units that form the external fascia of the modular unit retaining wall system.
- B. Infill Soil – specified material that is placed directly behind the drainage soil and within the reinforced zone, if applicable.
- C. Retained Soil – an in-situ soil or a specified soil that is placed behind the wall infill soil.
- D. Foundation Soil – the in-situ soil beneath the wall structure.
- E. Drainage Aggregate – a free draining soil with natural soil filtering capabilities, or a free draining soil encapsulated in a suitable geotextile, or a combination of free draining soil and perforated pipe all wrapped in a geotextile, placed directly behind the modular concrete units.
- F. Drainage Pipe – a perforated pipe used to carry water, collected at the base of the soil retaining wall, to outlets in order to prevent pore water pressures from building up behind the wall facing modules.
- G. Non-woven Geotextiles – permeable synthetic fabrics formed from a random arrangement of fibers in a planar structure. They allow the passage of water from one soil medium to another while preventing the migration of fine particles that might clog a drainage medium.
- H. Geogrid Reinforcement – a polymer grid structure having tensile strength and durability properties that are suitable for soil reinforcement applications.

1.8 SOIL PARAMETERS:

- A. The Contractor shall obtain values for the following parameters for retained soil and foundation soil and submit same for review during the retaining wall construction drawing submittal process:

B. RETAINED SOIL

1. The retained soil shall be imported and select fill and approved by the Owner's Representative.
2. The effect of the retaining wall and retained soil on undisturbed native soil shall have a minimum allowable bearing pressure of 2 tsf, which the native soils can accommodate.
3. The following backfill soil parameters shall be used for the design:

<u>Soil Parameter</u>	<u>In-Situ Soils</u>
Angle of internal friction of backfill	34°
Active earth pressure coefficient (Ka) for horizontal backfill surface	0.28
At rest earth pressure coefficient (Ko) for horizontal backfill surface	0.44
Passive earth pressure coefficient	3.54
Coefficient of base friction	0.40
Total unit weight of soil (lb/ft ³)	125

C. FOUNDATION SOIL

1. The foundation Soil shall be the native undisturbed on site soils. The foundation soil shall be examined and approved by the Engineer prior to the placement of the base material.
2. The effect of the retaining wall and retained soil on undisturbed native soil shall have a minimum allowable bearing pressure of 2 tsf, which the native soils can accommodate.
3. The following foundation soil parameters shall be used for the design:

<u>Soil Parameter</u>	<u>In-Situ Soils</u>
Angle of internal friction of backfill	38°
Active earth pressure coefficient (Ka) for horizontal backfill surface	0.24
At rest earth pressure coefficient (Ko) for horizontal backfill surface	0.38
Passive earth pressure coefficient	4.2
Coefficient of base friction	0.40

Total unit weight of soil (lb/ft³)

130

PART 2 - PRODUCTS

2.1 MODULAR CONCRETE RETAINING WALL UNITS

- A. Modular concrete units shall conform to the following architectural requirements:
 - 1. Face Color - standard manufacturers' color to be specified by the Owner's representative.
 - 2. Bond Configuration - running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.
 - 3. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused lighting.
- B. Modular concrete units shall conform to the following structural and geometric requirements measured in accordance with appropriate references:
 - 1. compressive strength = 5000 psi minimum for 28-day compressive strength as tested in accordance with ASTM C 140;
 - 2. absorption = 5 % maximum for the concrete to ensure adequate freeze-thaw protection;
 - 3. dimensional tolerances = $\pm 1/8$ " from nominal unit dimension;
 - 4. unit size - 6" (H) x 8" (W) x 12" (D) minimum;
 - 5. unit weight - 45 lbs/solid unit minimum for the retaining wall modules;
- C. Manufacturer and System (or approved equal)
 - 1. Unilock, 845-469-1230
 - 2. Pisa2

2.2 SHEAR CONNECTORS

- A. Shear connectors shall be an integral shear key connection that shall be offset to permit a minimum wall batter of 1H:8V.
- B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.3 INFILL SOIL

- A. The infill soil shall consist of free draining sands or gravels with less than 5% passing the #200 sieve size. Select fill (as defined under 31 20 00 (2.1) (A)) may be used if the percent passing the #200 sieve does not exceed five (5) percent.

2.4 RETAINED SOIL

- A. The retained soil shall be select fill approved by the Owner's representative.

2.5 FOUNDATION SOIL

- A. The foundation Soil shall be the native undisturbed on site soils. The foundation soil shall be examined and approved by the Owner's representative prior to the placement of the base material.

2.6 LEVELING BASE MATERIAL

- A. The footing material shall be non-frost susceptible, well graded compacted crushed stone (GW-Unified Soil Classification System), or a concrete leveling base, or as shown on the Construction Drawings.

2.7 DRAINAGE SOIL

- A. Unit drainage fill shall consist of clean 1" plus/minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch	100
3/4 inch	75-100
No. 4	0 - 10
No. 50	0 - 5

- B. One cubic foot, minimum, of drainage fill shall be used for each square foot of wall face. Drainage fill shall be placed within cores of, between, and behind units to meet this requirement.
- C. No heavy compaction equipment shall be allowed within three (3) feet off the back of the wall fascia.

2.8 DRAINAGE PIPE

- A. The drainage pipe shall be perforated corrugated HDPE or PVC pipe, with a minimum diameter of 4 inches, protected by a geotextile filter to prevent the migration of soil particles into the pipe, or as specified on the construction drawings.

2.9 GEOTEXTILE FILTER

- A. The non-woven geotextile shall be installed as specified on the construction drawings. Although selection of the appropriate geotextile specification is site soil specific, a commonly used geotextile for filtration will have an Apparent Opening Size ranging between U.S. Sieve Sizes 100 to 70 (between 0.149 and 0.210 mm) and a minimum unit weight of 135 grams per square meter (4.0 oz / square yard). The coefficient of permeability will typically range between 0.1 and 0.3 cm/second.

2.10 GEOGRID REINFORCEMENT

- A. The design Engineer shall determine the type, strength, and placement location of the reinforcing geosynthetic. The design properties of the reinforcement shall be determined according to the procedures outlined in this specification.
- B. Detailed test data shall be submitted with the design calculations and shall include tensile strength (ASTM D 4595 or GGI GG-1), creep potential (ASTM D 5262), site damage and durability (GRI GG-4) and pullout resistance (GRI GG-5 or GRI-GT-6) and connection strength (NCMA SRWU-1).

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Contractor is responsible for meeting all the requirements of the specification. This includes the use of approved materials and their proper installation.

3.2 SITE PREPARATION

- A. The foundation soil shall be excavated or filled as required to the grades and dimensions on the Construction Drawing or as directed by the Owner's representative.
- B. The foundation soil shall be proof rolled and examined by the Owner's representative to ensure that it meets the minimum strength requirements according to the design assumptions. If unacceptable foundation soil is encountered, the contractor shall excavate the affected areas and replace with suitable quality material under the direction of the Owner's representative.
- C. In cut situations, the native soil shall be excavated to the lines and grades shown on the Construction Drawings and removed from the site or stockpiled for reuse as retained soil.
- D. All work shall be performed in accordance with the requirements of Section 02300, "Earthwork."

3.3 INSTALLING DRAINAGE SYSTEM

- A. The approved non-woven geotextile shall be set against the back of the first retaining wall unit, over the prepared foundation, and extend towards the back of the excavation, up the excavation face and back over the top of the infill soil to the retaining wall, or as shown in the Construction Drawings.
- B. The drainage pipe shall be placed behind the leveling base, or lower course of facing units as shown in the Construction Drawings or as directed by the Engineer. The pipe shall be laid at a minimum gradient of 2% to ensure adequate drainage to free outlets.
- C. T-Sections and outlet pipes shall be installed on the drainage pipe at 50 feet centers or as shown on the Construction Drawings.

- D. The remaining length of geotextile shall be pulled taut and pinned over the face of the retained soil. Geotextile overlaps shall be a minimum of one (1) foot and shall be shingled down the face of the excavation to prevent the infiltration of retained soil into the wall infill.

3.4 LEVELING BASE

- A. The leveling base material shall be crushed stone compacted to 95% Modified Proctor Density, or vibrated concrete along the grades and dimensions shown on the Construction Drawings.
- B. The minimum thickness of the leveling base shall be 6 inches.

3.5 INSTALLATION OF MODULAR CONCRETE RETAINING WALL UNITS

- A. The bottom row of retaining wall modules shall be placed in the prepared leveling base as shown on the Construction Drawings. Care shall be taken to ensure that the wall modules are aligned properly, leveled from side to side and front to back and are in complete contact with the base material.
- B. The wall modules above the bottom course shall be placed such that the tongue and groove arrangement provide the design batter (i.e., setback) of the wall face.
- C. Successive courses shall be placed to create a running bond pattern with the edge of all units being approximately aligned with the middle of the unit in the course below it.
- D. The wall modules shall be swept clean before placing additional levels to ensure that no dirt, concrete or other foreign materials become lodged between successive lifts of the wall modules.
- E. A maximum of 4 courses of the wall units can be placed above the level of the infill soil at any time.
- F. The contractor shall check the level of wall modules with each lift to ensure that no gaps are formed between successive lifts that may affect the pullout resistance of geogrid reinforcement, if applicable.
- G. Care shall be taken to ensure that the wall modules and geosynthetic reinforcement are not broken or damaged during handling and placement.
- H. Coordinate installation with proposed surface drainage system and associated penetrations, as well as with fence support system.

3.6 DRAINAGE SOIL

- A. The drainage soil will be placed behind the retaining wall modulus with a minimum width of one (1) foot and separates from other soils using the approved nonwoven geotextile.

- B. Drainage soil shall be placed behind the wall facing in maximum lifts of six (6) inches and compacted to a minimum density of 95% Modified Proctor.
- C. No heavy compaction equipment shall be allowed within three (3) feet or one (1) meter off the back of the wall fascia.

3.7 INFILL SOIL

- A. Wall infill soil shall be placed behind the first course of the wall facing units in maximum lifts of six (6) inches and compacted to a minimum density of 95% Modified Proctor. At the specified elevations, geogrid reinforcement shall be placed, as described in section 3.8. The fill shall be placed and compacted level with the top of the wall modules at the specified geogrid elevations prior to placing the geogrid reinforcements.
- B. Wall infill soil shall be placed on top of the geogrid reinforcement layers in maximum lifts of six (6) inches and compacted to a minimum of 95% Modified Proctor Density. Care shall be taken to ensure that the geogrid lays flat and taut during placement of the infill soil. This is best achieved by placing fill on top of the geogrid near the wall fascia and spreading towards the back of the infill soil zone.
- C. No tracked construction equipment shall be allowed to operate directly on top of the geogrid until a minimum thickness of six (6) inches of fill has been placed. Rubber tired equipment may drive on top of the geo grid at slow speed but should exercise care not to stop suddenly or make sharp turns. No heavy equipment shall be allowed within three (3) feet or one (1) meter off the back of the wall.

3.8 GEOGRID SOIL REINFORCEMENT

- A. Pre-cut sections of geogrid reinforcement shall be placed horizontally at the specified elevations and with longitudinal axis perpendicular to the wall face (i.e., machine direction), at the elevations shown on the Construction Drawings.
- B. The geogrid shall be placed over the compacted infill soil and the wall facing units with the outside edge extending over the tongue of the bottom unit and to within one (1) inch of the front facing unit. Care shall be taken to ensure that the wall modules are swept clean and that the geogrid is in complete contact with the top and bottom faces of the adjacent wall modules. The next course of wall modules shall be carefully placed on top of the lower modules to ensure that no pieces of concrete are chipped off and become lodged between unit layers.
- C. The geogrid shall be pulled taut away from the back wall modules during placement of infill soil. Alternatively, suitable anchoring pins or staples can be used to ensure that there are no wrinkles or slackness prior to placement of the infill soil.
- D. The geogrid shall lay perfectly flat when pulled back perpendicular to the back of the wall fascia.

3.9 RETAINED SOIL

- A. Retained soils shall be placed and compacted behind the infill soil or drainage soil if applicable, in maximum lift thickness of six (6) inches. The retained soils shall be undisturbed native material or engineering fill compacted to a minimum density of 95% Modified Proctor.
- B. No heavy compaction equipment shall be allowed within three (3) feet of one (1) meter off the back of the wall modulus.

3.10 FINISHING WALL

- A. Items 3.4 to 3.9 shall be repeated until the grades indicated on the Construction Drawings are achieved.
- B. Finish grading above the wall to direct surface runoff water away from the segmental retaining wall. Use a soil with a low permeability to restrict the rate of water infiltration into the retaining wall structure.

3.11 CAP INSTALLATION

- A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.

3.12 AS-BUILT CONSTRUCTION TOLERANCES

- A. Vertical Control: ± 1.25 inches over a ten (10) foot distance, ± 3 inches total;
- B. Horizontal Control: ± 1.25 inches over a ten (10) foot distance, ± 3 inches total;
- C. Rotation: ± 2 degrees from planned wall batter;
- D. Bulging: 1.0 inch over a ten (10) foot distance.
- E. Corners, bends, curves: ± 1 ft to theoretical location.
- F. Variation in Plan Position: For ends and faces of walls in relation to property lines, buildings, and other objects, do not vary from plan dimensions by more than 1 inch or from depicted plan relationship (scaled dimensions) by more than 3 inches.
- G. Variation in Linear Wall Line: For walls indicated as straight, do not exceed 1/4 inch in 10 feet or 1 inch in 40 feet or more from a straight line.
- H. Maximum horizontal gap between erected units shall be 1/2 inch.

3.13 FIELD QUALITY CONTROL

- A. Comply with requirements of Division 2 Section "Earthwork" for in-place soil density testing.

- B. Revise subparagraph below as required by soil report or retaining wall engineering design.
- C. In each compacted backfill layer, perform at least 1 field in-place density test for each 100 feet or less of retaining wall length, but no fewer than 2 tests along a wall face. The Contractor shall engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. The Contractor's consultant shall prepare and submit reports attesting to the proper construction of the wall directly to the Owner's representative for review and approval.
- D. Testing and inspections services shall only be performed by qualified and experienced technicians and engineers.
- E. As a minimum, quality assurance testing should include foundation soil inspection, soil and backfill testing, verification of design parameters, and observation of construction for general compliance with design drawings and specifications.

3.14 ADJUSTING AND CLEANING

- A. Remove and replace segmental retaining walls of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if methods and results are approved by the Owner's representative.
 - 2. Segmental retaining walls not matching approved samples and mockups.
 - 3. Segmental retaining walls not complying with other requirements indicated.
- B. Replace in a manner that results in segmental retaining wall's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

END OF SECTION 323223

SECTION 324000 - SIGNS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Placement, erection, relocation, and/or resetting of traffic signs as indicated on the plans.
 - 2. The replacement of traffic signs damaged or impacted during construction.
 - 3. The provision, maintenance and removal of temporary traffic signs as required or as directed by the owner's representative.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. FHWA MUTCD, latest revision, with the New York State Supplement, latest revision.
- D. FHWA Standard Highway Signs, latest revision.

1.3 SUBMITTALS

- A. Shop Drawings: Show shop drawings, not necessarily to scale, but sufficient enough in detail to show color, wording, lettering size and style, overall sign size, construction details and installation details for each type of sign.

1.4 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving: Section 312000.

PART 2 - PRODUCTS

2.1 TRAFFIC SIGNS

- A. Construction Materials: Comply with the applicable requirements of NYS DOT Section 645.

B. Ground Mounted Sign Panels:

1. Posts: NYS DOT Item 645.81, 2.5 lb/ft spliced u-channel by Franklin Industries as shown on NYS DOT material detail sheets MD645E-FEZ-01 through 05, or approved equal.
2. Panel: Compliant with NYS DOT Section 645-2.02.
3. Retroreflectance: NYS DOT Section 730-05, Type III.

C. Street Sign Panels:

1. Footing: 4,000 psi concrete (min.), 38 inches (min.) embedment.
2. Posts: NYS DOT Item 645.81, 1.96 lb/ft Socket Round by Northwest Pipe Company as shown on NYS DOT material detail sheets MD645E-POZ-01 through 04, or approved equal.
3. Panel: NYS DOT Item 645.7301, Street Sign blade shall be 30 inches long to accommodate a maximum of twelve character spaces, 9 inches high, 0.080 inches (min.) thick, extruded reflective green aluminum with 6 inch high white legend (see plans for contents) by Pac Sign Company, or approved equal. Legends with more than twelve character spaces shall be provided with appropriate blade lengths increased above the 30 inch minimum in 6 inch increments to accommodate text in accordance with FHWA MUTCD standards.
4. Galvanized steel post-top bracket shall be provided with sign and be compatible with extruded aluminum blade and post diameter.
5. Retroreflectance: NYS DOT Section 730-05, Type III.

D. Temporary Traffic Control Signs

1. Posts: NYS DOT Item 645.81, 2.5 lb/ft spliced u-channel by Franklin Industries as shown on NYS DOT material detail sheets MD645E-FEZ-01 through 05, or approved equal.
2. Panel: Compliant with NYS DOT Section 645-2.02. Panels need not be reflectorized.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Erect signs in their designated locations, as indicated and in accordance with the approved shop drawings and the applicable requirements of NYS DOT Section 645.
- B. Protect surfaces and finishes from abrasion and other damage during handling and installation.
- C. Replace damaged or faulty signs.

END OF SECTION 324000

SECTION 328000 – LANDSCAPE IRRIGATION

PART 1-GENERAL

1.1 WORK INCLUDED

- A. General Contractor shall develop and install a complete automatically controlled lawn irrigation system supplied by a rain-harvesting cistern (specified elsewhere) including, but not limited to PVC pipe, fittings, sprinkler heads, electric zone valves, isolation valves, ball valves, quick coupler valves, valve boxes, control wires, sleeves, level monitoring, controllers and all necessary equipment, testing, and materials as required to provide a complete and fully operational irrigation system in accordance with the performance standards herein. Subcontracting to a specialized irrigation subcontractor is acceptable to meet installers qualifications.
- B. Cooperation and interface with the other prime contractors.
 - 1. Electrical contractor will prepare interior space, conduit, and access for the irrigation contractor to install controls, wiring in the space allocated. Electrical connections from the controls to the building electrical system will be furnished and made by the electrical contractor.
 - 2. Furnishing and installing all associated irrigation electrical equipment and wiring outside the building five (5) feet from the point of exit. The electrical contractor shall be responsible for all penetrations and connections into the proposed building.
 - 3. Construction of all piping and specialties for irrigation services outside the building. No connections will be made into the proposed building or to a potable water source.

1.2 REFERENCE SPECIFICATIONS

- A. Manufacturer's Standard Materials Cut Sheets.
- B. Manufacturer's recommended installation standards
- C. New York State Department of Transportation Standard Specifications, as currently amended.

1.3 SITE FEATURES AND UTILITIES

The contractor shall verify all site features and utilities prior to installation of the irrigation system. The contractor shall call for mark out and notify the Owner's Agent four (4) days prior to his commencement of installation of the irrigation system. The contractor shall verify all site features and utilities to but limited to the items below.

- A. Existing Landscape Plantings
- B. All Site Utilities
- C. Plumbing

- D. Architectural
- E. Electrical
- F. Mechanical

1.4 REQUIRED SYSTEM PARAMETERS

- A. Irrigation (cistern water source)
 - 1. 16,000 (min) square feet of irrigated area
 - 2. 4 zones (min)
 - 3. Delivery pressure at main control valve inlet: 50 psi (min)
 - 4. Delivery rate to furthest zone : 20 gpm (min)
 - 5. Automatic calendar controller (panel located within building)
 - 6. Remote rain sensor (panel located within building)
 - 7. Remote cistern level sensor (panel located within building)
 - 8. Rotor, spray, or drip application.
 - 9. 1 inch (min) distribution polyethylene tubing to connect each zone to a valve box adjacent to the cistern housing 4 automatic zone valves
 - 10. 1 inch (min) main pipe between cistern and distribution valve box
 - 11. Winterizing tee with threaded brass or stainless plug in cistern riser
 - 12. Main shut off ball valve
 - 13. Submersible pump with floating intake sleeve and controller, installed in most westerly cistern riser.
 - 14. Associated fittings, electrical and appurtenances
- B. On-Demand Water (cistern water source)
 - 1. Delivery pressure at furthest point: 40 psi (min)
 - 2. Delivery rate at furthest point: 12 gpm (min)
 - 3. 3 spigots (frost-free/freezless yard hydrants) adjacent to west and south faces of building (approximate location shown on plans)
 - 4. 1.5 inch (min) distribution polyethylene tubing to connect each spigot to a valve box adjacent to the cistern housing 3 manual ball valves
 - 5. 1 inch (min) main pipe between cistern and distribution valve box
 - 6. Winterizing tee with threaded brass or stainless plug in cistern riser
 - 7. Main shut off ball valve
 - 8. 2-gallon (min) pressure tank
 - 9. Bottom suction cistern pump with floating intake sleeve and controller, installed in most westerly cistern riser.
 - 10. Associated fittings, electrical and appurtenances

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Companies regularly engaged in manufacturing irrigation system materials and products, of types and sizes required as specified, whose products have been in satisfactory use in similar projects for not less than fifteen (15) years.
- B. Installer's Qualifications: Companies who have successfully designed and completed a minimum of five (5) contracts over a three (3) year period involving installation of irrigation and piping projects similar in size and scope to that required for this project. Such experiences and references shall be included in the shop drawings submitted for the project.

Codes and Standards:

1. Comply with all applicable State and Local ordinances and codes.
2. All materials and work shall meet the requirements of ASTM, AWWA, and UL.
3. Contractor shall be and experienced irrigation contractor. Include signed statement below:

I am a bona fide irrigation contractor with _____ years of installation experience and possess the equipment to complete this project within _____ days from starting the project.

Signature

Company name

1.6 SUBMITTALS

- A. Contractor shall develop a submittal package meeting the performance standards of this specification including: shop drawings, irrigation layout, zone configuration, catalog sheets for all equipment, manufacturers' data for materials to be used, and operation and maintenance information for a complete system. The Contractor shall submit legible PDF copies of the complete package with all selections clearly indicated. If providing paper copies, four (4) original binder copies of the package for review (Two (2) copies for the Owner's representative and two (2) copies to be returned to the Contractor upon execution). Fax submissions of shop drawings for review and approval shall not be accepted. Include:

1. Sprinkler Heads and spigots
2. Controllers
3. Electric Valves
4. Isolation Valves
5. Ball Valves
6. PVC Piping and SCH 40 Fittings
7. Valve Boxes
8. Control Wire
9. Wire Splices
10. Polyethylene Tubing
11. Quick Coupler Valves
12. Swing Joints
13. Level Sensors
14. Pumps

- B. Drawings of Record: At the project close a drawing of record shall be delivered to the Owner in both record mylar and digital format. Digital submissions shall be in AutoCAD, 2017 format on a compact disc in compatible format, or higher showing all the locations of the irrigation plan and any and all changes. The main elements of the drawing of record, i.e.; Main line fittings, Electric valves, gate valves, quick coupler, splice boxes and locations of ends of sleeves shall be shown on the drawing of record. All measurements shall be triangulated by means pf tape measurements, no wheel measurements will be

allowed. Contractor may use GPS. During the installation process the contractor shall keep a field copy of changes on site.

1.10 INSPECTION OF SITE

- A. The contractor shall acquaint himself/herself with all site conditions. Should utilities not shown on the plans be found during excavations, the contractor shall promptly notify the owner site agent for instructions as to further action? Failure to do so will make the Contractor liable for any and all damage that arises from his neglect.
- B. The contractor shall take the necessary precautions to protect all existing site conditions, including plant materials. Should damage be incurred, the contractor shall repair or replace the damage to its original condition at his expense.

1.11 PERMITS AND FEES

- A. Obtain all permits and pay required fees to any governmental agency having jurisdiction over the work including all inspection fees that may be required by local ordinances.

1.12 DRAWINGS, SPECIFICATIONS AND DETAILS

- A. Scale and Dimensions:
 - 1. Consider drawings and specifications as being compatible and therefore work called for by one and not the other shall be furnished and installed as though called for by both. When discrepancies exist between scale and dimensions or between the works to be accomplished by each trade, they shall be called to the attention of the project manager immediately. The project manager decision regarding such discrepancies shall be final and binding.
 - 2. Where diagrams and details not to scale have been shown to piping connections and other accessories the contractor is cautioned that these are diagrammatic only and not to be used for obtaining lineal runs or numbers and types of fittings or materials used.
 - 3. All measurements shall be verified at the site; all pipe routing is for diagrammatic purposes and shall be staked out in the field prior to installation. And approved by the Owner's representative.

1.13 PIPING ARRANGEMENTS

- A. The contractor shall make necessary adjustments in the layout of the irrigation system and the pipe routing. Should conflicts arise during installation the contractor shall obtain a change order for this adjustment to the plan. This change order shall not authorize an additional fee but shall resolve any existing site condition problems.
- B. The contractor shall not proceed with out the work order and shall provide in written assurance that such changes will not cause any extra costs due to these changes. Any work that does not receive a work order and is in conflict with existing site conditions shall be removed and reinstalled by the contractor at no expense to the owner or owner's agent.

1.14 WORKMANSHIP

- A. The Contractor shall follow the manufacturer's recommendations for installing all pipe, fittings, valves, electric valves, sprinklers, controllers and all other appurtenances. The Contractor shall also follow all standards and installation practices which have been established by all related associations and local, state, and federal codes. The Contractor shall always perform his work in a professional and orderly manner. The Contractor at all times shall have a Project Superintendent on the site who is completely familiar with all installed materials and will be responsible for the installation of all materials.

1.15 ACCURACY

- A. Lay out work as accurately as possible to the drawings. The drawings, though carefully drawn, are generally diagrammatic to the extent that swing joints, offsets, and all fittings are not shown.

1.16 COVERAGE

- A. The Contractor shall be responsible for full and complete coverage of all irrigated areas and shall make any necessary minor adjustments at no additional cost to the Owner. If not specified on the plans, the Contractor shall be responsible for proper nozzle choice and arc adjustment to assure:
 - 1. Matched precipitation of all heads within each area and zone.
 - 2. Proper flow rates not to exceed 5.0 feet/second in any piping.

1.17 REVISIONS

- A. Any major revisions to the irrigation system must be submitted and answered in written form, along with any negotiated change in contract price.

1.18 COORDINATION

- A. All work shall be coordinated with other trades on the site; any conflicts shall be resolved by the project manager in order to proceed with the work as rapidly and efficiently as possible.

1.19 GUARANTEE

- A. All work shall be guaranteed for one (1) year from date of acceptance of the completed installation against all defects in materials, equipment and workmanship. Guarantee shall cover the repair of damage to any part of the installation site resulting from leaks or other defects in materials, equipment and workmanship to the satisfaction of the owner. Repairs if required under the guarantee period shall be done at no costs to the owner. All manufacturers' extended warranties shall be transferred to owner with the caveat that any labor after the one year general contractor guarantee shall be billable by the contractor should the owner decide to use the contractor's service to install any manufacturer's equipment through extended warranty.
- B. Guarantee shall include system shut down for 1st winterization, spring start up, and 2nd winterization. The development of an approved water application schedule by the

contractor and approved by the Owner's representative. Winter damage due to improper winterizations will be the responsibility of the contractor and repairs to the irrigation system through both included winterizations shall be preformed at no cost to the Owner.

1.20 RELATED WORK SPECIFIED ELSEWHERE

Earth Moving	Section 312000
Erosion and Sediment Control	Section 312500
Turf and Grasses	Section 329200

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Subject to compliance with requirements, provide materials by the following irrigation manufacturers, or approved equal. Mixing manufacturers for single system elements is not acceptable, but multiple manufacturers for disparate elements may be submitted if operationally compatible.

THE TORO COMPANY
5825 Jasmine Street
Riverside, CA 92504
www.toro.com

BUCKNER IRRIGATION
4381 N. Brawley Ave
Fresno, CA 93722
www.bucknerirrigation.com

HUNTER
1940 Diamond Street
San Marcos, CA 92078
www.hunterindustries.com

RAINBIRD
970 West Sierra Madre Ave.
Azusa, CA 91702
www.rainbird.com

HydroPoint Data Systems
1720 Corporate Circle
Petaluma, CA 94954
www.hydpoint.com

SWISS PACIFIC (STROM)
4160 Weaver Court South

Hilliard, Ohio 43026
www.swisspacific.com

PENTAIR (STA-RITE, MYERS)
5500 Wayzata Blvd, Suite 900
Golden Valley, MN 55416-1261
www.pentair.com

GRUNDFOS
902 Koomey Road
Brookshire TX 77423
www.grundfos.com

WCM INDUSTRIES, INC.
2121 Waynoka Rd.
Colorado Springs CO 80915
www.woodfordmfg.com

2.2 MATERIALS

- A. Provide all irrigation materials and factory-fabricated products of size, types, pressure ratings and capacities as indicated. If there are any discrepancies in materials or interpretation or their use the contractor shall be responsible to obtain proper clarification before any materials are installed
- B. All materials throughout the irrigation system shall be new and undamaged and in perfect working condition.

2.3 PIPING AND FITTINGS

- A. All rigid piping 2 ½ inch and smaller shall be solvent weld SDR 21 class 200 PVC pipe, extruded from 100 percent virgin polyvinyl chloride conforming to ASTM D 2241 and shall be continuously and permanently marked with the manufacturers name, material, size and schedule or type. Pipe shall conform to all specifications form ASTM, Department of Commerce, NSFTL (NSF) or the latest revisions.
 - 1. All fittings on 2 inch and smaller shall be SCH 40 PVC conforming to ASTM D-2466. No saddle or clamp type fittings shall be used
- B. All pipes under vehicular traffic shall be sleeved by SCH 40 PVC conforming to ASTM D-1785. Sleeve sizes shall be large enough to accommodate the bell housing of the ring tight pipe or the solvent weld belled end pipe. As a minimum, **the sleeve pipe ID shall be 1 ¼ times the irrigation pipe OD at the bell housing.**
- C. All flexible piping 2 ½ inch and smaller shall be polyethylene tubing conforming to ASTM F 771 or current, and shall be continuously and permanently marked with the manufacturers name, material, size and schedule or type. Pressure rating for 1 inch tubing shall be 100 psi. Pressure rating for 1.5 inch tubing shall be 160 psi. Tubing shall be rated for direct burial.

2.3 VALVES

- A. Ball valves shall be forged brass, 600W.O.G./150WSP two piece, full port, conforming to WWV 35, type II style with T-style handles
- B. Electric control valves for each zone of irrigated area shall be sized to match the connecting pipe with pressure regulation.
- C. All electric and line size isolation valves shall be in standard composite valve boxes with extensions and lids as required.
- D. Quick coupler valves shall be 1 inch brass with swing joint with top flange to prevent QCV from being unscrewed from swing joint. Swing joint shall accommodate brass nipple to connect the QCV all QCV shall be in 10 inch round composite valve boxes with a 6 inch PVC sleeve.

2.4 VOLT ELECTRICAL WIRE

- A. All 24-volt control wires from controller to the electric valves shall be #14/1 red wire for direct burial. All 24-volt common wire from the controller to the electric valves shall be #12/1 white wire for direct burial. Splices and connections to the electric valves shall be with 3M DBY and DBR connectors. There will be no tee splices allowed. The common wire will be one continuous run; more than one common run may be used and spliced at the controller. Spare wires shall be run from the controller a minimum of six (6) from each controller location to the last electric valve on the run. Spare wire shall be #14/1 blue wire for direct burial. No wire splices will be allowed in wire runs of less than 1000'.
- B. When control wires must go into the building the proper splice boxes must be used and the same size corresponding wire size shall be used at the splice box location. All wire shall conform to ASTM B3 or B-8 for soft drawn bare copper wire with polyethylene insulation.

2.5 SPRINKLER HEADS, SWING JOINTS, AND SPIGOTS

- A. Turf sprinklers shall be sized to produce the coverage required. The sprinklers shall have a swing joints. The lay on all swing joints shall not be less than 35 degrees nor greater than 55 degrees from the horizontal lateral zone pipe.
 - 1. The electric valve pressure setting shall be set at 40 PSI for all zones no sprinkler head shall be spaced greater than 35'-0". The contractor is required to provide 100% coverage in all areas.
- B. Spigots shall be free-standing freezeless/frost-free cast yard hydrants, 1 inch nominal diameter riser, buried 5 feet, with 1 CF pea stone drainage pocket around the 1/8 inch (min) drain hole. Provide manual lever operating handle. Outlet shall daylight 24 inches above finished grade. Woodford models Y1 or U100, or approved equal.

2.7 CONTROLLERS

- A. The controller shall be capable of twenty four (24) stations. The controller shall operate as a stand-alone controller. The controller shall have 16 total start times; the controller shall have 4 independent programs offer concurrent operation capability, with a 7 day calendar, odd/even or day interval options for one to 30 days. The Controller shall have excluded day option, when used with the odd/even day option, allows for no watering on specific days. The station run times shall be from one (1) minute to ten (10) hours with percent of adjust by program from ten (10) to two hundred fifty (200) percent.
- B. Zone valves shall be paired at the controller all paired zones shall be of similar sprinkler type or drip zones and of similar flows in zones. No zones shall be paired with greater than five (5) percent differences in zone flow. The contractor shall submit a controller zone pairing schedule to the Owner's representative for approval prior to starting of system. No more than two (2) zones will be on any controller station.
- C. Pump controller shall be compatible with furnished equipment.

2.8 VALVE BOXES

- A. All electric zone valves, isolation valves, drain valves, quick coupler valves, splices; air vent valves and flush valves shall be in composite valve boxes or approved equal. All electric zone valves shall be placed in standard valve boxes with the extensions required to provide the proper drainage and cover of the zone valve. The valve boxes and extensions shall extend to the bottom of the zone pipe feeding the zone and installed in accordance with the these and the manufacturer's specifications.
 - 1. All isolation valves, drain valves, splices and quick coupler valves shall be placed in ten inch (10") circular valve boxes, with a piece of six inch (6") PVC pipe reach wells.
 - 2. All valve box-lifting tools and unlocking tools shall be supplied to the owner after installation. The contractor shall provide three (3) sets of these tools.

2.9 PUMPS

- A. General
 - 1. 304 stainless steel construction
 - 2. Pumps shall be suspended by non-powered 1/8 inch diameter synthetic cables or stainless steel chains secured to the pump and riser by mechanical connections. Riser connection point shall be within 1 foot of finished grade.
 - 3. Pump discharge lines shall be flexible PEX tubing rated at least twice the pump operating discharge pressure and connected to the main discharge pipe.
 - 4. Include compatible synthetic floating intake sleeves
 - i. Float shall be bright orange or yellow, spherical
 - ii. Adjust to suspend intake 6 to 12 inches below cistern water surface
- B. Irrigation
 - 1. Submersible
 - 2. 1 HP (min)
 - 3. 2 wire, 60hz
 - 4. 115V, GFCI-protected circuit
 - 5. Strom 4SF25P series, or approved equal

- C. On-Demand Water
 - 1. Bottom suction with integral automatic pressure switch
 - 2. ¾ HP (min)
 - 3. 2 wire, 60 Hz
 - 4. 115V, GFCI-protected circuit
 - 5. Strom BSP007PF series, or approved equal
 - 6. Pressure tank:
 - i. 2 gallon, welded steel, painted
 - ii. 100 percent butyl rubber diaphragm with polypropylene liner
 - iii. 125 psi maximum pressure rating
 - iv. Install within cistern riser, above maximum water level

2.10 RAIN & LEVEL SENSORS

- A. All controllers shall have separate rain and cistern level sensors that will shut the irrigation cycle off during periods of low storage, rain or rainfall accumulated amounts. The sensors shall interrupt the controller's common wire and be able to have a bypass switch for testing and to override the sensors. Rain Sensor location shall be located by Owner's representative. Cistern sensor shall be located in the most westerly riser. Wireless sensors are acceptable if the base station is wired to the building power and equipped with a sensor battery warning indicator on station.

2.11 GROUNDING

- A. All controllers shall be grounded in accordance with the manufacturer's recommendations and shall be 10 Ohms or less.

PART 3 - INSTALLATION

3.1 STAKE OUT

- A. The Contractor shall stake out all proposed lines prior to trenching operations. The location of said lines shall conform in general with the locations shown on the approved submittals. The location of the stakes will be checked by the Owner's representative and approved prior to trenching.
- B. Of particular importance is the location of sprinkler heads where prevailing winds, surface slope and special ground conditions must be taken into consideration. The final location of all sprinklers must be approved by the Owner's representative.

3.2 EXCAVATION

- A. Trench for pipe shall be wide enough to allow for proper tamping around the pipe in accordance with the manufacturer's recommendations. Trenches shall also be made wide enough to allow a minimum of 2 inches between parallel pipelines. Trenches for pipelines shall be made of sufficient depths to provide minimum cover from finish grade as follows:

1. 24" minimum cover over main lines.
2. 16" minimum cover over control wires from controller to valves (or as required by code).
3. 16" minimum cover over lateral lines to heads.

B. Maintain all warning signs, shoring, barricades, flares and red lanterns as required by OSHA, and any local ordinances. The bottom of the trench shall be clean and smooth, with all rock, loose soil, and organic matter removed. The Contractor shall insure that there are no conditions in the trench that could damage the pipe or the wires. Any deviations from the above must be approved by the Owner. Vibratory plowing of wire and solvent weld pipe will be acceptable subject to Owner approval of plowing equipment and procedures. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavations to their original condition and in a manner approved by the Owner.

3.3 ROCK REMOVAL

A. See Section 312000

3.4 DELETERIOUS MATERIAL

A. See Section 312000

3.5 PIPE LINE ASSEMBLY

A. Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent with a non-synthetic bristle brush. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench bottom to allow for expansion and contraction. Make all connections between plastic pipe and metal valves or steel pipe with threaded fittings using SCH 80 PVC.

3.6 THRUSTING

A. Install thrust blocks or anchoring for all isolation valves larger than 3", and all piping including changes in direction and reducers, in strict accordance with pipe manufacturer's recommendations. Construct thrust blocks of Sakrete or concrete of the following mix, having a compressive strength of 2000 PSI: 1 part concrete; 2.5 parts sand; 4 parts washed gravel. All thrust blocks must bear against undisturbed soil. In no case will fieldstone or wood of any form be acceptable for thrusting.

3.7 SPRINKLER HEADS

A. Install sprinklers as per manufacturer's recommended specifications. Install all sprinkler heads on specified swing joints.

3.8 CLOSING PIPE AND FLUSHING LINES

- A. Cap or plug all openings as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation. Thoroughly flush out all water lines before installing heads. Test in accordance with paragraph on Hydrostatic Tests. Upon completion of the testing, the Contractor shall complete assembly and adjust sprinkler heads for proper distribution.

3.9 HYDROSTATIC TESTS

- A. Request the presence of the Owner's Representative in writing at least 48 hours in advance of testing. Testing to be accomplished at the expense of the Contractor and in the presence of the Owner. Center load piping with small amount of backfill to prevent arching or slipping under pressure. Apply a continuous and static water pressure of 80 PSI when welded plastic joints have cured at least 24 hours and with the risers capped as follows:
 - 1. Main lines and sub mains to be tested for 3 hours.
 - 2. Lateral lines to be tested for 2 hours. (If laterals and individual sub-mains downstream of control valves have less than 45 PSI working pressure or less than 5 GPM flow, hydrostatic tests are waived for these laterals.)
- B. Repair leaks resulting from tests.

3.10 AUTOMATIC CONTROLLERS

- A. Connect sprinkler valve wires to controller in a logical sequence to correspond with specification. Controller wires shall not be connected until system is ready to be activated.

3.11 ELECTRIC ZONE VALVES

- A. All electric zone valves shall be installed as proposed on the approved submittal. The Contractor shall take extra caution to avoid over tightening the nipples on the inlet side or the discharge side of the electric valve. No pipe dope shall be used: only Teflon tape.
- B. The Contractor shall lower the electric zone valve assembly completely with valve boxes and extension to cover the PVC lateral pipe with the valve box. All brick supports shall be complete around the valve box and brick shall be placed on undisturbed soil.
- C. Prior to installation of zone valves all main line piping shall be flushed and free from contaminants.

3.12 WIRE AND WIRE SPLICING

- A. Do not yank, stretch, or pull wires during installation. Provide a minimum of one foot of slack, in an expansion loop, in each 100 feet of wire. Lay wire on a firm even bed in the trench, which shall support the entire length. At splice locations, provide sufficient slack to allow the splice to be raised a minimum of 24 inches above grade for inspection. Do not lay wire above, or on top of the pipe, except when wire and pipe are being plowed simultaneously. When power wire runs do not follow the pipe, lay them in a straight line which shall be carefully located on the as-built plan. Minimum 2.5" pipe shall be used as wire conduit for all sleeves.

- B. Splice all wires to requirements of local minimum regulations or to the following recommendations, whichever is more restrictive: Make all splices by baring a minimum of three-quarters of an inch of copper conductor, twisting the leads together, and soldering them with a non-acid core solder. Wire nuts are acceptable in lieu of soldering. Make the splice completely waterproof by using connector kits in strict accordance with the manufacturer's recommendations.

3.13 AUTOMATIC CONTROL WIRING

- A. Install control wires, sprinkler mains and laterals in common trenches wherever possible. Install control wires at least 12 inches below finish grade and lay to the side and below main line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at ten foot intervals. Control wire splices will be allowed only in runs more than 1000 feet. Any splices must be installed in an existing valve box or separate valve box installed flush with finished grade. On runs longer than 2500 feet contractor shall use 12/1 field and 10/1 common.
- B. All wire passing under existing or future paving, construction, etc., shall be encased in plastic or galvanized steel conduit extending at least 16 inches beyond edges of paving or construction.

3.14 VALVE BOXES

- A. All valve boxes shall be set at finished grade and supported by brick foundations on undisturbed soil. All valve box sizes shall include all special tools necessary for removal and unlocking of lids. Contractor shall clean out all sedimented materials from valve boxes and provide 1 CF pea gravel sumps. The Contractor shall maintain the valve boxes during the construction process to protect them from damage and excessive sedimentation.

3.16 BACKFILL AND COMPACTING

- A. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil, free of rubbish and deleterious material.
- B. See Section 312000

3.17 CLEAN-UP

- A. Remove from the site all debris resulting from work of this section.

END OF SECTION 328000

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the Drawings and specified herein, including, but not limited to, the following:
 - 1. The preparation of the topsoil to receive stabilization.
 - 2. The seeding, establishment, watering and maintenance of lawns until the Owner accepts the project.
 - 3. The placement of fertilizers.
 - 4. The placement and maintenance of mulches.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Site Clearing: Section 311000.
- B. Earth Moving: Section 312000.
- C. Erosion and Sedimentation Controls: Section 312500.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

1.4 SUBMITTALS

- A. The Contractor shall submit a schedule of his proposed methods and operations of Site Preparation.
- B. The Contractor shall provide material certifications and/or shop drawings for the materials stated herein.

1.5 QUALITY ASSURANCE

- A. The Contractor shall perform all his operations in accordance with the rules, regulations and ordinances of those governing bodies having jurisdiction.

1.6 JOB CONDITIONS

- A. General: The Contractor shall place all required topsoil, replace sod or provide seeding and mulching in accordance with the lines and grades shown on the Drawings and as specified herein. The Contractor shall provide all topsoil required from the approved stockpile accumulated from the Site stripping operations or from offsite sources where a deficiency exists in the stockpiled amount, within the Contract Sum for the Project. No additional cost to the Owner will be incurred for topsoil which must be provided from offsite sources.
- B. Time of Planting: The Contractor shall notify the Owner's Representative when sections of the Work have progressed sufficiently, to commence Work on lawns, including placing of topsoil to finished grade. Thereafter, planting operations shall be performed under favorable weather conditions during the next season or seasons which are normal for such work.
- C. Unless otherwise approved the seeding schedule shall be as follows:

Seeding of Permanent Lawns

March 15 (if soil is frost-free and not excessively moist) to May 15.
August 15 to October 15.

If the lawn areas are not ready for seeding between the time periods designated above, the areas shall be seeded immediately upon completion of topsoil operations, with ryegrass (annual or perennial) at a rate of thirty (30) lbs. per acre for a temporary lawn. Lawn work will not be permitted when the soil is frozen or excessively moist. If temporary lawn work has to be provided, the permanent lawn shall be installed during the next seeding season as specified.

- D. All areas within the limit of disturbance not required to be developed otherwise shall be planted with grass under the Contract Sum.

1.7 WARRANTY

- A. Maintenance shall begin immediately following each operation of installation for each portion of lawn and shall continue for the length of this Contract.
- B. Inspection of the Work to determine completion of Contract Work will be performed by the Owner's Representative at the conclusion of the maintenance period upon written notice requesting such inspection, submitted by the Contractor at least ten (10) days prior to the anticipated date. The condition of lawns will be noted and a determination made by the Owner's Representative whether maintenance shall continue in any part.
- C. Acceptance - After inspection, the Contractor will be notified in writing by the Owner's Representative of acceptance of all Work under this Section.
- D. Acceptance in Part - The Work may be accepted in part by the Owner's Representative upon written application by the Contractor, provided the Work offered for acceptance is completed in accordance with this Section.

- E. Any areas which fail to show a "catch" for any reason whatsoever, shall be reseeded at the Contractor's expense until a "catch" is obtained. Damage resulting from erosion, rills, gulleys, construction activity, washouts or other causes shall be repaired by filling with topsoil, tamping and reseeded by Contractor at his own expense, until final acceptance of the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. TOPSOIL

1. The Contractor shall furnish, at his expense, any additional quantities of topsoil to properly install all work as specified herein and as shown on the Drawings.
2. Topsoil shall consist of natural loam topsoil, free from subsoil. Topsoil shall be of uniform quality, free from hard clods, stiff clay, hard pan, sods, partially disintegrated stone, or any other undesirable material.
3. Topsoil shall contain at least 6% and not more than 25% organic matter as determined by loss of ignition on a moisture-free sample dried in accordance with the current method of the Association of Official Agricultural Chemists. The acidity range shall be pH 5.5 to pH 7.5, inclusive. Largest object size shall be three (3) inches. Amend as necessary to achieve these standards using amendments specified herein. The mechanical gradation analysis of the soil shall be as follows:

Sieve Size	Percent Passing by Weight
2 inch	100
1 inch	85 to 100
¼ inch	65 to 90
No. 200	20 to 50

B. COMMERCIAL FERTILIZER

1. Shall be a complete fertilizer formula (5-10-10, or equivalent) and shall conform to the applicable State Fertilizer laws. It shall be uniform in composition, dry and free flowing, and shall be delivered to the Site in the original, unopened containers, each bearing the manufacturer's guaranteed analysis. Any fertilizer which becomes caked or otherwise damaged, making it unsuitable for use, will not be accepted.

C. WATER

1. The Contractor shall make, at his expense, whatever arrangements necessary to ensure an adequate supply of water to meet the needs of this Contract. He shall also furnish all necessary hose, equipment, attachments and accessories for the adequate

irrigation of lawns and planted areas as may be required to complete the Work as Specified.

D. SCREEN

1. Shall be one-half (1/2) inch mesh galvanized hardware cloth.

E. LAWN MATERIAL

1. Grass seed for mowed lawn areas shall be mixed and guaranteed by the Dealer as follows:
 - a. 65 lbs Kentucky Bluegrass per acre
 - b. 65 lbs. Perennial Ryegrass per acre
2. Grass seed for occasional mowing areas shall be mixed and guaranteed by the Dealer as follows:
 - a. 8 lbs Empire Birdsfoot, Trefoil or Dutch White Clover per acre
 - b. 20 lbs Tall Fescue per acre
 - c. 2 lbs Redtop or 5 lbs Perennial Ryegrass per acre
3. Grass seed for stabilization of steep slopes (including and exceeding 3:1) shall be mixed and guaranteed by Pennington Seed (800.285.SEED), or approved equal:
 - a. "Slopemaster"
 - b. 200 lbs. per acre
 - c. Mixture:
 - 1) 75% Turf Type Tall Fescue
 - 2) 11% Annual Ryegrass
 - 3) 9% Unhulled Serecia Lespedeza
 - 4) 5% Durana White Clover (low, spreading habit)
4. Total weed content shall not exceed 1.5% of the total seed mixture.
5. If the plans indicate a seed mixture other than as specified above, use the plan values.

F. EROSION CONTROL MATERIALS

1. Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6-inches long. North American Green (800.772.2040) or approved equal. See plan for type.
2. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 lb per sq. yd. minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6-inches long.

G. SOIL AMENDMENTS

1. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 sieve and a minimum 75 percent passing a No. 60 sieve.
 - a. Provide lime in the form of dolomitic limestone.

2. Aluminum Sulfate: Commercial grade, unadulterated.
3. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.
4. Perlite: Horticultural perlite, soil amendment grade.
5. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.
6. Select paragraph above or below or delete when not required. Sphagnum moss is too acid for many trees, shrubs, and plants.
7. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.
8. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - a. When site treated, mix with at least 0.15 lb of ammonium nitrate or 0.25 lb of ammonium sulfate per cu. ft. of loose sawdust or ground bark.
9. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
10. Herbicides: EPA registered and approved, of type recommended by manufacturer.
11. Water: Potable.

H. STRAW MULCH

1. Provide clean, seed-free salt hay or threshed straw of wheat, rye, oats, or barley.

I. TURFGRASS SOD

1. Turfgrass sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with TPI's "Specification for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
2. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not less than 0.5 percent weed seed
 - a. Athletic Field proportioned by weight as follows:
 - 1) 80 percent turf type Tall Fescue
 - 2) 10 percent perennial Ryegrass
 - 3) 10 percent Kentucky Bluegrass

PART 3 - EXECUTION

3.1 LAWN PLANTING PREPARATION

- A. The contractor shall be responsible to restore all site disturbance generated as a direct result of this project with topsoil, fertilizing, seeding, and straw mulching in accordance with the requirements of this specification.
- B. Limit subgrade preparation to areas that will be planted in the immediate future.

- C. Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous materials.
- D. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
 - 1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
 - 2. Allow for sod thickness in areas to be sodded.
- E. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
 - 1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
 - 2. Till surface soil to a depth of at least 6 inches. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
 - 3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - 4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- F. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches in any dimension, and other objects that may interfere with planting or maintenance operations.
- G. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- H. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.2 INSTALLATION

A. TOPSOIL

- 1. Upon completion of grading operations for each respective area of Work, the Contractor shall place topsoil to a minimum depth of four (4) inches on all embankments and seed areas, first scarifying the subgrade for a depth of two (2) inches for the bonding of the topsoil with the subsoil. Where embankments are too steep for hand raking or tamping, topsoil may be compacted by mechanical means. Topsoil shall not be spread in a frozen or muddy condition. Topsoil from stockpile shall be raked to remove objectionable and oversized material as directed by the Owner's Representative.

B. LIME

1. Ground limestone shall be applied sufficiently to the lawn areas being prepared for seeding to attain a acidity pH of 6.0 to 7.0. Incorporate limestone into top three (3) inches of the soil at least three (3) days prior to seeding.

C. COMMERCIAL FERTILIZER

1. Commercial fertilizer shall be applied at the rate of 600-lbs per acre of lawn area.

D. EROSION CONTROL MATTING

1. Prepare location to receive matting as specified in subpart 3.1 above.
2. Install matting at locations indicated on the plans, as directed by the Owner's Representative, or at locations of surface erosion in accordance with manufacturer's recommendations.
3. Secure matting to ground in a manner and pattern that is in accordance with the manufacturer's recommendations and appropriate for the installation location.

E. SODDING

1. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
2. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - a. Lay sod across angle of slopes exceeding 1:3
3. Saturate sod with fine water spray within two hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.3 HYDROSEEDING NEW LAWNS

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic tackifier.

- B. Apply slurry uniformly to all areas to be seeded in a 1-step process. Apply mulch at the minimum rate of 1500 lb per acre (16.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate.

- C. Apply slurry uniformly to all areas to be seeded in a 2-step process. Apply first slurry application at the minimum rate of 500 lb per acre (5.5 kg per 100 sq. m) dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 lb per acre (11 kg per 100 sq. m).

3.4 RECONDITIONING LAWNS

- A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.
 - 1. Recondition other existing lawn areas.
- B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.
- C. Where substantial lawn remains, mow, dethatch, core aerate, and rake. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Till stripped, bare, and compacted areas thoroughly to a depth of 6 inches.
- F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Provide new planting soil as required to fill low spots and meet new finish grades.
- G. Apply seed and protect with straw mulch as required for new lawns.
- H. Apply sod as required for new lawns.
- I. Water newly planted areas and keep moist until new grass is established.

3.5 MAINTENANCE

- A. The Contractor shall provide necessary watering, fertilizer, etc. as required to establish perennial vegetation cover with a minimum density of 80% over the entire pervious surface of the disturbed area, or until sufficient vegetation is established to prevent erosion, whichever is greater.
- B. The Contractor shall provide necessary watering, fertilizer, etc., required to establish and maintain seeded areas until same are accepted by the Owner.
- C. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. 60 days after date of Substantial Completion.
 - a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.

- D. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and mulch to produce a uniformly smooth lawn.
- E. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches.
 - 1. Water lawn at the minimum rate of 1 inch per week.
- F. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- G. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry.
 - 1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. of lawn area.
- H. Repair of eroded areas:
 - 1. Restore soil and reseed
 - 2. If problem persists, install erosion control materials as directed by the Owner's Representative.
 - 3. All repair work shall be performed at no additional cost to the Owner.

3.6 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 329200

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 – General Requirements, apply to this Section.
- B. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Trees.
 - 2. Fertilizers and mulches.
 - 3. Stakes and guys.
- C. RELATED WORK SPECIFIED ELSEWHERE:
 - 1. Site Clearing Section 311000
 - 2. Earth Moving Section 312000
 - 3. Turf and Grasses Section 329200

1.2 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 – General Requirements.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.
- C. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with analysis of existing surface soil.
- D. Submit three (3) copies of planting schedule showing scheduled dates for planting in each area of site.
- E. Submit typewritten instructions recommending procedures to be established by the Owner for maintenance of lawn and grass work for one full year. Submit prior to expiration date of required maintenance period(s).
- F. All bags need to be saved for lime, fertilizer, seed, and liquid mulch binder (if used as mulch anchoring method). Such proofs may need to be submitted to the Owner's Representative for verification of materials and quantities used for all seedings.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Municipal Engineer's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- C. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Construction Manager. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.
- C. Handle balled and burlapped stock by the root ball.
- D. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots in water for 2 hours if dried out.
 - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 3. Do not remove container-grown stock from containers before time of planting.
 - 4. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.5 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner that will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Construction Manager before planting.

1.6 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

1.7 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Warrantee the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
 - 1. Trees.
- C. Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season.
- D. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- E. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

1.8 TREE AND SHRUB MAINTENANCE

- A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintain trees and shrubs for the following period:
 - 1. Maintenance Period: 12 months following Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Construction Manager, with a proportionate increase in size of roots or balls.
- C. Label at least 1 tree and 1 shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

2.2 FERTILIZER

- A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb per 1000 sq. ft. (0.5 kg per 100 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.3 MULCHES

- A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of lawns, consisting of one of the following:
 - 1. Type: Unrotted pine straw, salt hay, or threshed straw.
- B. Peat Mulch: Provide peat moss in natural, shredded, or granulated form, of fine texture, with a pH range of 4 to 6 and a water-absorbing capacity of 1100 to 2000 percent.

- C. Asphalt Emulsion Tackifier: Asphalt emulsion, ASTM D 977, Grade SS-1, nontoxic shall not be permitted for use on this project.
- D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic and free of plant growth- or germination-inhibitors.
- E. Shredded Wood Landscaping Mulch: shredded, uncolored, natural cedar bark from a source located within the United States suitable for placement under trees, shrub planting beds, and other locations indicated on the plans.

2.4 WEED-CONTROL BARRIERS

- A. Sheet Polyethylene: Black, 0.006-inch (0.15-mm) minimum thickness.
- B. Nonwoven Fabric: Polypropylene or polyester fabric, 3 oz. per sq. yd. (100 g per sq. m) minimum.
- C. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz. per sq. yd. (160 g per sq. m).

2.5 STAKES AND GUYS

- A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches (50 by 50 mm) by length indicated, pointed at one end.
- B. Guy and Tie Wire: ASTM A 641 (ASTM A 641M), Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch (2.7 mm) in diameter.
- C. Guy Cable: 5-strand, 3/16-inch (4.8-mm) diameter, galvanized-steel cable, with zinc-coated turn buckles, 3-inch- (75-mm-) long minimum, with two 3/8-inch- (10-mm-) galvanized eyebolts.
- D. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch (13 mm) in diameter, black, cut to lengths required to protect tree trunks from damage.
- E. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

2.6 MISCELLANEOUS MATERIALS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions.
- B. Anti-Erosion Mulch: Provide clean, seed-free salt hay or threshed straw of wheat, rye, oats, or barley.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Lay out individual tree locations and areas for multiple plantings. Stake locations, outline areas, and secure Owner's acceptance before the start of planting work. Make minor adjustments as may be required.
- B. Finish grading for areas to be seeded shall be done with previously stockpiled (if any) and supplementary topsoil. Do not complete topsoil work until the installation of all underground utilities, sewers, storm drainage systems, etc. have been completed.
- C. Apply fertilizers by mechanical rotary or drop type distributor and thoroughly and evenly incorporate with soil to a depth of 3" by discing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.

3.3 PLANTING SOIL PREPARATION

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
- B. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.
 - 1. A "Planting Soil Amendments Schedule" is included at the end of this Section.
- C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.
- D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
 - 1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime from contacting roots of acid-tolerant plants.
 - 2. Apply phosphoric acid fertilizer, other than that constituting a portion of complete fertilizers, directly to subgrade before applying planting soil and tilling.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Pits and Trenches: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation.
 - 1. Bare-Root Trees and Shrubs: Excavate at least 12 inches (300 mm) wider than root spread and deep enough to allow setting of roots on a layer of planting soil and with collar set at same grade as in nursery, but 1 inch (25 mm) below finish grade, unless otherwise indicated.
 - a. Setting Layer: Allow 3 inches (75 mm) of planting soil.
 - 2. Balled and Burlapped Trees and Shrubs: Excavate approximately 1-1/2 times as wide as ball diameter and equal to ball depth, plus the following setting layer depth:
 - a. Setting Layer: Allow 3 inches (75 mm) of planting soil.
 - 3. Container-Grown Trees and Shrubs: Excavate to container width and depth, plus the following setting-layer depth:
 - a. Setting Layer: Allow 3 inches (75 mm) of planting soil.
- B. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.
- C. Obstructions: Notify Construction Manager if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Construction Manager if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- E. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs.

3.5 PLANTING TREES AND SHRUBS

- A. Set balled and burlapped stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 - 1. Place stock on setting layer of compacted planting soil.
 - 2. Remove burlap and wire baskets from tops of balls and partially from sides, but do not remove from under balls. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
 - 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water

thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.

- B. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 - 1. Carefully remove containers so as not to damage root balls.
 - 2. Place stock on setting layer of compacted planting soil.
 - 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
- C. Dish and tamp top of backfill to form a 3-inch- (75-mm-) high mound around the rim of the pit. Do not cover top of root ball with backfill. Place mulch 4" thick.

3.6 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs as directed by Construction Manager.
- B. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Construction Manager, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are size after pruning.

3.7 TREE AND SHRUB GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 72 inches (1800 mm) above grade. Set vertical stakes and space to avoid penetrating balls or root masses. Support trees with 2 strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Guying and Staking: Guy and stake trees exceeding 14 feet (4.2 m) and more than 3-inch (75-mm) caliper unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 inches (760 mm) long, driven to grade. Attach flags to each guy wire, 30 inches (760 mm) above finish grade.

3.8 MULCHING

- A. Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.

- B. Weed-Control Barriers: Install the following weed-control barriers according to manufacturer's recommendations, before mulching. Completely cover area to be mulched, lapping edges a minimum of 6 inches (150 mm).
 - 1. Material and Seam Treatment: Sheet polyethylene with seams taped.
 - 2. Material and Seam Treatment: Nonwoven fabric with seams pinned.
 - 3. Material and Seam Treatment: Composite fabric with seams pinned.
- C. Organic Mulch: Apply the following average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.
 - 1. Thickness: 4 inches.

3.9 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
 - 1. When deciduous trees or shrubs are moved in full-leaf, spray with antidesiccant at nursery before moving and again 2 weeks after planting.

3.10 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.11 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

3.12 PLANTING SOIL AMENDMENTS SCHEDULE

- A. Tree Pits or Trenches: Provide soil amendments in not less than the recommended quantities as determined by the independent testing laboratory. The cost of all testing, fertilizer and amendments are the responsibility of the contractor, and shall be included as part of the price bid for each item.
- B. Ground Cover and Planting Beds:
 - 1. Provide soil amendments in not less than the recommended quantities as determined by the independent testing laboratory. The cost of all testing, fertilizer and amendments are the responsibility of the contractor, and shall be included as part of the price bid for each item.

END OF SECTION 32 93 00

SECTION 331000 - WATER UTILITIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Construction of all piping and specialties for both potable water and fire protection services outside the building five (5) feet from the point of exit.
 - 2. The general contractor shall be responsible for coordinating all horizontal and vertical locations of connections into the building line with the plumbing contractor.
 - 3. All water distribution improvements shall be also constructed in accordance with the "Recommended Standards for Water Works (Ten States Standards)", 2018 edition.
 - 4. All water distribution improvements shall be also constructed in accordance with all standards and specifications as required by the Municipality and/or Authority having jurisdiction over the project.
 - 5. The general contractor shall be responsible for closing and sealing all existing water connections that are no longer required by the proposed configuration.
 - 6. Pressure, leakage, and disinfection testing of the piping installed under this project.
 - 7. The general contractor shall be responsible for fire and potable connections to existing on-site facilities and/or Local Water Utility (LWU) installed facilities within the roadway. The general contractor shall maintain the serviceability of the water supply system to the facility at all times.
 - 8. The LWU must be notified seventy-two (72) hours in advance of any work being performed on the Municipal Water System. Inspections by departments having jurisdiction will be scheduled at that time.
 - 9. Suez retains the right to supersede the material specifications.
 - 10. All existing utility laterals not in service are to be capped and sealed in accordance with the applicable utility requirements.
 - 11. General contractor shall make any/all tap requests to Suez and coordinate all construction.
 - 12. Unless otherwise noted, general contractor shall be responsible for all excavation, trenching, and backfill operations.
- B. Cooperation and interface with the other prime contractors.
 - 1. The plumbing contractor shall be responsible for all penetrations and connections into the proposed building.
 - 2. Installation of the backflow prevention devices and metering shall be performed by the building plumbing contractor. See plumbing specifications for installation.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving Section 312000.
- B. Flexible Paving Section 321200.

1.3 RELATED DOCUMENTS

- A. Local Water Utility (hereafter “LWU”) standards, specifications, materials, and practices

Frank McGlynn (contact)
New Business Manager
New York Operations
Suez
162 Old Mill Road
West Nyack, NY 10994
Phone: (845) 620-6215
Fax: (845) 620-3347
- B. New York State Department of Transportation Standard Specifications, 2008 as currently amended.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressures: The following are minimum pressure requirements for piping and specialties, unless otherwise indicated:
 - 1. Potable-Water Service: 200 psig
 - 2. Fire-Protection Water Service: 150 psig

1.5 SUBMITTALS

- A. Product Data: Product data shall be provided for Pipe and Fittings, Valves, Fire Hydrants, and Fire department connections in the form of shop drawings.
- B. Coordination Drawings: For piping and specialties including relation to other services in same area. Show piping and specialty sizes and valves, and specialty locations, and elevations.
- C. Record Drawings in accordance with Division 01 Section “Contract Close-Out”.
 - 1. These drawings shall show the following information:
 - a. As-built location of water line in plan
 - b. Invert elevation
 - c. Rim elevation
 - d. Pipe diameter, material, length and grade

- e. Locations and size of valves (by triangulation)
 - f. Utility crossing locations
 - g. Backflow preventer assembly and water meter within protective enclosure
 - 2. These drawing shall comply with the following standards:
 - a. Clearly marked and easily readable
 - b. A scale identical to the construction plans
 - c. Horizontal datum: North American Datum (NAD) 1983
 - d. Vertical datum: North American Vertical Datum (NAVD) 1988
 - e. Signed and sealed by a Licensed Professional Surveyor
 - 3. As-builts shall be delivered to the Owner in both record mylar and digital format. Digital submissions shall be in AutoCAD, Release 2000 format on a compact disc in IBM-PC compatible format.
- D. Shop Drawings: Include plans, elevations, details, and attachments as required. The Contractor shall also submit construction drawings and a jacking procedure for the jacking of water pipe below a existing structure prior to commencement of work in accordance with the requirements of NYSDOT Subsection 650-3.01A.
- E. Test Reports: As specified in Part C of this section.
- F. Purging and Disinfecting Reports: As specified in "Cleaning" Article in Part C.
- G. Operation and Maintenance Data: For specialties to include in the maintenance manuals specified in Division 01. Include data for the following:
- 1. Water meters.
 - 2. Valves.
 - 3. Backflow preventers.
 - 4. Protective enclosures.

1.6 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-service piping specialties and are based on specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Division 01.
- B. Comply with standards of authorities having jurisdiction for potable water-service piping. Include materials, installation, testing, disinfection and tapping of water mains and backflow prevention.

Comply with NSF 61, "Drinking Water System Components--Health Effects," for materials for potable water.

- C. Comply with standards of authorities having jurisdiction for fire-protection water-service piping. Include materials, hose threads, installation, and testing.
- D. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," for materials, installations, tests, flushing, and valve and hydrant supervision.
- E. Comply with NFPA 70, "National Electrical Code," for electrical connections between wiring and electrically operated devices.
- F. Provide listing/approval stamp, label, or other marking on piping and specialties made to specified standards.
- G. Listing and Labeling: Provide electrically operated specialties and devices specified in this Section that are listed and labeled.
- H. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
 - 1. Ensure that valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends and flange faces.
 - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
 - 1. Do not remove end protectors, unless necessary for inspection; then reinstall for storage.
 - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

- D. Deliver piping with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located
- B. Verify water-service piping may be installed to comply with original design and referenced standards.
- C. Site Information: Reports on subsurface condition investigations made during design of Project are available for informational purposes only; data in reports are not intended as representations or warranties of accuracy or continuity of conditions between soil borings. Owner assumes no responsibility for interpretations or conclusions drawn from this information.

1.9 SEQUENCING AND SCHEDULING

- A. Coordinate connection to water main with LWU.
- B. Coordinate piping materials, sizes, entry locations, and pressure requirements with building water distribution piping.
- C. Coordinate piping materials, sizes, entry locations, and pressure requirements with building fire-protection water piping.
- D. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 PIPES AND VALVES

- A. Pipe shall be Ductile Iron, Class 52, cement lined, and shall have push on joints. (ANSI/AWWA 151/A21.51)
- B. Valves shall be Mueller 2360 Series Resilient Wedge Gate Valve for Water Systems, 250 psi Operating Pressure, 500 psi Test Pressure, 2 inch square operating nut, mechanical joint ends, Non-Rising stem and shall open right (clockwise), or approved equal. They shall conform to or exceed the requirements of AWWA C509 and AWWA C500. The size range is between 3 inches and 30 inches inclusive.

- C. Fittings shall be ductile iron pressure rating 350, cement lined and shall have mechanical end joints. (ANSI/AWWA C110/A21.10).

2.2 SERVICES

- A. Corporations shall be Mueller copper service thread connection, (catalog #H15008), or approved equal, 3/4 inch or 1 inch size, and shall have an inlet with Mueller CC thread and an outlet with a flared CTS straight connection suitable for “K” copper service tubing. Corporations for 1-1/2 inch or 2 inch shall be Mueller H15013.
- B. The copper flare nut end would be removed and the following service fitting would be added. The Mueller 110 Compression Connection, (catalog #H15071), or approved equal, 1-1/2 inch or 2 inch size, and shall have an inlet with Mueller CC thread and an outlet with a Mueller 110 Conductive Compression Connection for CTS O.D. PE tubing by Female Copper Flare Thread.
- C. Curb stops for 3/4 inch through 2 inch shall be Mueller #15219 Conductor Compression, with Drain
- D. Curb boxes shall be Mueller Iron Boxes – Improved Extension Type – Arch Pattern, with pentagonal plug, or approved equal. Box extension shall be 38.5 inches to 60 inches fully extended. Curb box shall fit 1-1/2 inch or 2 inch size, Mark II Oriseal Mueller 110 Compression, or approved equal.
 - 1. Connection curb valve. Mueller (catalog #H 10386), or approved equal. Curb valve rods shall be Mueller (catalog #84233) 27 inches long. Service tubing shall be 1-1/2 inch or 2 inch size CTS (OD ASTM D-2737) polyethylene with a maximum working pressure of 200 psi., a dimension ratio of 9.0, and a standard PE material code designation PE 3406/3408(AWWA C901) or ASTM B88 type “K” copper.

2.3 VALVE BOXES

- A. Top sections shall be Opelika (Bingham & Taylor) catalog #55-S, or approved equal, 15 inches long. or catalog #56.S, 24 inches long, and shall have the additional support flanges 6 inches from the top of the top section, and shall have lids marked with “Water”. Shaft diameter shall be 5-1/4”.
- B. Bottom sections shall be Opelika (Bingham & Taylor) catalog # 64-S, or approved equal, and shall be 36 inches long.

2.4 STEEL COUPLING DEVICES

- A. Steel Coupling Devices shall be Smith-Blair style 441 or Dresser Style 38 or Powerseal style 3501, or approved equal.

1. Sleeve: Ductile iron ASTM A-536. Ends shall have smooth inside taper for uniform gasket seating.
2. Gaskets: Grade 30-standard-specially compounded rubber with ingredients to produce superior storage characteristics, performance and resistance to set after installation. Temperature range -40° F to +150°F.
3. Follower Flanges: ductile Iron ASTM A-536. Designed for high strength/weight ratio. Thickness determined by coupling size.
4. Bolts and Nuts: High strength low alloy steel with heavy, semi-finished hexagon nuts to AWWA C111 (ANSI-A21.11) standards.
5. Finish: Blue shop coat enamel.

2.5 REPAIR CLAMP COUPLINGS

- A. Repair Clamp Couplings shall be Smith-Blair Style 226 or Dresser Style 360, or approved equal
1. Band: Stainless Steel.
 2. Lugs: High Strength Ductile Iron ASTM A536.
 3. Gasket: Grade 30 specially compounded rubber of all new materials with ingredients to produce superior storage characteristics, performance and resistance to set after installation. Temperature range -40° F to +150° F.

2.6 TAPPING SLEEVES AND TAPPING VALVES

- A. Tapping Sleeves and Tapping Valves shall meet AWWA approved standards and all LWU approved standards.
- B. The sleeve shall be Mueller H615 Mechanical Joint Tapping Sleeve (flanged tapping end) with AB/CD gaskets compatible with the pipe material being tapped (e.g. ductile iron, cast iron, transite, steel, plastic, etc.)
- C. The tapping sleeve shall meet the following performance standards:
1. Body: 3/8" Carbon Steel ASTM A285 Grade A PVQ.
 2. Flanges: AWWA C207 Class D, ANSI 150 lb. Drilling.
 3. Gasket: Grade 60 Concave Wedge Gasket-compounded to resist-oil, acids, alkalis, most (aliphatic) hydro-carbon fluids, water and many compounds. Temperature up to 212° F.
 4. Bolts and Nuts: High strength low alloy steel with heavy semi-finished hexagon nuts to AWWA C111 (ANSI A21.11) standards. Optional-type 304 stainless steel bolts and nuts. Nuts are Teflon coated to prevent galling.
 5. Finish: Blue shop coat enamel. Optional-fusion bonded epoxy, coated to an average of 12 mil thickness.
- D. The valve shall be Mueller T2360 Resilient Wedge Tapping Valve, open right (clockwise), flanged by mechanical joint.

- E. The tapping valve shall meet the following performance standards:
1. Valve: AWWA C509-87 and AWWA C500-86, 250 psi working pressure except 20" valves. 20" and 24" valves 150 psi working pressure.
 2. Body: D.I., Full shell Thickness
 3. Exterior: D.I., Protective coatings per AWWA C550-81.
 4. Interior: Free of pockets or ledges.
 5. Bonnet: D.I., Protective coatings per AWWA C550-81.
 6. Gate: It shall be completely covered with rubber over all interior and exterior ferrous surfaces.
 7. "O" Ring Steam: It shall be replaceable with the valve under pressure in the full-open position.
 8. Tapping Sleeve Flange: It shall be in accordance with MSS SP60.
- F. The Mueller H615 shall apply with regards to the various sizes of tapping sleeves and tapping valves with the exception of a size on size cut.

2.7 THREADED RODS

- A. All rods used for clamping shall be 3/4" rolled thread and conform to ASTM A242-81.

2.8 90° BEND EYE BOLT

- A. All 90° Bend Eye Bolts shall be Corrosion Resistant High Strength Tensile 70,000 psi minimum; yield point 50,000 psi minimum, Low Alloy with the eye welded closed rolled thread 3/4" diameter 10 threads UNC 2.

2.9 UNDERGROUND PIPE CLAMPS

- A. All underground pipe clamps shall be formed from 1/2" x 2-1/2" steel with two 1/2" x 2-1/2" washers with 9/16" holes. All parts shall be corrosion resistant high strength, tensile 70,000 psi minimum, yield point 50,000 psi minimum Low Alloy and shall conform to ASTM A242-81.

2.10 FIRE HYDRANTS

- A. Mueller Super Centurion Model A-423 AWWA C502 dry barrel fire hydrant, or approved equal.
1. Left opening.
 2. Dry top traffic model design with breakaway coupling.
 3. Valve opening sizes shall be 5" nominal.
 4. The minimum working pressure shall be 250 psi.

5. The fire hydrant nozzle shall be (NST) National Standard Thread (as per NFPA 1963 Standard for fire hose connections) consisting of two 2-1/2" butts and one 4-1/2" butt.
6. Anti-freezing and equipped with automatic drip valves.
7. Bronze mounted working parts and bronze valve seats.
8. An "arrow" and the work "Open" cast in relief on top of hydrant.
9. Paint: Hydrant manufacturer's standard primer and 2 finish coats of rust inhibitive, high gloss alkyd enamel. Color shall be per municipality and/or LWU.
10. Tools: Furnish 2 wrenches to fit hydrants. Deliver wrenches to the Owner's Representative.

2.11 RESTRAINTS

- A. Ductile iron pipe bell restraint consists of a wedge action restraint ring on the spigot joined to a split ductile iron ring behind the bell. The restraint ring consist have individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. Restraints shall be used with the standardized mechanical joint bell or push-on bell. Restraint must be capable of full mechanical joint deflection during assembly, and must be capable of joint deflection after assembly. The restraint ring and its wedging components shall be made of a minimum grade of 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be heat treated to a minimum hardness of 370 BHN. Torque limiting twist off nuts shall be used to insure proper actuation of the restraining wedges.. The split ring shall be made of a minimum grade of 60-42-10 ductile iron conforming to ASTM A536. The connecting tie rods that join the two rings shall be made of low alloy steel that conforms to ANSI/AWWA C111/A21.11. The assembly shall have a rated pressure, with a minimum two to one safety factor of 350 psi in sizes sixteen inch and below 250 psi in the sizes eighteen inch through thirty-six inch. The product shall be the appropriate 1100 or 1700 series Megalug restraint harness manufactured by EBAA Iron, Inc., or approved equal.

2.12 PIPING SPECIALTIES

- A. Dielectric Fittings: Assembly or fitting with insulating material isolating joined dissimilar metals to prevent galvanic action and corrosion.
 1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
 2. Dielectric Unions: Factory-fabricated union assembly, designed for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C). Include insulating material isolating dissimilar metals and ends with inside threads according to ASME B1.20.1.
 3. Dielectric Flanges: Factory-fabricated companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum pressure to suit system pressures.
 4. Dielectric-Flange Insulation Kits: Field-assembled companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers. Provide separate companion flanges and steel bolts and nuts for 150- or

300-psig (1035- or 2070-kPa) minimum working pressure to suit system pressures.

5. Dielectric Couplings: Galvanized-steel couplings with inert and noncorrosive thermoplastic lining, with threaded ends and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
6. Dielectric Nipples: Electroplated steel nipples with inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig (2070-kPa) working pressure at 225 deg F (107 deg C).

B. Materials for thrust blocks shall comply with the following standards:

1. Cement: ASTM C 150, Type I.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

2.13 IDENTIFICATION

- A. Install metallic warning tapes made of solid blue film with continuously printed black-letter caption "CAUTION--WATER LINE BURIED BELOW."

2.14 WATER METERS AND ACCESSORIES

- A. SEE MEP PLANS AND SPECIFICATIONS

2.15 BACKFLOW PREVENTERS AND ASSEMBLIES

- A. SEE MEP PLANS AND SPECIFICATIONS

2.16 PROTECTIVE ENCLOSURES

- A. SEE MEP PLANS AND SPECIFICATIONS

2.17 BACKFLOW PREVENTION ASSEMBLY

- A. Model: Watts Regulator, $\frac{3}{4}$ inch, Series 909, Reduced Pressure Zone Assemblies, 909NRS; or approved alternative.
- B. Manufacturer: WATTS®, Backflow Prevention Products:
815 Chestnut Street
No. Andover, MA 01845-6098
www.wattsreg.com

2.18 BACKFLOW PREVENTION ENCLOSURE

- A. Model: WattsBox Insulated Enclosure, Model #WB N8; or approved alternative.
- B. Dimensions: aluminum box, 118" x 40" x 58"; mounting pad, 130" x 52"
- C. Manufacturer: WATTS®, Backflow Prevention Products:
815 Chestnut Street
No. Andover, MA 01845-6098
www.wattsreg.com

2.19 METER

- A. Meter shall be as specified by LWU. Contractor to supply and install.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavation, trenching, and backfilling to be performed by the general contractor unless otherwise specified.
- B. Refer to Division 32 Section "Flexible Paving" for cutting and patching of existing paving to be performed by the general contractor unless otherwise specified.

3.2 GENERAL

- A. It is the intent of this procedure to secure the best workmanship consistent with the job conditions and the contractor's skill. No provision in this procedure shall be construed by the contractor as an excuse for poor workmanship or results. The contractor shall guarantee that the material, equipment, and apparatus required for the development shall be free from all defects in the material, design, and the workmanship. The contractor shall give satisfactory and continuous service under all conditions of service required and specified or which may be reasonably inferred from the submitted mark-up plans, procedures, and specifications and that all work performed by him/her shall be perfect in material and workmanship. The contractor shall agree to repair or replace, at his own expense, any part of the material, apparatus, or workmanship proving defective in inspection prior to the Owner's takeover of the new water distribution facilities.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

Install piping as indicated, unless deviations to layout are approved on Coordination Drawings.

- B. Install piping at indicated slope.
- C. Install components with pressure rating equal to or greater than system operating pressure.
- D. Install piping free of sags and bends.
- E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- F. Install fittings for changes in direction and branch connections.
- G. Piping Connections: Unless otherwise indicated, make piping connections as specified below:
 - 1. Install unions, in piping 2-inch NPS and smaller, adjacent to each valve and at final connection to each piece of equipment with 2-inch NPS or smaller threaded pipe connection.
 - 2. Install flanges, in piping 2-1/2-inch NPS and larger, adjacent to flanged valves and at final connection to each piece of equipment with flanged pipe connection.
 - 3. Install dielectric fittings to connect piping of dissimilar metals.

3.4 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications:
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- C. Potable Water-Service Piping: Use the following:
 - 1. 2-1/2-Inch ASTM B88 Type “K” copper
- D. Fire-Protection Water-Service Piping: Use the following:
 - 1. 4-Inch NPS: Ductile-iron, push-on-joint pipe; ductile-iron, mechanical joint fittings; gasketed joints, and approved restraining system.

3.5 JOINT CONSTRUCTION

- A. Ductile-Iron Piping, Gasketed Joints: According to AWWA C600.
- B. Ductile-Iron Piping, Gasketed Joints for Fire-Service Piping: According to UL 194 and AWWA C600.
- C. Flanged Joints: Align flanges and install gaskets. Assemble joints by sequencing bolt tightening. Use lubricant on bolt threads.

- D. Dissimilar Materials Piping Joints: Use adapters compatible with piping materials, OD, and system working pressure. Refer to "Piping Systems - Common Requirements" Article for joining piping of dissimilar metals.

3.6 VALVE BOXES

- A. See details for additional valve box installation requirements.
- B. Both sections of the valve box shall be plumb, and the bottom of the valve box shall be situated so that the valve nut is centered and can be operated with the valve key.
- C. Valve boxes shall also be free of dirt, asphalt, stones, rocks, sand, or any other material, or debris.
- D. No Adapters shall be used to raise the valve boxes to finished grade.

3.7 MECHANICAL JOINT END (M.J.E.) GATE VALVES

- A. See standard valve replacement detail for additional Mechanical Joint End (M.J.E.) Gate Valves
- B. The appropriate M.J.E. gate valve from the Resilient Wedge Series, open right, made by Mueller, or approved equal.
- C. All valves shall open clockwise (open right). The Owner shall not accept any counter-clockwise (left-handed) to open valves.
- D. All gate valves in the project must be fully open when the project's final inspection is performed unless indicated by the Owner or the appropriate representative of the LWU.

3.8 FIRE HYDRANTS

- A. See details for additional requirements regarding fire hydrant installation.
- B. The Contractor shall provide all hydrants for this project.
- C. Hydrants shall be installed plumb and have a distance of no more than 5 inches between the top of the curb and the bottom of the breakaway coupling. **NO HYDRANT ADAPTORS SHALL BE ALLOWED.**
- D. If a Mechanical Joint Tee is used, the hydrant shall be rodded back to the gate valve and the gate valve must be rodded back to the Mechanical Joint Tee. All hydrants shall have a concrete thrust block below the location of where the drip hole is on the hydrant.

- E. Stone (clean gravel) shall be placed around the area below the hydrant barrel for a distance of 18" and 6" above the Hydrant Lateral to allow for adequate drainage from the hydrant.
- F. A minimum distance of 18 inches shall exist between the street side of the curb to the front of the 4 ½" steamer cap.

3.9 CURB BOXES

- A. See Service Line Installation Detail for additional requirements regarding curb box installation.
- B. The curb stop lid shall be visible and flush with the surrounding ground. The pentagonal insert shall be intact and free of dirt, cement, etc.
- C. The curb stop box shall be at a distance of approximately 18 inches from the street side of the curb to the center of the curb box.
- D. Services to curb stops from the main shall be perpendicular to the main. If for any reason this is not possible, the deviation must be noted on as-built sketches.

3.10 WATER MAIN

- A. The top of the water main shall be installed with 4.5 feet of cover. This is the distance from the top of the pipe to the top of grade.
- B. The water main shall be installed at the locations shown on the plans.
- C. Comply with NFPA 24 for fire-protection water-service piping materials and installation.
- D. Install ductile-iron piping according to AWWA C600. Encase piping with PE film according to ASTM A 674 or AWWA C105.
- E. Install disinfection in accordance with this specification.
- F. Bury all piping with depth of cover over top at least 54 inches with top at least 12 inches below level of maximum frost penetration, and according to the following:
 - 1. Under Driveways: With at least 48 inches cover over top.
 - 2. Under Railroad Tracks: With at least 48 inches (1200 mm) cover over top.
 - 3. In Loose Gravelly Soil and Rock: With at least 12 inches (300 mm) additional cover.
- G. Install piping under streets and other obstructions that cannot be disturbed, by tunneling, jacking, or combination of both.

3.11 TAPPING SLEEVES AND TAPPING VALVES

- A. Before the wet cut can be made, the appropriate water meter(s), backflow prevention device(s), and street opening permit(s) must be obtained and installed following the approved specifications with approval from the LWU.
- B. The plumbing contractor shall make a construction tap request prior making the watermain connection wet cut in the LWU distribution system off Dutch Hill Road to Frank McGlynn of Suez Water, contact information is provided in Section 1.3, subsection A of this specification.

3.12 SERVICE ENTRANCE PIPING

- A. The contractor shall be responsible to connect the services to the Owner's distribution system. Before the connection can be made, the appropriate water meter(s), backflow prevention device(s), and street opening permit(s) must be obtained and the LWU must be notified 48 hours in advance to allow the scheduling of a representative to observe the making of the cut.
- B. Extend water-service piping and connect to building water-piping systems at outside face of building wall in locations and pipe sizes indicated.
- C. Terminate water-service piping at building wall until building water piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building water-piping systems when those systems are installed.
- D. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.13 THRUST BLOCKS AND RODDING OF MECHANICAL JOINT FITTINGS

- A. It is the responsibility of the contractor to assure that all mechanical joint fittings are properly restrained.
- B. At a minimum, Retainer glands or the U.S. Pipe M.J. Gripper Gland with ¾" threaded rods shall be used on ALL JOINTS within 20 feet from a Mechanical Joint Fitting.
- C. All plugs, caps, tees, flushers, and bends, unless otherwise specified, shall be provided with thrust blocks or suitably restrained joints as shown or directed the Owner or LWU. Refer to the detail drawings showing thrust and anchoring blocks.
- D. All thrust restraints shall be designed to withstand the test pressure, working pressure, and any potential surge pressure of the pipe.
- E. Concrete thrust blocks of both the vertical and horizontal orientation shall be made of concrete having a compressive strength of not less than 4000 psi after 28 days. Thrust blocks shall be placed between solid ground and the fitting to be anchored. Each instance shall be as shown in the details or as directed by LWU.

3.14 RESTRAINTS

- A. All restrained joints shall be installed in accordance with the manufacturer's recommendations. All valves, bends or other fittings shall be provided with at least eight (8) inches of dense graded aggregate placed below and surrounding the fittings.

3.15 BACKFLOW PREVENTION ASSEMBLY

- A. Install as indicated by the manufacturer's specifications.

3.16 BACKFLOW PREVENTION ENCLOSURE

- A. Install as indicated by the manufacturer's specifications.

3.17 JACKING

- A. Where required, the Contractor shall install by jacking, pipe of the size and at the locations shown on the plans. All work shall be performed in accordance with the applicable requirements of NYSDOT Subsections 650-3.01, 650-3.02 and 650-3.03 of the standard specifications. The Contractor is responsible for surface subsidence and pressure grouting in accordance with the requirements of NYSDOT Subsection 650-3.03.

3.18 IDENTIFICATION INSTALLATION

- A. Install continuous plastic underground warning tape with metallic locator strip during back-filling of trench for underground water-service piping. Locate 6 to 8 inches below finished grade, directly over piping.

3.19 CLOSURE OF UNUSED FACILITIES

- A. The contractor shall be responsible for closing and sealing all existing water connections to the tract that are no longer required by the proposed configuration. All work shall be performed to the standards and satisfaction of both the Owner and LWU.

3.20 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently.
- B. Upon written notice from the contractor to the effect that he/she has performed all the work required by the specifications, marked up plans, and requirements, LWU will inspect the job promptly to see if everything is Satisfactory. Most of what has been previously inspected and accepted by the LWU need not be re-examined in great detail, but if something needing correction is discovered in the work that had been approved

earlier, the former acceptance shall not prevent the Owner from requiring that it be remedied by the contractor.

3.21 DISINFECTION OF MAINS:

- A. During construction, the pipe and appurtenances shall be kept clean and dry.
- B. When installation has been completed, the water main shall be flushed with water at a minimum velocity of 2.5 fps. The main shall then be charged with a solution of Chlorine-bearing compound in water, and disinfected in accordance with AWWA Standard C651-05: Disinfection of water mains, excluding Section 4.4.2 for the tablet method and the optional section 4.6 for the final connection into existing mains.
- C. After the required contact period, the Contractor shall determine the residual chlorine concentration remaining.
- D. The main shall not be flushed until after the hydrostatic test has been performed by the Contractor and approved by LWU, the County Health Department and the Owner.
- E. During the performance of the test, all valves and appurtenances shall be charged to ensure maximum chlorine contact.
- F. Prepare reports for disinfection activities and submit to Owner, the County Health Department and the LWU.

3.22 HYDROSTATIC TESTING OF NEW MAINS

- A. Upon installation of the water main facilities, hydrostatic testing shall be performed in accordance with AWWA Standard C600-05 Section 5.2 and shall be performed under the supervision of the LWU and the Owner.
- B. The contractor shall subject the water main, services (corporation to curbstop), valves, hydrants and appurtenances to a water pressure applied in the amount of 1.5 times the stated working pressure of the test section or 150 pounds per square inch (psi), whichever is greater, for a two (2) hour duration. The test pressure shall not vary by more than ± 5 psi for the duration of the test.
- C. The Contractor shall be required to perform leakage tests, the test pressure shall be run on every section prior to acceptance and shall meet the following testing allowance (allowable makeup water) over a two (2) hour duration:

$$L = \frac{SD(P^{0.5})}{148,000} \quad \text{equation (1)}$$

Where: L = leakage (makeup water), GPH; S = length of pipe tested, feet; D = nominal diameter, inches; and P = average test pressure, psi.

- D. All pipes shall be tested in sections between gate valves except in cases of practical difficulty or where conditions make it necessary to test in shorter sections. The length to be tested will be determined by the Engineer. Leakage tests shall not be performed until the pressure is stabilized in the pipe for a period of not less than two (2) hours. Any leaks or breaks developing under this test shall be repaired immediately at the expense of the Contractor.
- E. The contractor shall provide the hydraulic pump with an “in line” check valve to prevent backflow through the pump during testing.
- F. Prepare reports for hydrostatic testing activities and submit to the LWU, the County Health Department and the Owner.

3.23 BACTERIOLOGICAL AND TURBIDITY TESTING

- A. After the Hydrostatic test has passed and has been accepted by the LWU, the County Health Department and the Owner, the water main and all valves and appurtenances shall be flushed and refilled with water from the existing water supply to remove the heavily chlorinated water and to scour the interior of the pipe. The duration of the flushing shall be determined in the field by the Owner or the duly authorized representative of the LWU.
- B. Once flushing is completed, the Contractor shall perform a Bacteriological and a Turbidity analysis in accordance with NYSDOH Standards, with the LWU standards and with a LWU representative on-site. Laboratory tests on two (2) successive days shall indicate that the water supply is equal in quality to that specified in Part 72 of the State Sanitary Code. Repetition of charging the pipes and appurtenances will be required if laboratory testing fails to indicate water of equal or greater quality. Water must meet acceptable bacteriological tests for drinking water.
- C. Prepare reports for purging and disinfecting activities and submit to Owner, County Health Department, and the LWU.

3.24 CERTIFICATION

- A. The Contractor shall supply a New York State Licensed Engineer’s Certificate of Construction Compliance attesting to the proper installation and testing of the water main and all other requirements of the County Department of Health and Suez.

END OF SECTION 331000

SECTION 333000 - SANITARY SEWERAGE UTILITIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Construction of all sanitary sewerage outside the building five (5) feet from the point of exit.
 - 2. The general contractor shall be responsible for coordinating all horizontal and vertical locations of connections into the building line with the plumbing contractor.
 - 3. All sanitary sewer improvements shall be also constructed in accordance with the "Recommended Standards for Wastewater Facilities (Ten States Standards)", latest edition.
 - 4. All sanitary sewer improvements shall be also constructed in accordance with all standards and specifications as required by the Municipality and/or Authority having jurisdiction over the project.
 - 5. The general contractor shall be responsible for closing and sealing all existing sanitary connections that are no longer required by the proposed configuration.
 - 6. Low pressure and deflection testing of the sanitary sewer piping installed under this project.
 - 7. Work on sewer laterals and connection is to be performed by licensed plumber and requires a plumbing permit.
 - 8. Unless otherwise noted, general contractor shall be responsible for all excavation, trenching, and backfill operations.
- B. Cooperation and interface with the other prime contractors.
 - 1. The plumbing contractor shall be responsible for all penetrations and connections into the proposed building.

1.2 Related work specified elsewhere:

- A. Earthwork Section 312000
- B. Flexible Paving Section 321200.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.
- C. Municipal standards, specifications, materials, and practices.
- D. “Recommended Standards for Wastewater Facilities (Ten States Standards)”, latest edition.

1.4 **DEFINITIONS**

- A. PVC: Polyvinyl chloride plastic.

1.5 **PERFORMANCE REQUIREMENTS**

- A. Gravity-Flow, Non-pressure Piping Pressure Ratings: At least equal to system test pressure.

1.6 **SUBMITTALS**

- A. Shop Drawings: Include plans, elevations, details, and attachments as required for all structures, pipe, fittings, and castings.
- B. Coordination Drawings: Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and approximate structures.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- D. Record Drawings in accordance with Division 1 Section “Contract Close-Out”.
 - 1. These drawings shall show the following information:
 - a. As-built locations of sanitary sewer line in plan
 - b. Invert elevations
 - c. Rim elevations
 - d. Pipe diameters, materials, length and grades
 - e. Locations of lateral cleanouts (by triangulation)
 - f. Utility crossing locations
 - 2. These drawings shall comply with the following standards:
 - a. Clearly marked and easily readable
 - b. A scale identical to the construction plans
 - c. Horizontal datum: North American Datum (NAD) 1929
 - d. Vertical datum: North American Vertical Datum (NAVD) 1929
 - e. Signed and sealed by a Licensed New York Professional Land Surveyor

3. As-builts shall be delivered to the Owner in both record mylar and digital format. Digital submissions shall be in AutoCAD, 2017 format on a compact disc in compatible format.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.8 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner not less than three (3) working days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Manufacturers shall be submitted for approval during the shop drawing review.

2.2 PIPES AND FITTINGS

- A. PVC Sewer Pipe and Fittings, NPS 4 to NPS 15: ASTM D-3034, bell and spigot for gasketed joints. Pipe shall be PVC SDR 35.
 1. Gaskets: ASTM F 477, elastomeric seals; or other watertight joint construction methods acceptable to the owner.

2.3 SPECIAL PIPE COUPLINGS AND FITTINGS

- A. Sleeve-type and bushing-type pipe couplings ('Fernco') shall not be permitted.
- B. Pipe Couplings shall be DIP, PVC, HDPE or other approved rigid connectors for joining existing and dissimilar piping materials as manufactured by Dresser (814) 362-9200, Genco (800) 345-6454, Harco (502) 366-4596 or other approved equal.

2.4 CLEANOUTS

- A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Include brass cap with recessed key.

2.5 MANHOLES

- A. Normal-Traffic Precast or cast-in-place Concrete Manholes: ASTM C 478 precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 3. Base Section: 8-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4. Precast Riser Sections: 5-inch minimum thickness, and lengths to provide depth indicated.
 - 5. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 - 6. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 7. Gaskets: ASTM C 443, rubber.
 - 8. Grade Rings: Reinforced-concrete rings, of 6- to 9-inch total thickness, that matches the frame diameter and cover.
 - 9. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12-inch intervals.
 - 10. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 - 11. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".
- B. Manhole Frames and Covers: Manhole frame and cover shall be round Model 1012B as produced by Campbell Foundry.

2.6 CONCRETE

- C. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- D. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.

2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 deformed steel.
- E. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert slope shall be one (1) percent through manhole.
 2. Benches: Concrete, sloped to drain into channel. Slope shall be four (4) percent.
- F. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 deformed steel.

2.7 PROTECTIVE COATINGS

- A. Description: Two-coat, high-build epoxy; 15-mil minimum thickness, unless otherwise indicated; factory applied to the following surfaces:
1. Concrete Manholes: On exterior and interior surfaces.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfill materials are specified in Section 31 20 00 "Earth Moving." and shall be performed by the general contractor unless otherwise specified.

3.2 IDENTIFICATION

- A. Contractor shall install green warning tape directly over piping and at outside edges of underground structures.
1. Use detectable warning tape over ferrous piping.
 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.
 3. Install detectable warning tape 6-inches to 12-inches below finished grade.

3.3 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods. Use the following pipe couplings for non-pressure applications:
1. Rigid connection fittings

- B. Encase all dissimilar connections or connections to existing piping materials located under proposed structures (buildings, roadways, etc.) with concrete.

3.4 ABANDONMENT

- A. Locate all existing sanitary disposal lines servicing the existing site.
- B. Remove all on-site existing sanitary facilities as required. Disposal of same shall be in accordance with Section 31 10 00 "Site Clearing".
- C. Abandon remaining connection points at right of way line with 3000 psi concrete, with provisions not to permit concrete to enter the main trunk sewerage line.

3.5 GENERAL INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping.
- B. Notify the Owner seventy-two (72) hours in advance of all sewer work.
- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated. Install piping with three (3) foot minimum cover.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. PVC Sewer Pipe and Fittings: As follows:
 - 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321 manufacturer's written instructions.
 - 2. Join profile sewer pipe fittings with gaskets according to ASTM D 2321 and manufacturer's written instructions.
 - 3. Install according to ASTM D 2321.

3.7 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use PVC fittings in sewer pipes at branches for cleanouts and PVC for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.
- C. In roadway traffic areas, enclose top of the cleanout stack in a cast iron casting set in concrete.

3.8 MANHOLE INSTALLATION

- B. General: Install manholes, complete with appurtenances and accessories indicated.
- C. Form continuous concrete channels and benches between inlets and outlet.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 2 inches above finished surface elsewhere, unless otherwise indicated.
- E. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- F. Construct cast-in-place manholes as indicated.

3.9 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.
- B. Core drill when making connection to existing structures.
- C. Make branch connections from side into existing piping, NPS 21 or larger, or to underground structures by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
- D. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
- E. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
- F. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.10 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
 2. Flush piping between manholes and other structures to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of the Work.
1. Coordinate and meet inspection requirements and standards of Town of Orangetown Sewer Department and/or NYSDOH.
 2. Submit separate reports for each system inspection.
 3. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of mandrel of size not less than 95 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water/air leakage into piping.
 - e. Exfiltration: Water/air leakage from or around piping.
- C. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- D. Reinspect and repeat procedure until results are satisfactory.
- E. Test new piping systems, and parts of existing systems that have been altered, relocated, extended, or repaired, for leaks and defects. Do not enclose, cover, or put into service before inspection and approval.
1. Test completed piping systems according to authorities having jurisdiction.
 2. Schedule tests and inspections by authorities having jurisdiction with at least seventy-two (72) hours advance notice.
 3. Submit separate reports for each test.
 4. If authorities having jurisdiction do not have published procedures, perform tests as follows:
 - a. Air Pressure Test
 - i. Pressurize line to 5 psi.
 - ii. Maintain pressure for 5 minutes.
 - iii. Allowable leakage equals zero psi.
 - b. Deflection Test
 - i. Pull mandrel capable of measuring a minimum allowable deflection of 5 percent.
- F. Leaks and loss in test pressure constitute defects that must be repaired.
- G. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 333000

SECTION 334000 - STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section includes all labor, materials, equipment, and services necessary to complete the work of this section as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Installation of all exterior storm drainage elements outside of the building five (5) feet from the point of exit.
 - 2. The general contractor shall be responsible for coordinating all horizontal and vertical locations of connections into the building line with the plumbing contractor.
 - 3. The general contractor shall be responsible for closing and sealing all existing storm sewer connections that are no longer required by the proposed configuration.
 - 4. Facilitating the Owner's visual inspection of the storm sewer piping installed under this project.
- B. Cooperation and interface with the other prime contractors.
 - 1. The plumbing contractor shall be responsible for all penetrations and connections into the proposed building.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Earth Moving: Section 312000.
- B. Flexible Paving Section 321200.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. New York State Department of Transportation Standard Specifications, as currently amended through the bid date for this project.

1.4 DEFINITIONS

- A. HDPE: High Density Polyethylene plastic.
- B. PVC: Polyvinyl chloride plastic.
- C. DIP: Ductile Iron Pipe

1.5 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.6 SUBMITTALS

- A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
1. Precast concrete manholes, inlets and other structures, including frames, covers, and grates.
 2. Perimeter drain, grates, catch basins, layout, and manufacturer installation instructions.
 3. Cast-in-place concrete manholes, inlets and other structures, including frames, covers, and grates.
 4. Signed by a Licensed New York Professional Engineer specializing in structural design.
 5. Product specifications for pipes, clean-outs, connections and gaskets.
- B. Coordination Drawings: Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
- C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.
- D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- E. Record Drawings in accordance with Division 01 Section "Contract Close-Out".
1. These drawings shall show the following information:
 - a. As-built location of storm sewer line in plan
 - b. Invert elevation
 - c. Rim elevation
 - d. Pipe diameter, material, length and percent slope
 - e. Locations of lateral cleanouts (by triangulation)
 - f. Above-ground Detention pond structures and earthworks (if indicated on plans)
 - g. Under-ground Detention pond structures and earthworks (if indicated on plans)
 - h. Utility crossing locations
 2. These drawing shall comply with the following standards:
 - a. Clearly marked and easily readable
 - b. A scale identical to the construction plans
 - c. Horizontal datum: North American Datum (NAD) 1983
 - d. Vertical datum: North American Vertical Datum (NAVD) 1988
 - e. Signed and sealed by a Licensed New York Professional Land Surveyor

3. As-builts shall be delivered to the Owner in both record mylar and digital format. Digital submissions shall be in AutoCAD, 2017 format on a compact disc in compatible format.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic structures, pipe, and fittings in direct sunlight.
- B. If piping and structures are to be stored on site prior to placement in accordance with the construction documents, the following shall be required:
 1. All pipes shall be stored on grade. Stacking is not permitted.
 2. Sufficient barricades shall be provided around piping and structures to prevent unauthorized access to the storage area.
- C. Protect pipe, pipe fittings, and seals from dirt and damage.
- D. Handle precast concrete manholes, inlets and other structures according to manufacturer's written rigging instructions.

1.8 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Proposed material manufacturers shall be supplied and approved at the time of shop drawing submission.

2.2 PIPING MATERIALS

- A. Refer to Part C "Piping Applications" Article for applications of pipe and fitting materials.

2.3 PIPES AND FITTINGS

- A. Drainage Pipe and Fittings, NPS 8 and Smaller:
 - 1. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40
 - 2. Solvent-cemented joints.
- B. Sewer Pipe and Fittings, NPS 8 and Smaller:
 - 1. ASTM D 3034, SDR 35
 - 2. Solvent-cemented or gasketed joints.
 - a. Gaskets: ASTM F 477, elastomeric seals.
- C. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B, for gasketed joints.
 - 1. Gaskets: ASTM C 443, rubber.
- D. HDPE storm sewer pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252, and M294. Pipe and fittings shall be made from virgin PE compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350.
 - 1. Storm sewer piping greater than eight (8) inch in diameter shall be smooth interior/corrugated exterior pipe fitted with watertight joints meeting or exceeding ASTM 3212 lab test and ASTM 1417 watertight field test. N-12 IB WT® Product as manufactured by Advanced Drainage Systems, Inc. (ADS), Columbus, OH, (614) 457-3051 or approved equal.
 - 2. Underdrain piping less than or equal to eight (8) inch in diameter shall be perforated single-wall pipe fitted with soil-tight joints meeting ASTM standards F405 and F606 as manufactured by Advanced Drainage Systems, Inc. (ADS), Columbus, OH, (614) 457-3051 or approved equal.
- E. Ductile Iron pipe (DIP), Class 52, cement lined, and shall have push on joints. (ANSI/AWWA 151/A21.51)
- F. Underground Stormwater Vault ACF Model UD-Double-Mini, or approved equal.
- G. Hydrodynamic Separator: Contech CS-4 Unit, or approved equal.
- H. Yard Drains: As specified on plans, or approved equal.

2.4 SPECIAL PIPE COUPLINGS AND FITTINGS

- A. Sleeve-type and bushing-type pipe couplings ('Fernco') shall not be permitted.

- B. Pipe Couplings shall be DIP, PVC, HDPE or other approved rigid connectors for joining existing and dissimilar piping materials as manufactured by Dresser (814) 362-9200, Genco (800) 345-6454, Harco (502) 366-4596 or other approved equal.

2.5 MANHOLES

- A. Normal-Traffic Precast or cast-in-place Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
 - 1. Diameter: 48 inches minimum, unless otherwise indicated.
 - 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 - 3. Base Section: 8-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 - 4. Precast Riser Sections: 5-inch minimum thickness, and lengths to provide depth indicated.
 - 5. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 - 6. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 - 7. Gaskets: ASTM C 443, rubber.
 - 8. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 30-inch- diameter frame and cover.
 - 9. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12-inch
 - 10. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 - 11. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".
- B. Cast-in-Place Concrete Manhole (Doghouse): Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
 - 1. Ballast: Increase thickness of concrete, as required to prevent flotation.
 - 2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 30-inch diameter frame and cover.
 - 3. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 - 4. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-inch intervals.
 - 5. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".
- C. Manhole Frames and Covers: ASTM A 536, Grade 60 ID by 4- to 10-inch riser with 4-inch minimum width flange, and 30-inch- diameter cover. Include indented top design with lettering per Owner requirements cast into cover

2.6 CATCH BASINS

- A. Normal-Traffic, Precast or Cast-in-place Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
1. Base Section: 10-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 2. Riser Sections: 6-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
 3. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 4. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
 5. Gaskets: ASTM C 443, rubber.
 6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and grate.
 7. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps or anchor ladder into base, riser, and top section sidewalls at 12-inch intervals. Pipe Connectors: ASTM C 923M, resilient, of size required, for each pipe connecting to base section.
 8. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".
 9. Channels and Benches: Concrete.
- B. Cast-in-Place Concrete Structure (Doghouse): Construct of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16, heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
1. Ballast: Increase thickness of concrete, as required to prevent flotation.
 2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match inlet dimensions of frame and cover.
 3. Cast-in-place Riser Sections: 8-inch minimum block thickness up to a depth of 8 feet below finished grade; 12-inch minimum block thickness below 8 feet deep.
 4. Steps: Polypropylene, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12-inch intervals.
 5. Cast-in-place finish: mortar parge a minimum uniform thickness of 1/4".

2.7 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening, of materials and dimensions according to local standards.
- B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions according to local standards. Include heavy-duty frames and grates.
- C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions according to local standards. Include heavy-duty frames and grates.

- D. Frames and Grates: Heavy-duty cast iron frames and grates according to local standards with bicycle-safe grate patterns.
- E. Yard Inlets: As specified on plans or approved equal.

2.8 FILTER FABRIC

- A. Filter fabric shall be AASHTO M288 class 2 non-woven, TC Mirafi 140N or approved equal.
- B. Filter fabric in high-scour applications (e.g. riprap aprons) shall be AASHTO M288 class 1 woven, TC Mirafi FW500 or approved equal.
- C. See Plans for specified locations/USGS.

2.9 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.
- C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious ratio. Include channels and benches in manholes.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert slope shall be one (1) percent through manhole.
 - 2. Benches: Concrete, sloped to drain into channel. Slope shall be four (4) percent.
- D. Include channels in catch basins.
 - 1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: shall be one (1) percent through catch basin.
- E. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed steel.

2.10 PROTECTIVE COATINGS

- A. Description: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:
1. Concrete Manholes: On exterior and interior surfaces.
 2. Catch Basins: On exterior and interior surfaces.
 3. Stormwater Inlets: On exterior and interior surfaces.

2.11 CLEANOUTS

- A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.12 UNDERGROUND STORMWATER VAULT

- A. Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height and envelope shown on plans.
- B. Units shall meet the following Physical Characteristics:
- a. Void Area: 95%
 - b. Comprehensive Strength: 134.2 psi
 - c. HS-20 Minimum Cover: 12" (Stone Backfill)
- C. Supplier: ACF Environmental 2831 Cardwell Road Richmond, VA 23234 (T): 800-448-3636; (F): 804-743-7779 www.acfenvironmental.com, or approved equal.
- D. Bedding Materials: Stone (angular and smaller than 1.5" in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the system (3" minimum). Material must be free from lumps, debris, and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.
- E. Side and Top Backfill: Free draining material shall be used adjacent to (24" minimum) and above (for the first 12") the system. Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.
- F. For UD modules in traffic loaded (HS-20) applications with less than 14" of top cover, backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter). The use of soil backfill on the sides and top of the UD module is not permitted unless the modules are installed outside of traffic areas or with cover depths of 14" or more. Top

backfill material (from top of module to bottom of pavement base or 12" maximum) must be consistent with side backfill.

- G. System shall provide 3,524 cf of storage at a depth of 3.35 feet.

2.13 STORMWATER TREATMENT DEVICE (SWTD): HYDRODYNAMIC SEPARATOR

- A. This item shall govern the furnishing and installation of the SWTD, complete and operable as shown and as specified herein, in accordance with the requirements of the plans and contract documents.
- B. The manufacturer of the SWTD shall be one that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff for at least five (5) years and which have a history of successful production, acceptable to the Engineer. In accordance with the Drawings, the SWTD(s) shall be a hydrodynamic separation device manufactured by:

Contech Engineered Solutions LLC
9025 Centre Pointe Drive
West Chester, OH, 45069
Tel: 1 800 338 1122

- C. The manufacturer shall guarantee the SWTD components against all manufacturer originated defects in materials or workmanship for a period of twelve (12) months from the date the components are delivered to the owner for installation. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period at the cost to the manufacturer. The use of SWTD components shall be limited to the application for which it was specifically designed.
- D. The SWTD manufacturer shall submit to the Engineer of Record a "Manufacturer's Performance Certification" certifying that the SWTD is capable of achieving the specified removal efficiencies listed in these specifications. The certification shall be supported by independent third-party research.
- E. No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the Engineer of Record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.
- F. Performance
1. The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns.

2. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the following requirements: Minimum Sump Storage Capacity of 0.70 cubic yards and Minimum Oil Storage Capacity of 141.0 gallons. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.
3. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity as discussed in Section 2 of the Performance Specifications for the unit.
4. The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of New York. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

2.14 STORMWATER TREATMENT DEVICE: CISTERN

- A. This item shall govern the furnishing and installation of a cistern for rainwater harvesting and other underground water storage for nominal diameters 30" (750mm) through 120" (3000mm).
- B. A stormwater treatment device upstream of the cistern is recommended as the appropriate means of pretreating for the purpose of extending the maintenance interval on the cistern system and reducing the life cycle cost. Both engineered solutions shall be provided by a single supplier/manufacturer.
- C. Site layout drawings, product specifications, materials, hydraulic storage data and supported calculations of proposed alternatives shall be submitted to the Engineer of Record (EOR) for review at a minimum of 10 working days prior to bid closing.
- D. The cistern system proposal shall be sized in accordance with the design provided and approved by the Engineer of Record (EOR). Any Contractor deviating from the design shown on the plans, to include: material, footprint, etc., shall provide to the Engineer of Record (EOR) a summary report on stage-storage curves, design calculations, system modeling and engineering drawings.
- E. Shop drawings shall be annotated to indicate all materials to be furnished and installed under this section, and all applicable standards for materials, required tests of materials and design assumptions for structural analysis.
- F. Virgin high density polyethylene stress-rated resins are used to manufacture the cistern and complimentary fabricated fittings. Resins shall conform to the minimum requirements of cell classification 345464C as defined and described in the latest version of ASTM D3350
- G. Performance

1. All tanks must be leak tested and results documented using a positive pressure air test prior to shipment from the manufacturing location. Testing documentation shall include test air pressure and hold time. A copy of the leak test report must be provided to the Engineer of Record as requested.
2. Bulkheads shall be constructed of material in conformance with Section 2.14 F and designed for H-20/HS-25 final live loading conditions.
3. All cistern inlets shall be equipped with an inlet calming device that they may introduce water to the tank with little to no turbulence.
4. The cistern shall provide a minimum of one 36 inch diameter access riser.
5. Cistern tank spacing, and stone base thickness cannot be altered with consultation from the manufacturer.
6. The cistern shall be designed for a minimum HS-20/HS-25 final live loading conditions. The cistern shall meet HS-20/HS-25 loading requirements with a minimum cover of 1.5 ft. and a maximum cover of 8' measured from the top of tank to the bottom of flexible pavement. The cistern shall have a unit weight of 65.6 lbs./ft. and a minimum wall thickness of 0.220 in.

2.15 SWTD – PERFORMANCE

- A. The SWTD shall be sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate designated by the jurisdiction in which the project is located. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns.
- B. The SWTD shall be designed with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. The minimum storage capacity provided by the sump chamber shall be in accordance with the volume listed in Table 1. The boundaries of the sump chamber shall be limited to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. In order to not restrict the Owner's ability to maintain the SWTD, the minimum dimension providing access from the ground surface to the sump chamber shall be 16 inches in diameter.
- C. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in Table 1 of the required unit.
- D. The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, supporting documentation shall be submitted that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the State of the work. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.
 - 3. Install detectable warning tape 6-inches to 12-inches below finished grade.

3.3 PIPING APPLICATIONS

- A. General: Include watertight or soil-tight joints as specified.
- B. Refer to Part B of this Section for detailed specifications for pipe and fitting products. Use pipe, fittings, and joining methods according to applications indicated.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods. Use the following pipe couplings for nonpressure applications:
 - 1. Rigid connection fittings
- B. Encase all dissimilar connections or connections to existing piping materials located under proposed structures (buildings, roadways, etc.) with concrete.

3.5 INSTALLATION, GENERAL

- A. Unloading and Handling
 - 1. Follow all Occupational Safety and Health Administration (OSHA) safety requirements.
 - 2. When the truckload of pipe is initially received, it should be inspected for damage and quantities should be verified with shipping papers. Any damage or discrepancies should be noted on the delivery receipt and the supplier notified. The Owner shall not be responsible for acceptance and installation of defective materials.
- B. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of

piping layout take design considerations into account. Install piping as indicated, to extent practical.

- C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.
- D. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
- E. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
 - 1. Install piping pitched down in direction of flow, at minimum slope of 0.25 percent, unless otherwise indicated.
- F. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.6 INSTALLATION REQUIREMENTS, HDPE OR PVC

A. Unloading and Handling

- 1. HDPE pipe is designed to withstand normal field handling and can be easily unloaded by hand or with equipment. To avoid damage, the pipe should not be dropped. When using equipment to unload or move the pipe, a fork extension can be used. When unloading by hand, gloves should be worn.
- 2. Do not use chains or wire rope to lift the pipe. Use nylon slings and do not pick up 20-foot lengths from only one place on pipe.

B. Trenching

- 1. Excessive groundwater necessitates dewatering. Plastic pipe will float in standing water, requiring immediate haunching and initial backfill to hold line and grade. If the contractor encounters this condition. Dewatering shall be employed.
- 2. An unstable trench bottom must be stabilized with gravel or stone bedding materials.
- 3. Excavation from 0 to 12 inches below the pipe should be filled with acceptable bedding material and compacted to a minimum 95 percent Proctor density in accordance with ASTM D 1557. Fill area of over-excavation beyond 12 inches with processed stone or gravel.
- 4. Before installing pipe, bring bedding material to grade along the entire length of the pipe.
- 5. When excavating in Class IV materials (silt, silty clays, and clays), provide a uniform, improved trench bottom in accordance with the plan details.

C. Field cutting

1. Use a handsaw or power pipe cutoff saw.
2. For ribbed pipe, cut in the valley of a corrugation. Do not cut into the sidewall of an annular corrugation. For pipe with external spiral corrugations, place a split coupling around it and use the coupling edge as a cutting guide.
3. It is not necessary to bevel the cut pipe edge prior to installing an o-ring gasket joint system.
4. Skew or bevel cuts shall not be permitted.

D. Laying plastic pipe

1. Curvilinear installation shall not be permitted.
2. Plastic pipe can be easily carried to the trench and in sizes below 24 inches, installed by hand without the use of special equipment. Do not drop the pipe into the trench.

E. Embedment for bedding, haunching and initial backfill

1. Embedment materials are those used for bedding, haunching and initial backfill. ASTM D-2321 classifies soil materials as:
 - a. Class I: Angular crushed stone or rock, dense or open-graded, with little or no fines (1/4 inch to 1-1/2 inches in size).
 - b. Class II: Clean, coarse-grained materials, such as gravel, coarse sands, and gravel/sand mixtures (1-1/2 inches in size).
 - c. Class III: Coarse-grained material with fines including silty or clayey gravels or sands. Gravel or sand must comprise more than 50 percent of Class III: materials (1-1/2 inches maximum size.)
 - d. Class IV: Fine-grained materials, such as fine sand and soils, containing 50 percent or more clay or silt. Soils classified as Class IVa (ML or CL) have medium to low plasticity and are not recommended in the embedment zone. Soils classified as Class IVb (MH or CH) have high plasticity and are not recommended for embedment materials.
 - e. Class V: These materials include organic silts and clays, peat, and other organic materials. They are not recommended for embedment materials.
2. Do not place lumps of frozen soil or ice in the embedment zone.

F. Bedding

1. The contractor shall place bedding material providing uniform support to hold the pipe on line and grade in accordance with the plan details. Bedding materials under pipe shall be Class I, II or III.

G. Haunching

1. Proper haunching provides a major portion of the pipe's strength and stability. Poor workmanship will lead to excessive pipe deflection and grade and alignment problems. Haunching materials shall be Class I, II or III and must be compacted to minimum 90 percent standard Proctor.
2. Haunching Requirements

- a. Work enough material under the haunch of the pipe to provide proper compaction and side support.
- b. Where trench walls are unstable, prevent loss of side support by controlling sloughing, etc.
- c. Do not allow the pipe move when placing material under the haunch of the pipe.
- d. Take care not to damage the smaller size pipe with shovels or tamping equipment.
- e. Haunching shall be in 6-inch lifts.
- f. Controlled low strength material (CLSM) slurry is suitable for embedment. Trench width may be narrower if allowed by the Owner. Prevent floating with stakes or other methods.

H. Initial Backfill

1. Initial backfill materials extend from the spring line to 6 inches to 12 inches above the pipe to provide the remainder of the pipe support and protect the pipe from stones or cobbles in the final backfill. Class I, II, III materials shall be used. However:
 - a. Class I materials shall be used in wet trenches if Class I bedding and haunching materials are used.
 - b. Class II materials shall be compacted in 6-inch lifts to 95 percent modified Proctor density in accordance with ASTM D 1557.
 - c. Class III materials shall be compacted in 6-inch lifts to 95 percent modified Proctor density in accordance with ASTM D 1557.

I. Construction Loads

1. During construction, avoid heavy equipment wheel loads over the pipe or place additional cover at vehicle crossings. If a hydro-hammer or hoe-pak is to be used to compact the trench at least 48 inches of cover must be provided.
2. When connections to structures, laterals, deep laterals, risers, or drop manholes are required, the installation must be designed to ensure that the pipe and fittings are not damaged by loads generated due to soil settlement, dragdown, and/or poor installation practices.
3. When removing sheeting or other trench protection, do not disturb the embedment material. If sheeting or trench protection must be used below the top of the pipe, bracing shall be cut at the top of pipe elevation and left in place.
4. If any damage occurs due to construction loading of the pipes, contractor shall bear entire expense for repair and/or replacement.

3.7 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to installations indicated.
- B. PVC Sewer Pipe and Fittings: As follows:
 1. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.

2. Install according to ASTM D 2321.
- C. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:
 1. Round Pipe and Fittings: ASTM C 443, rubber gaskets.
- D. HDPE Pipe and Fittings: Install split couplings as follows:
 1. Split Couplings: This joint system is used where a soil-tight system is required.
 2. The sides of these split couplings are "hinged" so they easily open up to accept each end of adjacent pipe sections. There are matching holes at the split in the top of the coupling that are secured for a tight fit with nylon ties.
- E. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.
- F. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.
- G. All labor, materials, and equipment required to join and provide fittings for all pipe joints shall be included in the price bid for the proposal.

3.8 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated in accordance with manufacturer's guidelines and recommendations.
- B. Form continuous concrete channels and benches between inlets and outlet.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 2 inches above finished surface elsewhere, unless otherwise indicated.
- D. Install precast concrete manhole sections with gaskets according to ASTM C 891.
- E. Construct cast-in-place manholes as indicated.

3.9 STORMWATER CATCH BASIN/INLET INSTALLATION

- A. Construct catch basins/inlets to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.10 UNDERDRAIN

- A. General: Install filter fabric, stone, piping and backfill as indicated.

3.11 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.12 PIPE BENEATH BUILDING SLABS AND FOUNDATIONS

- A. All pipe shall be Ductile Iron, Class 52.
- B. Reinforced pipe material shall extend from structure to structure. Material changes shall not be permitted mid-run.
- C. Pipe shall be cement-lined where used to sleeve PVC/HDPE principal conduit material.
 - 1. Principal conduit shall be aligned along the central axis of the sleeve pipe, braced into position utilizing cement or HDPE shims, and the annular space filled with pea gravel (1/2" maximum particle size).
- D. Pipe backfill shall be 3/4" quarry process clean stone placed in 1 foot lifts and compacted in place in accordance with Division 31 section "Earth Moving". Stone backfill shall extend from the pipe springline to finished grade.

3.13 CONNECTION TO EXISTING STRUCTURES

- A. Where connection into an existing storm sewer structure is required, the Contractor shall be responsible for maintaining the integrity of the existing structure. No separate payment shall be made for repair work required to correct damage to the structure because of the connection work.
- B. All cuts into the existing structure walls shall be made with an approved power saw.
- C. All joints and excess wall surface removed to facilitate pipe installation shall be sealed water-tight with masonry block and grout.
- D. All backfill shall be in accordance with Section 31 20 00 Earth Moving.

3.14 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use HDPE/PVC pipe fittings in sewer pipes at branches for cleanouts and HDPE/PVC pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1/4 inch below surrounding earth grade.
- C. In roadway traffic areas, enclosed top of cleanout stack in a cast iron casting set in concrete to prevent crushing of the stack.

- D. All labor, materials, and equipment required to join and provide fittings for all cleanout assemblies shall be included in the price bid for the proposal.

3.15 UNDERGROUND STORMWATER VAULT

- A. Install in accordance with manufacturer specifications and requirements.

3.16 STORM WATER TREATMENT DEVICE

- A. Install in accordance with manufacturer specifications and requirements.

3.17 REHABILITATE EXISTING STRUCTURES

- A. This work shall consist of removing and cleaning the existing castings, replacement of any damaged block and/or brick, replacement of any loose or missing mortar, parging of the inlet interior, resetting of any loose ladder rings, resetting of the existing castings to the final grade and any work necessary as directed by the Owner.

3.18 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below as appropriate:
 - 1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
 - 3. Fill with flowable fill where indicated on the plans.
- B. Abandoned Structures: Excavate around structure as required and remove structure and close open ends of remaining piping.

3.19 ADJUSTMENTS TO GRATE RIM ELVATIONS

- A. Raise or lower the existing frames, covers and gratings of manholes, and drainage structures to the grades shown on the plans or directed by the Owner.
- B. Parge exterior surface with mortar when brick or masonry units are added or when the exterior surface is disturbed.
- C. Replace frames, covers or gratings damaged during the Work of the Contract

3.20 FIELD QUALITY CONTROL

- A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
 - 1. In large, accessible piping, brushes and brooms may be used for cleaning.
 - 2. Place plug in end of incomplete piping at end of day and when work stops.
 - 3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
 - 1. Submit separate reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 - 4. Reinspect and repeat procedure until results are satisfactory.
- C. Upon completion of storm sewer installation, the contractor shall schedule a final acceptance inspection with the Owner's Representative. The contractor shall furnish at his expense, labor and equipment to inspect all pipe runs (i.e. lights, mirrors, pry-bars, laborers, etc.)
 - 1. Do not enclose, cover, or put into service before inspection and approval.
 - 2. Test completed piping systems according to authorities having jurisdiction.
 - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 - 4. Submit separate reports for each test.
- D. Leaks constitute defects that must be repaired.
- E. Replace leaking piping using new materials.

END OF SECTION 334000