architects + engineers

PROJECT MANUAL

VILLAGE OF MOUNT KISCO
104 Main Street
Mount Kisco, NY 10549

ADDITIONS AND ALTERATIONS AT

MUTUAL STATION
99 MAIN STREET
MT KISCO, NY 10549

Project No: MKIV 1802

CONTRACT G - GENERAL CONSTRUCTION
Volume III of III: Division 22 - 33

FINAL BID DOCUMENTS
February 8, 2022

H2M architects + engineers
3 Lear Jet Lane, Suite 205, Latham, NY 12110
tel 518.765.5105 fax 518.765.5107

www.h2m.com

TABLE OF CONTENTS

VOLUME I DIVISIONS 00 - 01

DIVISION 00 – BIDDING AND CONTRACT REQUIREMENTS

DIVISION 01 – GENERAL REQUIREMENTS

TABLE OF CONTENTS

VOLUME II – DIVISIONS 02 - 14

DIVISION 02 – EXISTING CONDITIONS

DIVISION 03 – CONCRETE

DIVISION 04 – MASONRY

DIVISION 05 – METALS

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

DIVISION 12 – FURNISHINGS

DIVISION 14 – CONVEYING EQUIPMENT

VOLUME III – DIVISIONS 22 - 33

DIVISION 22 – PLUMBING

DIVISION 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

DIVISION 26 – ELECTRICAL

DIVISON 28 – ELECTRONIC SAFETY AND SECURITY

DIVISION 31 – EARTHWORK

DIVISION 32 – EXTERIOR IMPROVEMENTS

DIVISION 33 – UTILITES

APPENDIX A

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 099113 - Exterior Painting: Preparation and painting of exterior piping systems.

C. Section 099123 - Interior Painting: Preparation and painting of interior piping systems.

D. Section 220523 - General-Duty Valves for Plumbing Piping.

E. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

F. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.05 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 this section.
   1. Approved by manufacturer.

C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 PIPE SLEEVES

A. Manufacturers:
   1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Vertical Piping:
   1. Sleeve Length: 1 inch (25 mm) above finished floor.
   2. Provide sealant for watertight joint.
   3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
   4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.

C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.

D. Pipe Passing Through Below Grade Exterior Walls:
   1. Zinc coated or cast iron pipe.
   2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

E. Pipe Passing Through Concrete Beam Flanges, except where Brass Pipe Sleeves are Specified:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

F. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
   1. Galvanized steel pipe or black iron pipe with asphalt coating.
   2. Connect sleeve with floor plate except in mechanical rooms.

G. Penetrations in concrete beam flanges are permitted but are prohibited through ribs or beams without prior approval from the H2M.

H. Clearances:
   1. Provide allowance for insulated piping.
   2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.
   3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
   2. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.
   3. Elastomer element size and material in accordance with manufacturer's recommendations.
   4. Glass reinforced plastic pressure end plates.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:
   1. Provide inserts for placement in concrete formwork.
   2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 m).
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Structural Considerations:
   1. Do not penetrate building structural members unless indicated.

F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
   1. Aboveground Piping:
      a. Pack solid using mineral fiber complying with ASTM C592.
      b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
   2. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.
   3. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

G. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.

5. Tighten bolting for a water-tight seal.
6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

C. See Section 017419 - Construction Waste Management and Disposal, for additional requirements.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Applications.

B. Angle valves.

C. Ball valves.

D. Check valves.

E. Gate valves.

F. Globe valves.

G. Plug valves.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 083100 - Access Doors and Panels.

C. Section 220553 - Identification for Plumbing Piping and Equipment.

D. Section 220716 - Plumbing Equipment Insulation.

E. Section 220719 - Plumbing Piping Insulation.

F. Section 221005 - Plumbing Piping.

1.03 ABBREVIATIONS AND ACRONYMS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene.

G. RS: Rising stem.

H. SWP: Steam working pressure.

I. TFE: Tetrafluoroethylene.

J. WOG: Water, oil, and gas.

1.04 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.

B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013 (Reaffirmed 2018).

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2015.

D. ASME B16.5 - Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard; 2017.

E. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2017.

F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

G. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

H. ASME B31.9 - Building Services Piping; 2017.

I. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

J. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2003 (Reapproved 2016).

K. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).

L. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).

M. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2019)e1.

N. ASTM B61 - Standard Specification for Steam or Valve Bronze Castings; 2015.

O. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

P. AWWA C606 - Grooved and Shouldered Joints; 2015.

Q. MSS SP-45 - Bypass and Drain Connections; 2003 (Reaffirmed 2008).

R. MSS SP-67 - Butterfly Valves; 2017.

S. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; 2011.

T. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; 2018.

U. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.

V. MSS SP-78 - Cast Iron Plug Valves, Flanged and Threaded Ends; 2011.

W. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

X. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; 2011.

Y. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

Z. MSS SP-125 - Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves; 2018.

AA. NSF 61 - Drinking Water System Components - Health Effects; 2019.

AB. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.05 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

E. Maintenance Materials: Furnish Owner with one wrench for every five plug valves, in each size of square plug valve head.
   1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.
   3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
   4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
   5. Secure check valves in either the closed position or open position.
   6. Adjust butterfly valves to closed or partially closed position.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.

1.08 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

A. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Provide the following valves for the applications if not indicated on drawings:
   1. Shutoff: Ball, butterfly, gate or plug.
   2. Dead-End: Single-flange butterfly (lug) type.
   3. Throttling: Provide globe, ball, or butterfly.

B. Domestic, Hot and Cold Water Valves:

1. 2 NPS (50 DN) and Smaller:
   a. Bronze and Brass: Provide with solder-joint ends.
   b. Bronze Angle: Class 125, bronze disc.
   c. Ball: One piece, full port, brass with brass trim.
   d. Bronze Swing Check: Class 125, bronze disc.
   e. Bronze Gate: Class 125, NRS.
   f. Bronze Globe: Class 125, bronze disc.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Gear Actuator: Quarter-turn valves 8 NPS (200 DN) and larger.
   2. Hand Lever: Quarter-turn valves 6 NPS (150 DN) and smaller except plug valves.
   3. Wrench: Plug valves with square heads.

D. Valves in Insulated Piping: With 2 NPS (50 DN) stem extensions and the following features:
   1. Gate Valves: Rising stem.
   2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   3. Butterfly Valves: Extended neck.

E. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Pipe Flanges and Flanged Fittings 1/2 NPS (15 DN) through 24 NPS (600 DN): ASME B16.5.
   3. Solder Joint Connections: ASME B16.18.
   4. Grooved End Connections: AWWA C606.

F. General ASME Compliance:
   1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
   2. Solder-joint Connections: ASME B16.18.
   3. Building Services Piping Valves: ASME B31.9.

G. Potable Water Use:
   1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
   2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.

H. Source Limitations: Obtain each valve type from a single manufacturer.

2.03 BRONZE, ANGLE VALVES

A. Class 125: CWP Rating: 200 psig (1380 kPa).
   1. Comply with MSS SP-80, Type 1.
   2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
   3. Ends: Threaded.
   4. Stem: Bronze.
   5. Disc: Bronze.
   6. Packing: Asbestos free.

7. Handwheel: Bronze or aluminum.

2.04 BRASS, BALL VALVES

A. Two Piece, Full Port with Brass Trim and Threaded Connections:
   1. Comply with MSS SP-110.
   2. SWP Rating: 150 psig (1035 kPa).
   3. CWP Rating: 600 psig (4140 kPa), WOG.
   4. Body: Forged brass.
   5. Seats: PTFE.
   6. Ball: Chrome-plated brass.

2.05 BRONZE, BALL VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. One Piece, Reduced Port with Bronze Trim:
   1. Comply with MSS SP-110.
   2. SWP Rating: 400 psig (2760 kPa).
   3. CWP Rating: 600 psig (4140 kPa).
   4. Body: Bronze.
   5. Ends: Press.
   6. Seats: PTFE.

2.06 STAINLESS STEEL, BALL VALVES

A. Two Piece, Full Port with Stainless Steel Trim:
   1. Comply with MSS SP-110.
   2. SWP Rating: 150 psig (1035 kPa).
   3. CWP Rating: 1000 psig (6895 kPa).
   4. Body: Stainless steel.
   5. Ends: Threaded or press.
   6. Seats: PFTE.
   7. Stem: Stainless steel.
   8. Ball: Stainless steel.

2.07 BRASS, INLINE CHECK VALVES

A. Class 150: CWP Rating: 300 psig (2,068 kPa), WOG.

B. Maximum Service Temperature: 250 deg F (121.1 deg C).

C. Body: Forged brass.

D. Disc: Forged brass.

E. Seal: PTFE, bubble-tight.

F. End-Connections: Threaded.

2.08 BRONZE, SWING CHECK VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125 CWP Rating; 200 psig (1,380 kPa) WOG:
1. Comply with MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. Body: Bronze, ASTM B62.
4. Ends: Threaded.
5. Disc: Bronze.

2.09 IRON, HORIZONTAL SWING CHECK VALVES

A. Class 125:
1. Comply with MSS SP-71, Type I.
2. CWP Rating: 200 psig (1380 kPa).
3. Design: Clear or full waterway.
4. Body: ASTM A126, gray cast iron with bolted bonnet.
5. Ends: Flanged.
6. Trim: Composition.
7. Seat Ring and Disc Holder: Bronze.
8. Disc: PTFE.
9. Gasket: Asbestos free.

2.10 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP:
1. CWP Rating: 300 psig (2070 kPa).
2. Body: ASTM A536, Grade 65-45-12 ductile iron.
3. Seal: EPDM.
4. Disc: Ductile iron.
5. Coating: Black, non-lead paint.

2.11 IRON, CENTER-GUIDED CHECK VALVES

A. Class 125, Globe:
1. Comply with MSS SP-125.
2. CWP Rating: 200 psig (1380 kPa).
3. Style: Spring loaded.
4. Ends: Flanged.

2.12 BRONZE, GATE VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. NRS (Non-rising Stem) or OS & Y (Rising Stem):
1. Comply with MSS SP-80, Type I.
2. Class 125: CWP Rating 200 psig (1380 kPa).
3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
4. Ends: Threaded or solder joint joint.
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel: Malleable iron, bronze, or aluminum.

2.13 BRONZE, GLOBE VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125: CWP Rating 200 psig (1380 kPa):
   1. Comply with MSS SP-80, Type 1.
   2. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
   3. Ends: Threaded joint.
   4. Stem: Bronze.
   5. Disc: PTFE.
   6. Packing: Asbestos free.
   7. Handwheel: Malleable Iron.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

END OF SECTION

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components for equipment, piping, and other plumbing work.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2019b.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

F. MFMA-4 - Metal Framing Standards Publication; 2004.

G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Installer's Qualifications: Include evidence of compliance with specified requirements.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems:
1. Comply with MFMA-4.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

D. Thermal Insulated Pipe Supports:
1. General Construction and Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch (12.7 mm to 762 mm) iron pipes.
    d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by a 360 degree, PVC jacketing.
2. PVC Jacket:
    a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
    b. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
    c. Thickness: 60 mil (1.524 mm).

E. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

F. Pipe Installation Accessories:
1. CPVC Pipe Supports:
    a. Manufacturers:
        1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
        2) Substitutions: See Section 016000 - Product Requirements.
2. Thermal Insulated Pipe Supports:
    a. Manufacturers:
        1) HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by H2M, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by H2M, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Secure fasteners according to manufacturer's recommended torque settings.

I. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

1.02 RELATED REQUIREMENTS

A. Section 099123 - Interior Painting: Identification painting.

1.03 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

E. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Piping: Tags.

B. Pumps: Nameplates.

C. Tanks: Nameplates.

D. Valves: Tags.

2.02 NAMEPLATES

A. Manufacturers:
   1. Seton Identification Products: www.seton.com/#sle.
   2. Bunting
   3. Brady
   4. Substitutions: See Section 016000 - Product Requirements.

B. Description: Laminated three-layer plastic with engraved white letters on dark contrasting background color.

2.03 TAGS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com/#sle.
   2. Seton Identification Products: www.seton.com/#sle.
   3. Bunting
   4. Substitutions: See Section 016000 - Product Requirements.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

2.04 STENCILS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com/#sle.
   2. Seton Identification Products: www.seton.com/#sle.
   3. Bunting
   4. Substitutions: See Section 016000 - Product Requirements.

B. Stencils: With clean cut symbols and letters of following size:
   1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
   2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
   3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.

C. Stencil Paint: As specified in Section 099123, semi-gloss enamel, colors complying with ASME A13.1.

2.05 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation: www.bradycorp.com/#sle.
   2. Seton Identification Products: www.seton.com/#sle.
   3. Bunting
   4. Substitutions: See Section 016000 - Product Requirements.

B. Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

E. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil (0.10 mm) thick, manufactured for direct burial service.

F. Color code as follows:
   1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.
   2. Flammable Fluids: Yellow with black letters.
   3. Compressed Air: Blue with white letters.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Section 099123 for stencil painting.

3.02 INSTALLATION

A. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Apply stencil painting in accordance with Section 099123.

D. Install plastic pipe markers in accordance with manufacturer's instructions.

E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

F. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.

G. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
   1. Identify service, flow direction, and pressure.
   2. Install in clear view and align with axis of piping.
   3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

H. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 099113 - Exterior Painting: Painting insulation jacket.

C. Section 099123 - Interior Painting: Painting insulation jacket.

D. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2019b.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER

A. Manufacturers:
   1. Johns Manville Corporation: www.jm.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   2. Maximum Service Temperature: 850 degrees F (454 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible, with wicking material to transport condensed water to the outside of the system for evaporation to the atmosphere.
   1. K (Ksi) Value: ASTM C177, 0.23 at 75 degrees F (0.034 at 24 degrees C).
   2. Maximum Service Temperature: 220 degrees F (104 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

D. Insulation: ASTM C547 and ASTM C795; semi-rigid, noncombustible, end grain adhered to jacket.
   1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
   2. Maximum Service Temperature: 650 degrees F (343 degrees C).
   3. Maximum Moisture Absorption: 0.2 percent by volume.

E. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches (0.029 ng/Pa s m).

F. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

G. Vapor Barrier Lap Adhesive: Compatible with insulation.

H. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

I. Fibrous Glass Fabric:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.

J. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, black color.

K. Insulating Cement: ASTM C449.

2.03 JACKETS

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation: www.jm.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
      b. Maximum Service Temperature: 150 degrees F (66 degrees C).
      c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/Pa s m), maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil (0.25 mm).
      e. Connections: Brush on welding adhesive.
   3. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.
   1. Install seal over seams with factory-approved room temperature vulcanization (RTV) silicone sealant to ensure a positive vapor barrier seal in outdoor and sanitary washdown environments.

F. Glass fiber insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

G. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

H. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.

I. Glass fiber insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

J. Inserts and Shields:
   1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
   2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   3. Insert Location: Between support shield and piping and under the finish jacket.
   4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

K. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 078400.

L. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.

M. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

N. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.
   1. Sanitary sewer.
   2. Domestic water.
   3. Storm water.
   4. Flanges, unions, and couplings.
   5. Pipe hangers and supports.
   6. Manufactured sleeve-seal systems.
   7. Ball valves.
   8. Butterfly valves.
   9. Balancing valves.
   10. Control and service valves.
   11. Strainers.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 099113 - Exterior Painting.

C. Section 099123 - Interior Painting.

D. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.

E. Section 220553 - Identification for Plumbing Piping and Equipment.

F. Section 220719 - Plumbing Piping Insulation.

G. Section 330110.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 2015.

B. ANSI Z223.1 - National Fuel Gas Code; 2016.

C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

F. ASME B31.1 - Power Piping; 2018.

G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2017.

I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

J. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

K. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2018.

N. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

O. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

P. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2015a.

Q. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, Culvert Pipe and (Metric); 2015a.

R. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe; 2019b.

S. ASTM C76M - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric); 2019b.

T. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2012 (Reapproved 2017).

U. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2011 (Reapproved 2017).

V. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2014.

W. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2015, with Editorial Revision (2018).

X. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings; 2004 (Reapproved 2016).

Y. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter; 2012a.

Z. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

AA. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.

AB. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2019.

AC. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012 (Reapproved 2018).

AD. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2015.

AE. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings; 2014, with Editorial Revision (2018).

AF. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2014.

AG. ASTM D2680 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping; 2001 (Reapproved 2014).

AH. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2014.

AI. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2017.

AJ. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019.

AK. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

AL. ASTM D2996 - Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe; 2017.

AM. ASTM D2997 - Standard Specification for Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe; 2015.

AN. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

AO. ASTM D3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe; 2016.

AP. ASTM D3517 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe; 2019.

AQ. ASTM D3754 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe; 2019.

AR. ASTM D3840 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Fittings for Nonpressure Applications; 2019.

AS. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2015.

AT. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2017.

AU. ASTM F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.

AV. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2015.

AW. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2019.

AX. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014.

AY. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.

AZ. ASTM F628 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe With a Cellular Core; 2012, with Editorial Revision (2018).

BA. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2016.

BB. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992,with Editiorial Revision (2018).

BC. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2019a.

BD. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2019.

BE. ASTM F1281 - Standard Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe; 2017.

BF. ASTM F1282 - Standard Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe; 2017.

BG. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Polyethylene of Raised Temperature (PE-RT) Tubing; 2019.

BH. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2010.

BI. AWWA C651 - Disinfecting Water Mains; 2014.

BJ. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution; 2016.

BK. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service; 2017.

BL. AWWA C950 - Fiberglass Pressure Pipe; 2013.

BM. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).

BN. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2012 (Revised 2018).

BO. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.

BP. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2015.

BQ. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.

BR. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.

BS. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

BT. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

BU. NSF 61 - Drinking Water System Components - Health Effects; 2019.

BV. NSF 372 - Drinking Water System Components - Lead Content; 2016.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 016000 - Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY SEWER PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

2.03 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.
   1. Fittings: Cast iron.
   2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. Cast Iron Pipe: CISPI 301, hubless.
   1. Fittings: Cast iron.
   2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

2.04 SANITARY SEWER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2729.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.05 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. Joints: ASTM B32, alloy Sn95 solder.

2.06 STORM WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.07 STORM WATER PIPING, ABOVE GRADE

A. PVC Pipe: ASTM D2665 or ASTM D3034.
   1. Fittings: PVC.
   2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.08 NATURAL GAS PIPING, BURIED BEYOND 5 FEET (1500 MM) OF BUILDING

A. Polyethylene Pipe: ASTM D2513, SDR 11.
   1. Fittings: ASTM D2683 or ASTM D2513 socket type.
   2. Joints: Fusion welded.

2.09 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASTM A234/A234M, wrought steel welding type.
   2. Joints: ASME B31.1, welded.

3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.10 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

2.11 FLANGES, UNIONS, AND COUPLINGS

A. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.12 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
   3. Trapeze Hangers: Welded steel channel frames attached to structure.
   4. Vertical Pipe Support: Steel riser clamp.
   5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
   6. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
      a. Bases: High-density polypropylene.
      b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
      c. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
      d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
      e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.

B. Plumbing Piping - Drain, Waste, and Vent:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
   3. Wall Support for Pipe Sizes to 3 inch (80 mm, DN): Cast iron hook.

C. Plumbing Piping - Water:
   1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
   2. Hangers for Cold Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
   3. Hangers for Hot Pipe Sizes 2 to 4 inch (50 to 100 mm, DN): Carbon steel, adjustable, clevis.

2.13 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:
   1. The Metraflex Company; MetraSeal: www.metraflex.com/#sle.

B. Modular/Mechanical Seal:
   1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.
   2. Provide watertight seal between pipe and wall/casing opening.
   3. Elastomer element size and material in accordance with manufacturer's recommendations.
   4. Glass reinforced plastic pressure end plates.

2.14 BALL VALVES

A. Manufacturers:
   1. Apollo Valves: www.apollovalves.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Construction, 4 inch (100 mm, DN) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze or ductile iron body, 304 stainless steel or chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, threaded or grooved ends with union.

2.15 BALANCING VALVES

A. Manufacturers:
   1. Taco, Inc; _____: www.taco-hvac.com/#sle.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C. Manual Operated Y-Pattern Globe, Size 1/2 to 2 inch (15 to 50 mm, DN):
   1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi (2,068 kPa), minus 4 to 250 deg F (minus 20 to 121.1 deg C) WOG service.

D. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

2.16 STRAINERS

A. Manufacturers:
   1. Armstrong International, Inc; _____: www.armstronginternational.com/#sle.
   2. Jomar Valves, a division of Jomar Group; _____: www.jomarvalve.com/#sle.
   3. Substitutions: See Section 016000 - Product Requirements.

B. Size 1/2 inch (15 mm, DN) to 3 inch (80 mm, DN):
   1. Class 150, threaded forged bronze Y-pattern body, stainless steel perforated mesh screen with cap, and rated for 150 psi (1,034 kPa), 250 deg F (121.1 deg C) WOG service.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

H. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

I. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

J. Sleeve pipes passing through partitions, walls, and floors.

K. Manufactured Sleeve-Seal Systems:
   1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
   2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
   3. Locate piping in center of sleeve or penetration.
   4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
   5. Tighten bolting for a watertight seal.
   6. Install in accordance with manufacturer's recommendations.

3.04 APPLICATION

A. Provide flow controls in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/8 inch per foot (1:100) slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 330110.58.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Hose bibbs.

D. Washing machine boxes and valves.

E. Backflow preventers.

F. Water hammer arrestors.

G. Sanitary waste interceptors.

H. Mixing valves.

I. Catch basins and manholes.

J. Hose Reels

K. Exterior penetration accessories.

1.02 RELATED REQUIREMENTS

A. Section 016000 - Product Requirements: Procedures for Owner-supplied products.

B. Section 221005 - Plumbing Piping.

C. Section 223000 - Plumbing Equipment.

D. Section 224000 - Plumbing Fixtures.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASME A112.6.3 - Floor and Trench Drains; 2016.

C. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2008 (Reaffirmed 2012).

D. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2004, with Errata.

E. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2009.

F. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.

G. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).

H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

I. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

J. DIN 19580 - Drainage channels for vehicular and pedestrian areas - Durability, mass per unit area and evaluation of conformity; 2010.

K. NEMA MG 1 - Motors and Generators; 2018.

L. NSF 2 - Food Equipment; 2018.

M. NSF 61 - Drinking Water System Components - Health Effects; 2019.

N. NSF 372 - Drinking Water System Components - Lead Content; 2016.

O. PDI-WH 201 - Water Hammer Arresters; 2010.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

C. Certificates: Certify that grease interceptors meet or exceed specified requirements.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

E. Operation Data: Indicate frequency of treatment required for interceptors.

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

G. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Roof Drains [RD-1]
   1. Assembly: ASME A112.6.4.
   2. Manufacturers:

a. ZURN.
b. Model No. Z100
c. Fifteen (15) inch diameter roof drain and overflow drain, with static extension, Dura-Coated cast iron bodies with combination membrane flashing clamp/gravel guards, double top-set deck plate, and low silhouette cast iron domes.
d. Substitutions: See Section 016000 - Product Requirements.

B. Floor Drains [FD-1]
1. Manufacturers:
a. ZURN.
b. Model No. Z415-SZ1
c. Dura-Coated cast iron body with bottom outlet, trap seal protection device, combination invertible membrane clamp and adjustable collar with seepage slots.
d. Substitutions: See Section 016000 - Product Requirements.

C. Floor Sink [FS-1]
1. Manufacturers:
a. ZURN.
b. Model No. Z1900
c. Sani-Flor Receptor 12"x12"x6" deep cast body and square, combination invertible membrane clamp and adjustable collar with seepage slots.
d. Substitutions: See Section 016000 - Product Requirements.

2.03 CLEANOUTS

A. Manufacturers:
1. ZURN.
2. Model No. Z-1400
3. Lacquered cast iron body with anchor flange, adjustable threaded top assembly, and round gasketed scored cover in concrete floor areas and square gasketed depressed cover to accept floor finish in finished floor areas.
4. Substitutions: See Section 016000 - Product Requirements.

B. Cleanouts at Interior Finished Wall Areas:
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

2.04 HOSE BIBBS [HB-1]

A. Manufacturers:
1. Acorn.
2. Model No. 8121
3. Cartridge-operated hose valve with vandal resistant lock shield bonnet, removable wheel handle, and ¾ inch male hose thread outlet. Hose bib shall be of the bent nose type and provided with a polished chrome finish, vacuum breaker, and flange for wall installation. Hose bib shall be in conformance with ANSI/ASSE Standard 1011.
4. Substitutions: See Section 016000 - Product Requirements.

2.05 WASHING MACHINE BOXES AND VALVES

A. Box Manufacturers:
1. Viega LLC; _____: www.viega.us/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Valve Manufacturers:

1. Viega LLC; _____: www.viega.us/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

C. Description: Plastic preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch (50 mm) waste, slip in finishing cover.

2.06 BACKFLOW PREVENTERS

A. Manufacturers:
1. Watts Regulator Company, a part of Watts Water Technologies; LF909: www.wattsregulator.com/#sle.
2. Substitutions: See Section 016000 - Product Requirements.

B. Reduced Pressure Backflow Preventer Assembly:
1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
2. Size: 1-1/2" inch (_____ mm) assembly with threaded full port ball valves.
3. Accessories: Provide air gap fitting, lead-free Y-strainer, and test cocks.

2.07 WATER HAMMER ARRESTORS

A. Manufacturers:
1. Sioux Chief Manufacturing.
2. Model No. 650
3. Sioux Chief 650 series piston-type water hammer arrestors shall be required in piping systems. Water hammer arrestors shall have sufficient volume of air to dissipate the calculated kinetic energy generated in the piping system. Arrestors shall be effective when installed at any angle and approved for installation without an access panel. Water hammer arrestors shall be ANSI/ASSE 1010 2004 certified and shall be sized and placed per manufacturer's instructions.
4. Substitutions: See Section 016000 - Product Requirements.

2.08 SANITARY WASTE INTERCEPTORS

A. Manufacturers:
1. Substitutions: See Section 016000 - Product Requirements.

B. Grease Interceptors:
1. Construction:
a. Material: Epoxy-coated fabricated steel.
b. Rough-in: Fully recessed (shallow rough-in) with anchor flange.
c. Cover: Steel, epoxy coated, non-skid with gasket, securing handle, and enzyme injection port, recessed for floor finish.
2. Unit Rating: 75 gpm (_____ L/s) flow and 150 lbs (_____ kg) grease capacity.
3. Manufacturers:
a. Schier, Inc; GB3.
b. Substitutions: See Section 016000 - Product Requirements.

C. Lint Interceptors:
1. Watts LI-807 Epoxy coated Stainless steel lint interceptor with gasketed epoxy coated steel skid-proof cover secured with hex head center bolt, removable steel filter screens, and IPS threaded connections.

2.09 MIXING VALVES

A. Thermostatic Mixing Valves:
   1. Manufacturers:
      a. Leonard Valve Company; 210-LF-F: www.leonardvalve.com/#sle.
      b. Substitutions: See Section 016000 - Product Requirements.
   2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
   3. Accessories:
      a. Volume control shut-off valve on outlet.
      b. Stem thermometer on outlet.

2.10 FLOOR DRAIN TRAP SEALS

A. Manufacturers:
   1. Zurn, Inc; Z1072.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

2.11 CATCH BASINS [CB-1]

A. Manufacturers:
   1. ZURN.
   2. Model No. Z887-24-HD
   3. Substitutions: See Section 016000 - Product Requirements.

2.12 HOSE REEL [HR-1]

A. Manufacturers:
   1. Hannay Reels.
   2. Model No. 1822-17-18

B. Substitutions: See Section 016000 - Product Requirements.

2.13 EXTERIOR PENETRATION ACCESSORIES

A. Roof Drain Outlet Pipe Connection: Drain seal to connect roof drain to drain piping.

B. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for piping, cables, and roofing system to be installed; designed to accommodate existing penetrations where applicable.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.

E. Pipe relief from backflow preventer to nearest drain.

F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks or washing machine outlets.

G. Install air chambers on hot and cold water supply piping to each fixture or group of fixtures (each washroom). Fabricate same size as supply pipe or 3/4 inch (20 mm) minimum, and minimum 18 inches (450 mm) long.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe and pipe fittings.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 220523 - General-Duty Valves for Plumbing Piping.

C. Section 220553 - Identification for Plumbing Piping and Equipment: Identification of piping system.

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

E. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.

F. ASME B31.1 - Power Piping; 2018.

G. ASME B31.3 - Process Piping; 2020.

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

J. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

K. NSF 372 - Drinking Water System Components - Lead Content; 2016.

L. NSF 61 - Drinking Water System Components - Health Effects; 2019.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

PART 2 PRODUCTS

2.01 PIPE AND PIPE FITTINGS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded or welded to ASME B31.1.

2.02 AIR OUTLETS

A. Quick Connector: 3/8 inch (10 mm) brass, snap-on connector with self closing valve, Style A.

2.03 UNIONS AND COUPLINGS

A. Unions:
   1. Ferrous Pipe: 150 psi (1034 kPa) malleable iron threaded unions.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Make air cock and drain connection on horizontal casing.

C. Install line size gate valve and check valve on compressor discharge. See Section 220523.

D. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.

E. Identify piping system and components. See Section 220553.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements, for additional requirements.

B. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ASME B31.1.

C. Repair or replace compressed air piping as required to eliminate leaks, and retest to demonstrate compliance.

D. Cap and seal ends of piping when not connected to mechanical equipment.

END OF SECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. In-line circulator pumps.

B. Submersible sump pumps.

1.02 RELATED REQUIREMENTS

A. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 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. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

D. NEMA MG 1 - Motors and Generators; 2018.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data:
   1. Indicate pump type, capacity, power requirements.
   2. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   3. Provide electrical characteristics and connection requirements.

C. Project Record Documents: Record actual locations of components.

D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

B. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:
   1. Taco, Inc; 003-B4.
   2. Substitutions: See Section 016000 - Product Requirements.

B. Casing: Bronze, rated for 125 psig (860 kPa) working pressure, with stainless steel rotor assembly.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Drive: Flexible coupling.

2.02 SUBMERSIBLE SUMP PUMPS

A. Manufacturers:
   1. Zoeller Company; 940-0013: www.zoeller.com/#sle.

B. Type: Completely submersible, vertical, centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber.

D. Impeller: Cast iron; open non-clog, stainless steel shaft.

E. Bearings: Ball bearings.

F. Sump: Fiberglass basin with steel cover plate; ____ inches (____ mm) diameter, ____ inches (____ mm) deep.

G. Accessories: Oil resistant 6 foot (2 m) cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

H. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.

2.03 ELECTRICAL WORK

A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.

B. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.

C. Pumps:
   1. Ensure shaft length allows sump pumps to be located minimum 24 inches (600 mm) below lowest invert into sump pit and minimum 6 inches (150 mm) clearance from bottom of sump pit.
   2. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Kitchen Sinks.

F. Service sinks.

G. Mop sinks.

H. Showers

I. Drinking fountains.

1.02 RELATED REQUIREMENTS

A. Section 011000 - Summary: Owner-furnished fixtures.

B. Section 064100 - Architectural Wood Casework: Preparation of counters for sinks and lavatories.

C. Section 079200 - Joint Sealants: Sealing joints between fixtures and walls and floors.

D. Section 114000 - Foodservice Equipment: Food service sinks.

E. Section 123600 - Countertops: Preparation of counters for sinks and lavatories.

F. Section 221005 - Plumbing Piping.

G. Section 221006 - Plumbing Piping Specialties.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2013.

C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

D. ASME A112.18.1 - Plumbing Supply Fittings; 2018.

E. ASME A112.19.1 - Enamelled Cast Iron and Enamelled Steel Plumbing Fixtures; 2018.

F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018.

G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017.

H. ASME A112.19.4M - Porcelain Enameled Formed Steel Plumbing Fixtures; 1994 (R2009).

I. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.

J. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2015.

K. IAPMO PS 106 - Tileable Shower Receptors And Shower Kits; 2015.

L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

M. ITS (DIR) - Directory of Listed Products; current edition.

N. NSF 61 - Drinking Water System Components - Health Effects; 2019.

O. NSF 372 - Drinking Water System Components - Lead Content; 2016.

P. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

2.03 FLUSH VALVE WATER CLOSETS - WALL HUNG [WC-1 & WC-2]

A. Water Closets: Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action, china bolt caps.
   1. Bowl: ASME A112.19.2; 16.5 inches (420 mm) high with elongated rim.
   2. Flush Valve: Exposed (top spud).
   3. Flush Operation: Manual, oscillating handle.
   4. Supply Size: 1-1/2 inches (38 mm).
   5. Outlet Size: 2 inches (50 mm).
   6. Color: White.
   7. Manufacturers:
      a. American Standard, Inc: www.americanstandard-us.com/#sle.
      b. Model AFWALL MILLENIUM FloWise No. 2856.128
      c. Substitutions: See Section 016000 - Product Requirements.

B. Flush Valves:
   1. Manufacturers:
      a. Sloan Valve Company: www.sloanvalve.com/#sle.

b. Model CORWN No. 111
c. Substitutions: See Section 016000 - Product Requirements.

C. Seats:
1. Manufacturers:
a. American Standard, Inc: www.americanstandard-us.com/#sle.
b. Substitutions: See Section 016000 - Product Requirements.
c. Model No. 5901.100
2. Solid black plastic, open front, extended back, self-sustaining hinge, brass bolts, with cover.

D. Water Closet Carriers:
1. Manufacturers:
a. Zurn Industries, Inc: www.zurn.com/#sle.
b. Model No. Z1202-ND4
c. Substitutions: See Section 016000 - Product Requirements.
2. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.04 WALL HUNG URINALS [UR-1]

A. Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com/#sle.
2. Model Washbrook FloWise No. 6590.525
3. Substitutions: See Section 016000 - Product Requirements.

B. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
1. Flush Volume: 0.125 gallons (0.47 liters), maximum.
2. Flush Valve: Exposed (top spud).
3. Flush Operation: Manual, oscillating handle.
4. Trap: Integral.

C. Flush Valves:
1. Manufacturers:
a. Sloan Valve Company: www.sloanvalve.com/#sle.
b. Model CROWN No. 3122665
c. Substitutions: See Section 016000 - Product Requirements.

D. Wall-Hung Urinal Carriers:
1. Manufacturers:
a. Zurn Industries, Inc: www.zurn.com/#sle.
b. Model No. Z1221
c. Substitutions: See Section 016000 - Product Requirements.
2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.05 LAVATORIES [LAV-1]

A. Manufacturers:
1. American Standard, Inc: www.americanstandard-us.com/#sle.
2. Model Aqualyn No. 0476.028
3. Substitutions: See Section 016000 - Product Requirements.

B. Vitreous China Counter Top Basin: ASME A112.19.2; vitreous china self-rimming counter top lavatory, _____ with drillings on 4 inch (100 mm) centers, front overflow, soap depression, seal of putty, calking, or concealed vinyl gasket.

C. Supply Faucet Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Model Monterrey No. 5502.175
   3. Substitutions: See Section 016000 - Product Requirements.

D. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 0.5 gallon per minute (low-flow) (1.9 liters per minute (low-flow)), indexed handles.

2.06 SINKS [SK-1]

A. Manufacturers:
   1. Advance Tabco .
   2. Model No. 94-41-24-24R
   3. Substitutions: See Section 016000 - Product Requirements.

B. Single Compartment Bowl: ASME A112.19.1; 24 by 24 by 14 inch (_____ by _____ by _____ mm) outside dimensions 14 gauge, _____ inch (___ mm) thick, Type 304 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
   1. Drain: 1-1/2 inch (38 mm) chromed brass drain.

C. Supply Faucet Manufacturers:
   1. American Standard, Inc: www.americanstandard-us.com/#sle.
   2. Model # 8350.243.002
   3. Substitutions: See Section 016000 - Product Requirements.

2.07 SERVICE SINKS [SS-1]

A. Sink Manufacturers:
   1. Griffin Products INC..
   2. Model No. LT-118
   3. Substitutions: See Section 016000 - Product Requirements.

B. Single Compartment Bowl: ASME A112.19.3; 18 by 18 by 18 inch (_____ by _____ by _____ mm) outside dimensions 20 gage, 0.0359 inch (0.91 mm) thick, Type 302 stainless steel, self rimming and undercoated, with ledge back drilled for trim.

C. Supply Faucet Manufacturers:
   1. Advance Tabco.
   2. Model No. K-132
   3. Include: T&S Model No. B-0502 Foot Pedals
   4. Substitutions: See Section 016000 - Product Requirements.

2.08 SHOWERS [SH-1]

A. Manufacturers:
   1. Aquatic, Inc; 1363BFC2P
   2. Provide shower rod and cuurtain.

B. Shower Valve:
   1. Comply with ASME A112.18.1.

2. Provide two handle in wall diverter valve body with integral thermostatic mixing valve to supply 1.5 gpm (0.094 L/s).
3. Shower Valve Manufacturers:
   a. American Standard, Inc.; Model 1662.601
   b. Provide shower rod and curtain.
   c. Substitutions: See Section 016000 - Product Requirements.

2.09 DRINKING FOUNTAINS [DF-1]

A. Manufacturers:
   1. Elkay Manufacturing Company: www.elkay.com/#sle.
   2. Model No. LVRCGRNTL8WSK
   3. Substitutions: See Section 016000 - Product Requirements.

2.10 MOP SINKS

A. Manufacturers:
   1. Fiat Products; MSB 2424.

B. Accessories:
   1. Hose clamp hanger.
   2. Mop hanger.
   3. Service Faucet (830-AA).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Install each fixture with a trap if it does not come integral to fixture, easily removable for servicing and cleaning.

B. Install components level and plumb.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 CLEANING

A. Clean plumbing fixtures and equipment.

3.06 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the general requirements for all mechanical items and systems required by the Contract Documents.

B. Comply with all Contract Requirements, General Conditions, Supplementary Conditions and Division 1 Sections applying to or affecting the Work of Division 23.

C. Unless specifically dimensioned, the Work shown on the Drawings is in diagrammatic form only to show general arrangement.

D. Include, in the Work, all accessories and appurtenances, necessary and integral, for the intended operation of any system, component or device, as such systems, components and devices are specified.

E. Do not install pipe or conduit through ductwork.

F. If the pipe or duct size shown on the Drawings does not match the connection size of the equipment that it is connected to, provide the necessary transition pieces at the piece of equipment.

G. Do not use or allow to be used asbestos or asbestos-containing materials on this project. Be rigorous in assuring that all materials, equipment, systems and components thereof do not contain asbestos. Any deviations from this requirement shall be remedied at the Contractor's expense without regard to prior submittal approvals.

1.02 RELATED DOCUMENTS

A. The General Conditions and General Requirements Division 1 apply to the Work of this Section.

1.03 REFERENCE STANDARDS

A. Compliance with the following codes and standards shall be required:

1.	Codes, Rules and Regulations of the State of New York	
2.	USAS	USA Standards Institute (Formerly ASA)
3.	AMCA	Air Moving and Conditioning Association
4.	ADC	Air Diffusion Council
5.	NEMA	National Electrical Manufacturers Association
6.	FM	Factory Mutual
7.	NFPA	National Fire Protection Association
8.	ASTM	American Society for Testing Materials
9.	UL	Underwriters Laboratories, Inc.
10.	NEC	National Electrical Code
11.	ASME	American Society of Mechanical Engineers
12.	ANSI	American National Standards Institute
13.	OSHA	Occupational Safety and Health Act
14.	BSA	Board of Standards and Appeals
15.	MEA	Materials and Equipment Acceptance
16.	DEC	New York State Department of Environmental Conservation - 6 NYCRR Part 613 Handling and Storage of Petroleum
17.	ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers.
18.	AWWA	American Water Works Association

19. MSS Manufacturer's Standardization Society of the Valve and Fitting Industry
20. ARI American Refrigeration Institute
21. SMACNA Sheet Metal and Air Conditioning Contractor's Nation-al Association
22. TEMA Tubular Exchanger Manufacturers Association
23. F.S. or FED Spec. Federal Specification
24. ASA Acoustical Society of America
25. NACE National Association or Corrosion Engineers
26. ASSE American Society of Sanitary Engineers
27. International Building Code
28. International Fire Code
29. International Existing Building Code
30. International Fuel Gas Code
31. International Plumbing Code
32. International Energy Conservation Code
33. International Mechanical Code
34. New York State Industrial Code Rules
35. IRI Industrial Risk Insurers
36. AGA American Gas Association
37. AABC American Air Balance Council
38. NEBB National Environmental Balancing Bureau
39. AWS American Welding Society

1.04 DEFINITIONS

A. "Provide" means furnish and install, complete the specified material, equipment or other items and perform all required labor to make a finished installation.

B. "Furnish and install" has the same meaning as given above for "Provide."

C. Refer to General Conditions for other definitions.

1.05 ABBREVIATIONS

A. Reference by abbreviation may be made in the Specifications and the Drawings in accordance with the following list:
1. HVAC Heating, Ventilating and Air Conditioning
2. CM Construction Manager
3. AC Air Conditioning
4. H & V Heating and Ventilating
5. AWG American Wire Gauge
6. BWG Birmingham Wire Gauge
7. USS United States Standard
8. B & S Brown & Sharpe
9. OS & Y Outside Screw and Yoke
10. IBBM Iron Body Brass Mounted
11. WSP Working Steam Pressure
12. PSIG Pounds per Square Inch Gauge
13. PRV Pressure Reducing Valve
14. GPM Gallons per Minute
15. MBH Thousand BTU per hour
16. BTU British Thermal Units
17. WG Water Gage
18. LB Pound (Also shown as: #)
19. ASME American Society of Mechanical Engineers

20. ASTM American Society for Testing Materials
21. ABMA American Boiler Manufacturers Association
22. ASA American Standards Associates
23. MER Mechanical Equipment Room

See Drawings for additional abbreviations

1.06 REVIEW OF CONTRACT DOCUMENTS AND SITE

A. Give written notice with the submission of bid to the Architect/Engineer of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules or regulations of Authorities having jurisdiction, and any necessary items of work omitted. In the absence of such written notice it is mutually agreed that the Contractor has included the cost of all required items in his proposal for a complete project.

B. Contractors shall acknowledge that they have examined the Plans, Specifications and Site, and that from his own investigations he has satisfied himself as to the nature and location of the Work; the general and local conditions, particularly those bearing upon transportation, disposal, handling and storage of materials; availability of labor, utilities, roads and uncertainties of weather; the composition and condition of the ground; the characters quality and quantity of subsurface materials to be encountered; the character of equipment and facilities needed preliminary to and during the execution of the Work; all federal, state, county, township and municipal laws, ordinances and regulations particularly those relating to employment of labor, rates of wages, and construction methods; and all other matters which can in any way affect the Work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with the available information concerning these conditions will not relieve him from the responsibility for successfully performing the Work.

C. Owner assumes no responsibility for any understanding or representation made during or prior to the negotiation and execution of this Contract unless such understanding or representations are expressly stated in the Contract and the Contract expressly provides that the responsibility, therefore, is assumed by the Owner.

1.07 MEASUREMENTS

A. Base all measurements, both horizontal and vertical from established bench marks. Make all Work agree with these established lines and levels. Verify all measurements at site; and check the correctness of same as related to the Work.

1.08 LABOR AND MATERIALS

A. Provide all materials and apparatus required for the Work of new and first-class quality. Furnish, deliver, arrange, erect, connect and finish all materials and equipment in every detail, so selected and arranged as to fit properly into the building spaces.

B. Remove all materials delivered, or work erected, which does not comply with Drawings or Specifications, and replace with proper materials, or correct such work as directed, at no additional cost to the Owner.

1.09 COVERING OF WORK

A. Do not cover up or hide from view any duct, piping, fitting, or other work of any kind before it has been examined or approved by the Architect/Engineer and/or other authority having jurisdiction over the same. Remove and correct immediately any unacceptable or imperfect work or unauthorized or disapproved materials discovered immediately after being disapproved.

1.10 PROTECTION

A. Protect the Work and material of all trades from damage and replace all damaged material with new.

B. Protect work and equipment until the Work is finally inspected, tested, and accepted; protect the Work against theft, injury or damage; and carefully store material and equipment received on site which is not immediately installed; close open ends of work with temporary covers or plugs during construction to prevent entry of foreign material.

C. Preserve all public and private property, along and adjacent to the Work, and use every precaution necessary to prevent damage or injury thereto. Use suitable precautions to prevent damage to pipes, conduits and other underground structures or utilities, and carefully protect from disturbance or damage all property marks until an authorized agent has witnessed or otherwise referenced their location, and do not remove them until directed.

1.11 CUTTING AND PATCHING

A. Provide all cutting and rough patching required for the Work. Perform all finish patching.

B. Furnish and locate all sleeves and inserts required before the floors and walls are built, pay the cost of cutting and patching required for pipes where sleeves and inserts were not installed in time, or where incorrectly located. Provide all drilling required for the installation of hangers.

C. Punch or drill all holes cut through concrete slabs or arches from the underside. Do not cut structural members without the approval of the Architect/Engineer. Perform all cutting in a manner directed by the Architect/Engineer.

D. Do not do any cutting that may impair strength of building construction. Do no drill any holes, except for small screws, in beams or other structural members without obtaining prior approval. All Work shall be done in a neat manner by mechanics skilled in their trades and as approved.

1.12 SUBMITTALS

A. Submit for review, shop drawings for all materials and equipment furnished and installed under this Contract. Submissions shall include but not be limited to:
   1. Ductwork layout drawings, air devices and accessories
   2. Breeching layout drawings
   3. Piping and equipment layout drawings.
   4. Piping materials, valves, hangers, supports and accessories
   5. Automatic temperature control equipment, diagrams and control sequences
   6. Equipment, fixtures, and appurtenances
   7. Insulation
   8. Rigging Plan - Include the name of the rigging company; a layout drawing that details the crane with its outriggers extended outward. Provide dimensions showing how rigging operations will affect the road and parking lines being used, the type of crane and its specification including crane arm height, lift capacity, crane reach.

B. Reports
   1. Compliance with listings and approvals for equipment and for fire ratings.
   2. Acceptance certificates from inspecting agencies.
   3. Complete printed and illustrated operating instructions in report format.
   4. Manufacturer's performance tests of equipment.
   5. Field pipe and duct testing reports.
   6. Field operating test results for equipment.

7. Performance report on the balancing of air and water systems.
8. Performance reports for vibration isolation equipment.
9. Manufacturer's reports on motorized equipment alignment and installation.

C. Specific references to any article, device, product or material, fixture or item of equipment by name, make or catalog number shall be interpreted as establishing a basis of cost and a standard of quality. All devices shall be of the make and type listed by Special Agencies, such as the Underwriters' Laboratories, and where required, approved by the Fire Department.

1.13 SPACE ALLOTMENTS AND SUBSTITUTIONS

A. The space allotments and equipment layouts on the Drawings are based on the manufacturer's model indicated or scheduled as the "Basis of Design". Ensure that any equipment that is submitted other than the "Basis of Design" will fit in the space allotment and will provide the necessary maintenance clearances as recommended by the manufacturer. If maintenance clearances are not met, pay for any changes such that maintenance clearances will be met.

B. Bear all costs associated with re-layout of the equipment, changes to piping/ductwork, and other changes as required if approved equipment other than the "Basis of Design" equipment is purchased. This shall also include any structural steel modifications and structural steel design changes. Submit, at no cost to the Owner, a steel design stamped by a structural engineer licensed in the state in which the Work is to be performed for structural modifications that must be made resulting from the use of equipment other than the "Basis of Design" or not specified.

1.14 PAINTING

A. Prime paint all bare supplemental steel, supports and hangers required for the installation of Division 23 Work in accordance with "Painting" Specification Section. Touch up welds of galvanized surfaces with galvanizing primer.

1.15 MATERIAL SAFETY DATA SHEETS

A. Submit material safety data sheets (MSDS) for all chemicals, hydraulic fluids, seal oils, lubricating oils, glycols and any other hazardous materials used in the performance of the Work, in accordance with the US Department of Labor, Occupational Safety and Health Administration (OSHA) hazard communication and right-to-know requirements stipulated in 29 CFR 1910.1200 (g).

1.16 MOTORS AND STARTERS

A. Provide new NEMA Standard electric motors, sized and designed to operate at full load and full speed continuously without causing noise, vibration, and temperature rise in excess of their rating. Provide motors with a service factor of at least 1.15.

B. Equip motors for belt driven equipment with rails with adjusting screws for belt tension adjustment. Weather protect motors exposed to the weather.

C. Install high efficiency electric motors for air handling units, relief fans, and exhaust fans.

D. Provide all motors for use with Variable Frequency Drives with "high efficiency inverter duty" insulation class "F" with class "B" temperature rise and that conform to or exceed the International Energy Conservation Code or the Federal EP Act of 1992 requirements for efficiency.

E. Provide stainless steel nameplates, permanently attached to the motor, and having the following information as a minimum:

1. Manufacturer
2. Type
3. Model
4. Horsepower
5. Service Factor
6. RPM
7. Voltage/Phase/Frequency
8. Enclosure Type
9. Frame Size
10. Full-Load Current
11. UL Label (where applicable)
12. Lead Connection Diagram
13. Bearing Data
14. Efficiency at Full Load.

F. Provide motors whose sound power levels do not exceed that recommended in NEMA MG 1-12.49.

G. Provide motors with drive shafts long enough to extend completely through belt sheaves when sheaves are properly aligned and balanced.

H. Protect motor starters on equipment located outdoors in weatherproof NEMA 4X enclosures.

I. Provide weatherproof NEMA 4X disconnect switches when located outdoors.

J. Motor Characteristics:
1. 120V/1/60 Hz, 208V/1/60 Hz or 240V/1/60 Hz: Capacitor start, open drip-proof type, ball bearing, rated 40 C. continuous rise.
2. 208V/3/60 Hz, 240V/3/60 Hz or 460/3/60 Hz: NEMA B, normal starting torque, single speed, squirrel-cage type, open drip-proof, rated 40 C continuous rise, with ball bearings rated for B-10 life of 100,000 hours and fitted with grease fittings and relief ports. Provide motors with aluminum end brackets with steel inserts in bearing cavities.

1.17 ACOUSTICAL PERFORMANCE OF EQUIPMENT AND SYSTEMS

A. Install the Work in such a manner that noise levels from operation of motor driven equipment, whether airborne or structure-borne, and noise levels created by or within air handling equipment and air distribution and control media, do not to exceed sound pressure levels determined by the noise criteria curves published in the ASHRAE guide.

B. Acoustical Tests
1. Owner may direct the Contractor to conduct sound tests for those areas he deems too noisy.
2. If NC level exceeds the requirements of the Contract Documents due to improper installation or operation of mechanical systems, make changes or repairs to bring noise levels to within required levels.
3. Retest until specified criteria have been met.

1.18 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Instructions and Demonstration for Owner's Personnel
1. Provide operating and maintenance instruction to the Owner when project is completed and all HVAC equipment serving the building is ready to be turned over to the Owner.
2. Turn over the HVAC equipment to the Owner only after the final testing and proper balancing of HVAC systems.

3. Instruct the Owner's personnel in the use, operation and maintenance of all equipment of each system.
4. The above instruction requirements are in addition to that specified for specific equipment or systems. Conform to specified requirements if more stringent or longer instruction is specified for specific equipment or systems.

1.19 CODES, RULES, PERMITS & FEES

A. Give all necessary notices, obtain all permits and pay all government sales taxes, fees, and other costs, in connection with the Work. Unless indicated otherwise, fees for all utility connections, extensions, and tap fees for water, storm, sewer, gas, telephone, and electricity will be paid directly to utility companies and/or agencies by the Owner. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for the Work and deliver same to the Owner's Representative before request for acceptance and final payment for the Work.

B. Conform to the requirements of the NFPA, NEC, FM, UL and any other local or State codes which may govern.

1.20 RECORD DRAWINGS

A. During the progress of the Work, make a record set of drawings of all changes by which the actual installation differs from the Drawings.

B. Create all record drawings in AutoCAD version 2002 or later in .dwg format. Upon completion of the Work, submit to the Architect/Engineer for approval three complete sets of hard copies of the record drawings, of the same size as the Drawings for approval. Upon approval by the Architect/Engineer furnish the Owner a CD copy of the record drawings along with one hard copy for his records.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 CLEANING AND ADJUSTING

A. Cleaning
1. Blow out, clean and flush each system of piping and equipment, to thoroughly clean the systems.
2. Clean all materials and equipment; leave in condition ready to operate and ready to receive final finishes where required.
3. Clean the operating equipment and systems to be dust free inside and out.
4. Clean concealed and unoccupied areas such as plenums, pipe and duct spaces and equipment rooms to be free of rubbish and dust.

B. Adjusting
1. Adjust and align equipment interconnected with couplings or belts.
2. Adjust valves of all types and operating equipment of all types to provide proper operation.
3. Clean all strainers after system cleaning and flushing and again before system startup.

C. Lubrication
1. Lubricate equipment as recommended by the manufacturer, during temporary construction use.
2. Provide complete lubrication just prior to acceptance.

D. Permanent Equipment Operating During Construction
   1. Use only in same service as the permanent applications.
   2. Use disposable filters during temporary operation.
   3. Replace expendable media, including belts used for temporary operation and similar materials just prior to acceptance of the Work.
   4. Repack packing in equipment operated during construction just prior to system acceptance, using materials and methods specified by the equipment manufacturer.

E. Retouch or repaint equipment furnished with factory finish as required to provide same appearance as new.

F. Tools
   1. Provide one set of specialized or non-standard maintenance tools and devices required for servicing the installed equipment.

3.02 EQUIPMENT BASES, PLATFORMS AND SUPPORTS

A. Provide supporting platforms, steel supports, anchor bolts, inserts, etc., for all equipment and apparatus provided.

B. Obtain prior approval for installation method of structural steel required to frame into building structural members for the proper support of equipment, conduit, etc. Welding will be permitted only when approved by the Architect/Engineer.

C. Submit shop drawings of supports to the Architect/Engineer for approval before fabricating or constructing.

D. Provide leveling channels, anchor bolts, complete with nuts and washers, for all apparatus and equipment secured to concrete pads and further supply exact information and dimensions for the location of these leveling channels, anchor bolts, inserts, concrete bases and pads.

E. Where supports are on concrete construction, take care not to weaken concrete or penetrate waterproofing.

3.03 ACCESSIBILITY

A. Install valves, dampers and other items requiring access conveniently and accessibly located with reference to the finished building.

3.04 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof, even with the Owner's consent, is not an indication of acceptance of the Work on the part of the Owner, nor shall it be construed to obligate the Owner in any way to accept improper work or defective materials.

3.05 MODIFICATIONS OF EXISTING WORK

A. Coordinate the Work with all other contractors and provide necessary dimensions for all openings. Provide all cuts and openings which are necessary for the Work for passage of piping and ductwork

B. Upon completion, remove all temporary piping and equipment, shoring, scaffolds, etc., and leave all areas clean and free from material and debris resulting from the Work performed under this Section. Provide rough patching in areas required.

3.06 EQUIPMENT INSTALLATION

A. Locate and set equipment anchor bolts, dowels and aligning devices for equipment requiring them.

B. Level and shim the equipment; coordinate and oversee the grouting work.

C. Perform field assembly, installation and alignment of equipment under direct supervision provided by the manufacturer or with inspections, adjustments and approval by the manufacturer.

D. Alignment and Lubrication Certification for Motor Driven Apparatus
   1. After permanent installation has been made and connections have been completed, but before the equipment is continuously operated, have a qualified representative of the equipment manufacturer inspect the installation and report in writing on the manufacturer's letterhead on the following:
      a. Whether shaft, bearing, seal, coupling, and belt drive alignment and doweling is within the manufacturer’s required tolerances so that the equipment will remain aligned in the normal service intended by the Contract Documents and that no strain or distortion will occur in normal service.
      b. That all parts of the apparatus are properly lubricated for operation.
      c. That the installation is in accordance with manufacturer's instructions.
      d. That suitable maintenance and operating instructions have been provided for the Owner's use.
      e. Make any corrections to items that are required or recommended based on the manufacturer’s inspection and have the equipment re-inspected.

E. Belt Drives
   1. V-belt drives - a driving and driven sheave grooved for belts of trapezoidal cross-section. Construct belts of fabric and rubber so designed so as not to touch the bottom of the grooves, the power being transmitted by the contact between the belts and V-shaped groove sides. Design drives for a minimum of 150 percent of motor horsepower. Provide companion type driven sheaves.
   2. Select drives to provide for 12-1/2 percent variation in speed, plus or minus, from specified speed. Provide all motors with adjustable sheaves except where indicated otherwise in the Specifications or on the Drawings.
   3. Install all fans with adjustable pitch sheaves on their drive motors. Select sheaves to provide air quantities under specified conditions. Put air systems into operation, and determine as a result of the completed air balance the actual size of sheaves required to produce specified air quantities on installed systems. The adjustable pitch sheaves shall then be replaced with the proper size fixed sheaves. Remove adjustable pitch sheaves from premises. Provide fixed motor sheaves manufactured by Wood's.
   4. Where indicated on the Drawings or specified, provide spare motor, bearings, and belts.

F. Machinery Guards
   1. Protect motor drives by guards furnished by the equipment manufacturer or in accordance with the Sheet Metal and Air Conditioning Contractors National Association's Low Pressure Duct Manual. Provide guards of all types approved as acceptable under OSHA Standards.

G. Equipment Start-up
   1. Require each equipment manufacturer to provide qualified personnel to inspect and approve equipment and installation and to supervise the start-up of the equipment and to supervise the operating tests of the equipment.
   2. If a minimum number of hours for start-up and instruction are not stated with the equipment specifications, these shall be 2 full 8-hour working days as a minimum.

3. Advise Owner of start-up at least 72 hours in advance.

3.07 CLOSEOUT PROCEDURES

A. General Operating and Maintenance Instructions: Arrange for each installer of operating equipment and other work that requires regular or continuing maintenance, to meet at the site with the Owner's personnel to provide necessary basic instructions in the proper operation and maintenance of the entire Work. Where installers are not expert in the required procedures, include instruction by the manufacturer's representatives.

B. Where applicable, provide instruction and training, including application of special coatings systems, at manufacturer's recommendation.

C. Provide a detailed review of the following items:
1. Maintenance manuals
2. Record documents and catalog cuts for each piece of equipment.
3. Spare parts and materials
4. Tools
5. Lubricants
6. Fuels
7. Identification systems
8. Control sequences
9. Hazards
10. Cleaning

D. Warranties, bonds, maintenance agreements, and similar continuing commitments.

E. Demonstrate the following procedures:
1. Start-up
2. Shut-down
3. Emergency operations
4. Noise and vibration adjustments
5. Safety procedures
6. Economy and efficiency adjustments
7. Effective energy utilization.

F. Prepare instruction periods to consist of approximately 50% classroom instruction and 50% "hands-on" instruction. Provide minimum instruction periods as follows:

Systems or Equipment	Training Time (Hours)
Roof Top Units	8 hrs.
All other equipment	4 hrs. (each)

Note: Consult individual equipment specification sections for additional training requirements.

G. Prepare a written agenda for each session and submit for review and approval. Include date, location, purpose, specific scope, proposed attendance and session duration.

H. Record training sessions in digital format, format as selected by the Owner. Turn over digital files to the Owner after training has been completed.

END OF SECTION 230010

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section describes the draining, disconnecting, dismantling, demolition, removal, relocation, rerouting and reconnection of existing mechanical facilities, in a neat and workmanlike manner, of mechanical systems, materials and accessories as required, as shown on the Drawings and specified herein, to accomplish alteration, restoration and to accommodate the Work.

1.02 RELATED WORK

A. General Mechanical Requirements - Section 230010

1.03 REFERENCES

A. BOCA Building Code

B. NFPA Fire Code

C. ANSI A10.6 - Safety Requirements for Demolition

D. National Association of Demolition Contractors (NADC) - Demolition Safety Manual

E. NFPA 51B - Cutting and Welding Processes

F. NFPA 70 - National Electrical Code

G. NFPA 241 - Safeguarding Building Construction and Demolition Operations

H. OSHA 29 CRF 1910 - Occupational Safety and Health Standards

I. US EPA - Clean Air Act Amendment of 1990.

1.04 SUBMITTALS

A. Demolition Schedule

B. Fire Watch Procedures

C. Inspection Report of Underground Piping Systems

D. Welding/Burning Permit - Obtain a welding/burning permit from the local Fire Official prior to the start of any welding or burning in accordance with the local Fire Code or as required by the Owner.

1.05 QUALITY ASSURANCE

A. Only employ workers skilled in the specific trades involved for cutting, patching and removal.

B. Job Conditions: Prior to start of the Work, make an inspection accompanied by the Architect/Engineer to determine physical condition of adjacent construction that is to remain.

1.06 SPECIAL PRECAUTIONS

A. Do not torch cut ductwork.

B. Torch cutting of other mechanical equipment will be permitted only with the specific written approval of the Architect/Engineer.

C. Include “Fire Watch” procedures as required by the Fire Code and/or Owner’s Fire Insurance Carrier for any cutting work that may produce sparks. Submit fire watch procedures for approval.

D. Perform draining operations so that damage to existing building components does not occur.

PART 2 - PRODUCTS

2.01 GENERAL

A. Adequately sized rubbish containers for the proper and safe disposal of all debris.

PART 3 - EXECUTION

3.01 PREPARATION

A. Construct temporary partitions enclosing respective work prior to any demolition work. Erect temporary fencing and signage around demolished materials.

B. Protect existing materials and equipment which are not to be demolished.

C. Prevent movement of structure; provide required bracing and shoring.

D. Do not begin the work until the time schedules and manner of operations have been approved by the Architect/Engineer and Owner. Include all interruptions of existing services in schedules submitted for approval by the Architect/Engineer and Owner.

3.02 GENERAL

A. Provide alteration and demolition of mechanical facilities as required by the Drawings and Specifications. The Drawings are diagrammatic and do not show the exact location of all existing mechanical work. Where existing equipment is to remain in service during construction, provide rerouting and reconnection of mechanical services as required to maintain continuous service.

B. Review all equipment with the Architect/Engineer and Owner prior to disposal. Completely remove existing ductwork, piping, conduit and similar items to be abandoned that are not embedded in walls or floor slabs unless otherwise shown on the Drawings. Cap open ends at all walls and floors.

C. Remove, store and protect all equipment or materials designated to be turned over to the Owner. Coordinate exact location of storage with the Owner.

D. Temporarily cap ends of ductwork, piping and sanitary vent piping to avoid entry of dirt, debris, or discharge of foul odors and gases.

E. Where existing louvers or ductwork penetrations are to remain, blank-off the opening on the inside with galvanized sheet metal on both sides of 2-inch thick, 6 pcf density rigid fiberglass board insulation. Paint side attached to the opening with weather resistant flat black paint.

F. Do not close or obstruct egress width to exits.

G. Do not disable or disrupt building fire or life safety systems without five (5) days prior written notice to the Architect/Engineer and Owner.

H. Conform to procedures applicable when discovering hazardous or contaminated materials.

I. Conduct demolition to minimize interference with adjacent building structures or Owner's operations.

J. Cease operations immediately if structure appears to be in danger or hazardous materials are encountered. Notify Architect/Engineer. Do not resume operations until directed.

K. Demolish in an orderly and careful manner. Do not cut or remove more than is necessary to accommodate the new construction or alteration.

L. Remove demolished materials from site daily. Do not burn or bury materials on site. Dispose of all material at an approved disposal facility.

M. Protect finished surfaces at all times and repair or replace, if damaged, to match existing construction to the satisfaction of the Architect/Engineer.

3.03 PIPING REMOVAL

A. Cut off all welded piping square at the locations indicated on the Drawings. No cutting is required where the demolition ends at a flanged valve or equipment. Close off all openings of any remaining valves, piping or fittings with weld caps or blind flanges to prevent debris from entering the existing system.

B. Disconnect all threaded piping at the location indicated on the Drawings. Close off all openings of remaining valves, piping, fittings and equipment with pipe plugs or pipe caps as required to prevent debris from entering the existing systems.

C. Remove all pipe hangers, supports, miscellaneous steel and anchors with the piping.

3.04 PROTECTION FROM FREEZING

A. It is intended that the building remain protected from damage due to freezing temperatures. To that end, keep in place and in operation existing equipment and systems used for heating until scheduling permits shutdown.

B. Where the removal of equipment, etc. will leave an area unprotected from freezing, notify the Owner and Architect/Engineer at least 72 hours in advance prior to removal so appropriate steps can be taken by the Owner to protect the area. Provide temporary heating equipment sufficient to prevent freezing.

C. It is the Contractor’s responsibility to ensure that piping systems that are being worked on are completely drained from water prior to the start of demolition. If water is not drained and the water freezes it is the Contractor’s responsibility to replace piping and repair all damages caused by water leakage at his own expense.

3.05 DISCONNECTION AND INTERRUPTION OF MECHANICAL SERVICES

A. When portions of an existing piping system or ductwork system are removed, and this removal causes loss of operation to another piece of equipment due to open or disconnected piping or ductwork, cap piping or ductwork or provide temporary piping or ductwork system to retain operation of the system.

3.06 MECHANICAL EQUIPMENT REMOVAL

A. Remove all mechanical equipment as shown on the Drawings. Remove all electrical work, including wiring between equipment, and wiring to power source or point of origin.

B. Where equipment is supported by steel and/or structural supports, remove these supports.

3.07 REFRIGERANT REMOVAL

A. Recover and dispose of all existing refrigerant charges in accordance with EPA regulations. Comply with all regulations applicable to the release of chlorofluorocarbon refrigerants to the atmosphere.

3.08 DUCTWORK REMOVAL

A. Disconnect all ductwork which must be removed, at the closest joint and support the remaining ductwork.

B. Prepare all remaining ductwork joints at the point of disconnection to receive new ducts or blank-off panels.

C. Remove all ductwork supports and miscellaneous steel with ductwork to be demolished.

3.09 INSULATION REMOVAL

A. Remove insulation, together with all piping, fittings, valves and equipment designated for demolition.

3.10 CONTROL WIRING REMOVAL

A. Disconnect and remove all control wiring and tubing, including conduit, for the Automatic Temperature Control (ATC) System associated with equipment and systems to be removed.

END OF SECTION 230015

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the tools, procedures and performance required for cleaning of the existing HVAC system.

B. NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).
   1. All terms in this specification shall have their meaning defined as stated in the NADCA Standards.
   2. NADCA Standards shall be followed with no modifications or deviations being allowed.

C. Scope: This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

D. The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

E. The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts, and outdoor air ducts, to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

1.02 QUALITY ASSURANCE

A. Contractors' personnel shall have OSHA Certification for OSHA 40-hour HAZWOPER, OSHA Lockout Tagout Procedures and OSHA Permit required, Confined Space Entry. Certifications shall be included with bid, in order for the bid to be considered.

B. Contractor shall have at least two (2) years experience in air duct cleaning. Three (3) commercial references, including contract name and telephone number shall be submitted with bid, in order for the bid to be considered.

C. Membership: The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.

D. Certification: The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

E. Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.

F. Experience: The HVAC system cleaning contractor shall submit records of experience in the field of HVAC system cleaning as requested by the Owner. Bids shall only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

G. Equipment, Materials and Labor: The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials and labor to adequately perform the specified services.
   1. The contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification. For work performed in countries outside of the U.S.A., contractors shall comply with applicable national safety codes and standards.
   2. The contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification.
   3. Contractor shall submit to the Owner and Engineer/ Architect, all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.

H. Licensing: The HVAC system cleaning contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.

1.03 REFERENCES

A. National Air Duct Cleaners Association (NADCA): "Assessment, Cleaning & Restoration of HVAC Systems (ACR 2005)," 2004.

B. National Air Duct Cleaners Association (NADCA): "Understanding Microbial Contamination in HVAC Systems," 1996.

C. National Air Duct Cleaners Association (NADCA): "Introduction to HVAC System Cleaning Services," 2004.

D. National Air Duct Cleaners Association (NADCA): Standard 05 "Requirements for the Installation of Service Openings in HVAC Systems," 2004.

E. Underwriters' Laboratories (UL): UL Standard 181.

F. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62-89, "Ventilation for Acceptable Indoor Air Quality".

G. Environmental Protection Agency (EPA): "Building Air Quality," December 1991.

H. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): "HVAC Duct Construction Standards - Metal and Flexible," 1985.

I. North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems," 1993.

1.04 LABORATORY SERVICES

A. Contractor shall provide testing and analysis of contaminants such as Legionella, asbestos, microbials or any other hazardous airborne particulates using the (Air Conveyance System) as

a pollutant pathway should such testing be deemed necessary. Swipe samples of the ACS shall be used to determine what contaminates are present. Laboratory results shall be included as part of the prepared Mechanical Hygiene Report.

1.05 SCOPE OF WORK - EXISTING AIR CONVEYANCE SYSTEM CLEANING

A. The entire air distribution system in the building shall be cleaned as per this specification this shall include all supply, return and exhaust ductwork, reheat coils and all air outlets and inlets.

B. Existing Air Duct Cleaning
   1. Access points shall be strategically placed throughout the supply and return duct systems, as required. SMACNA approved insulated access doors shall be used upon closure to prevent heat loss/gain, and to facilitate inspection.
   2. Interior surfaces of the ductwork, dampers, turning vanes, shall be cleaned by using HEPA filtered vacuums, rotary brush and air whip dislodging systems, and contact cleaning as required.

C. Sanitizing Existing Ductwork:
   1. Upon completion of cleaning, sanitizing shall be performed throughout the entire air conveyance system. This process shall eliminate mold, bacteria, odors and viruses, plus retard their growth.

1.06 NOTIFICATION

A. The Contractor shall notify the Owner that prior to commencing of the cleaning work, the Owner shall remove the smoke detectors and other safety devices from the ductwork.

1.07 HEALTH AND SAFETY REQUIREMENTS

A. Safety Standards: Cleaning contractors shall comply with applicable federal, state, and local requirements for protecting the safety of the contractor’s employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.

B. Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

C. Disposal of Debris: All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

PART 2 - PRODUCTS

2.01 GENERAL

A. Contractor shall provide all necessary material and tools to provide access doors in the ductwork to reach the areas around dampers and turning vanes, bends, coils, smoke detectors, etc.

2.02 ACCESS DOORS

A. Sandwich access door shall be as manufactured by:
   1. DUCTMATE INDUSTRIES, INC.
   2. Approved Equal.

B. Composition and material

1. The sandwich access door shall consist of three layers of precision stamped hot-dipped galvanized steel.
2. The inside door shall combine two layers of metal which be shall spot welded together along the rim, encapsulating high density fiberglass insulation - UL classified FHC25/50.
3. The inside surface of the access door shall be smooth to minimize friction.
4. Gasket: Closed cell neoprene gasket shall be UL94HF1 listed with a service temperature range of (ASTM D746) -20ºF to 200ºF. The gasket shall be permanently bonded to the inside of the door to eliminate leakage.
5. Springs: Zinc plated conical springs shall be installed over the bolts, between the inner and outer door, to facilitate opening.
6. Knobs: Knobs shall have threaded metal inserts to eliminate thread stripping. Knobs shall be easily turned by hand without wrenches. UL94HB listed.
7. Bolts: Zinc plated carriage bolts shall be clinched and sealed to the inner door.
8. Template: Self-adhesive cut-around template shall be provided for the exact size of cut opening required.
9. Technical Data: Each door shall be tested to 20” WG with no leakage noted.
10. Guarantees: The Sandwich Access Door shall be guaranteed against defective material.

2.03 TOOLS AND EQUIPMENT

A. Contractor, shall utilize HEPA filters and vacuums meeting the following minimum requirements:
   1. Vacuum: CFM minimum - 6,000
   2. HEPA filter: 99.97% collection efficiency for particulates 0.3 microns or greater

2.04 SANITIZING

A. Upon completion of cleaning, sanitizing will be performed throughout the entire air conveyance system. Sanitizer will be fogged into ACS using a portable fogging system. Envirocon or other EPA Registered sanitizer will be used.

PART 3 - EXECUTION

3.01 INSPECTION/PREPARATION

A. HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air handling units, a representative sample of the units should be inspected.

B. The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, implement environmental engineering control measures.

C. Damaged system components found during the inspection shall be documented and brought to the attention of the Owner.

D. Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

E. Protect all furniture and flooring in the work area using clean protective coverings. Perform cleanup of these areas by use of HEPA filtered vacuums, to avoid recontamination of occupied space.

F. Contractor prior to his work shall check if the smoke detectors were removed from the ductwork.

G. Insulation: Identify areas of internally lined air conveyance systems that are deteriorated and negatively impacting air quality. Notify the Owner of these conditions so that he may correct them.

H. Inspector Qualifications: Qualified personnel should perform the HVAC cleanliness inspection to determine the need for cleaning. At a minimum, such personnel should have an understanding of HVAC system design, and experience in utilizing accepted indoor environmental sampling practices, current industry HVAC cleaning procedures, and applicable industry standards.

3.02 GENERAL DUCT CLEANING REQUIREMENTS

A. Install filter material over all terminal diffusers to protect surrounding areas during cleaning operation. Remove all filter material from diffusers after cleaning is complete.

B. Wherever grilles and/or diffusers are removable, they shall be removed, vacuum cleaned, washed, dried, and then replaced. Welded or fixed grilles shall be cleaned in place.

C. Interior surfaces of the ductwork, dampers, turning vanes, VAV boxes, and reheat coils shall be cleaned by using HEPA filtered vacuums, rotary brush and air whip dislodging systems, and contact cleaning as required. All removable diffusers shall be removed for cleaning, while others shall be done in place.

D. All internally lined ductwork and flex duct shall be cleaned using soft nylon brushes for dislodging, to avoid damage to fibrous insulation.

E. Containment: Debris removed during cleaning shall be collected and precautions shall be taken to ensure that debris is not otherwise dispersed outside the HVAC system during the cleaning process.

F. Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.

G. Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.

H. Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

I. Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system shall have their position marked prior to cleaning and, upon completion, must be restored to their marked position.

J. Service Openings: The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.
   1. Contractor shall utilize the existing service openings already installed in the HVAC system where possible.
   2. Other openings shall be created where needed and they shall be created so they can be sealed in accordance with industry codes and standards.
   3. Closures shall not significantly hinder, restrict, or alter the airflow within the system.

K. Closures shall be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.
   1. Openings shall not compromise the structural integrity of the system.
   2. Construction techniques used in the creation of openings shall conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.
   3. Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.
   4. Rigid fiber glass duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques that comply with UL Standard 181 or UL Standard 181a are suitable for fiber glass duct system closures.
   5. All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the Owner in project report documents.

L. Ceiling sections (tile): The contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.

M. Air distribution devices (registers, grilles & diffusers): The contractor shall clean all air distribution devices.

N. Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fans: The contractor shall insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:
   1. Clean all air handling units (AHU) internal surfaces, components and condensate collectors and drains.
   2. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.
   3. Clean all coils and related components, including evaporator fins.

O. Duct Systems. Contractor shall:
   1. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.
   2. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards).

3.03 DUCT CLEANING METHODOLOGY

A. Source Removal Cleaning Methods: The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods that will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified

tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

1. All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device shall be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.
2. All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.
3. All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.
4. All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

B. Methods of Cleaning Fibrous Glass Insulated Components
   1. Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.
   2. Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

C. Damaged Fibrous Glass Material
   1. Evidence of damage: If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.
   2. Replacement: When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.
   3. Replacement material: In the event fiber glass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.

D. Cleaning of coils
   1. Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

E. Antimicrobial Agents and Coatings
   1. Antimicrobial agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.

2. Application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.
3. When used, antimicrobial treatments and coatings shall be applied in strict accordance with the manufacturer's written recommendations and EPA registration listing.
4. Antimicrobial coatings shall be applied according to the manufacturer's written instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces.

3.04 CLEANLINESS VERIFICATION

A. General: Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.

B. Visual Inspection: The HVAC system shall be inspected visually to ensure that no visible contaminants are present.
1. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the Owner reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.
2. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
3. NADCA vacuum test analysis shall be performed by a qualified third party experienced in testing of this nature.

C. Verification of Coil Cleaning
1. Cleaning shall restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

3.05 HVAC SYSTEM REPORT

A. At the conclusion of the project, the Contractor shall provide a bound report to the Owner indicating the following:

B. Success of the cleaning project, as verified through visual inspection (before and after photographs) and gravimetric analysis.

C. Areas of the system found to be damaged and/or in need of repair

3.06 PROTECTION/ CLEANUP OF PROPERTY

A. Protect all furniture, wood flooring, and equipment in the work area using clean protective coverings. Cleanup of these areas shall be performed by use of the HEPA filtered vacuums, to avoid recontamination of occupied space. The contractor shall perform clean up and remove the protective coverings on a daily basis.

3.07 REPAIRING OF DAMAGED DUCTWORK, ACCESSORIES AND THERMAL INSULATION

A. Contractor shall repair all damages resulted by his work to the ductwork, thermal insulation and vapor barrier.

END OF SECTION 230135

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Work covered under this Section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the pipe hanger and supports as described in this Specification. Size hangers and supports to fit the outside diameter of the

1.02 REFERENCES

A. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel

B. ASTM A123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

C. ASTM A653 - Specification for Steel Sheet, Zinc-Coated by the Hot-Dip Process

D. ASTM A1011 - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability (Formerly ASTM A570)

E. MSS SP58 - Manufacturers Standardization Society: Pipe Hangers and Supports- Materials, Design, and Manufacture

F. MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports- Selection and Application

G. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices

1.03 QUALITY ASSURANCE

A. Provide hangers and supports used in fire protection piping systems listed and labeled by Underwriters Laboratories.

B. Steel pipe hangers and supports shall have the manufacturer’s name, part number, and applicable size stamped in the part itself for identification.

C. Design and manufacture hangers and supports in conformance with MSS SP 58.

1.04 SUBMITTALS

A. Submit product data on all hanger and support devices, including shields and attachment methods. Include as a minimum as part of product data materials, finishes, approvals, load ratings, and dimensional information.

B. Submit Pipe Hanger and Support Application Schedule.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with these specifications, provide pipe hanger and support systems manufactured by:
   1. Cooper B-Line, Inc.
   2. Carpenter and Patterson

3. Grinnell

2.02 PIPE HANGERS AND SUPPORTS

A. Hangers
   1. Uninsulated pipes 2 inch and smaller:
      a. Adjustable steel swivel ring (band type) hanger, B-Line B3170.
      b. Adjustable steel swivel J-hanger, B-Line B3690.
      c. Malleable iron ring hanger, B-Line B3198R or hinged ring hanger, B3198H.
      d. Malleable iron split-ring hanger with eye socket, B-Line B3173 with B3222.
      e. Adjustable steel clevis hanger, B-Line B3104 or B3100.
   2. Insulated pipe- Hot piping:
      a. 2 inch and smaller pipes: use adjustable steel clevis with galvanized sheet metal shield. B-Line B3100 with B3151 series.

B. Pipe Clamps
   1. When flexibility in the hanger assembly is required due to horizontal movement, use pipe clamps with weldless eye nuts, B-Line B3140 or B3142 with B3200. For insulated lines use double bolted pipe clamps, B-Line B3144 or B3146 with B3200.

C. Multiple or Trapeze Hanger
   1. Construct trapeze hangers from 12 gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8 inch minimum, B-Line B22 strut or stronger as required.
   2. Mount pipes to trapeze with 2 piece pipe straps sized for outside diameter of pipe, B-Line B2000 Series.
   3. For pipes subjected to axial movement:
      a. Strut mounted roller support, B-Line B3126. Use pipe protection shield or saddles on insulated lines.
      b. Strut mounted pipe guide, B-Line B2417.

D. Wall Supports
   1. Pipes 4 inch and smaller:
      a. Carbon steel hook, B-Line B3191.
      b. Carbon steel J-hanger, B-Line B3690.

E. Floor Supports
   1. Hot piping:
      a. Carbon steel adjustable pipe saddle and nipple attached to steel base stand sized for pipe elevation. B-Line B3093 and B3088T or B3090 and B3088. Screw or weld pipe saddle to appropriate base stand.

F. Vertical Supports
   1. Steel riser clamp sized to fit outside diameter of pipe, B-Line B3373.
   2. Copper Tubing Supports
      a. Size hangers to fit copper tubing outside diameters.
         1) Adjustable steel swivel ring (band type) hanger, B-Line B3170CT.
         2) Malleable iron ring hanger, B-Line B3198RCT or hinged ring hanger B3198HCT.
         3) Malleable iron split-ring hanger with eye socket, B-Line B3173CT with B3222.
         4) Adjustable steel clevis hanger, B-Line B3104CT.
      b. For supporting vertical runs use epoxy painted or plastic coated riser clamps, B-Line B3373CT or B3373CTC.
      c. For supporting copper tube to strut use epoxy painted pipe straps sized for copper tubing, B-Line B2000 series, or plastic inserted vibration isolation clamps, B-Line BVT series.

G. Plastic Pipe Supports
   1. V-Bottom clevis hanger with galvanized 18-gauge continuous support channel, B-Line B3106 and B3106V, to form a continuous support system for plastic pipe or flexible tubing.
   2. Supplementary Structural Supports
      a. Design and fabricate supports using structural quality steel bolted framing materials as manufactured by Cooper B-Line. Provide roll formed channels, 12 gauge ASTM A1011 SS Grade 33 steel, 1-5/8 inch by 1-5/8 inch or greater as required by loading conditions. Submit designs for pipe tunnels, pipe galleries, etc., to Architect/Engineer for approval. Use clamps and fittings designed for use with the strut system.

H. Pipe Supports Between Anchors and Pipe Expansion Loops
   1. Provide supports between pipe anchors designed to cause minimal resistance to piping movement. Provide roller hanger supports or slide plates between anchors.
   2. Provide supports near the L bends of pipe thermal expansion loops. No more than 12 inches from either side of the horizontal elbow.

2.03 SPRING HANGERS

A. For critical high temperature piping, at hanger locations where the vertical movement of the piping is ¾ inch or more, or where it is necessary to avoid the transfer of load to adjacent hangers or connected equipment, provide approved constant support hangers. However, where the piping movement occurs at a hanger supporting a portion of piping riser on which a rigid support is also located, variable spring hangers may be used for any amount of expansion up to the full recommended working range of the spring, provided the change in supporting effect of the variable spring is added to the design load of the rigid support.

B. Where transfer of load to adjacent hangers or equipment is not critical, and where the vertical movement of the piping is less than ¾ inch, variable spring hangers may be used, provided the variation in supporting effect does not exceed 25 percent of the calculated piping load through its total vertical travel.

C. The total travel for constant support hangers shall be equal to actual travel plus 20 percent. In no case shall the difference between actual and total travel be less than one inch.

D. Furnish constant support hangers with travel stops, which shall prevent upward and downward movement of the hanger. The travel stops shall be factory installed so that the hanger level is at the “cold” position. Design the travel stops to permit future reengagement, even in the event the lever is at a position other than “cold”, without having to make hanger adjustments.

E. For low temperature systems where vertical movements are anticipated, use approved precompressed variable spring hangers.

2.04 UPPER ATTACHMENTS

A. Beam Clamps
   1. Use beam clamps where piping is to be suspended from building steel. Select clamp type on the basis of load to be supported, and load configuration.
   2. Use center loaded beam clamps where specified. For steel clamps provide B-Line B3050, or B3055. For malleable iron or forged steel beam clamps with cross bolt provide B-Line B3054 or B3291-B3297 Series as required to fit beams.

B. Concrete Inserts
   1. Use cast in place spot concrete inserts where applicable; either steel or malleable iron body, B-Line B2500 or B3014. Select spot inserts to allow for lateral adjustment and to

have means for attachment to forms. Select inserts to suit threaded hanger rod sizes, B-Line N2500 or B3014N series.

2. Use continuous concrete inserts where applicable. Provide 12 gauge channels, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with Styrofoam inserts and end caps with nail holes for attachment to forms. Provide continuous concrete inserts with a load rating of 2,000 lbs/ft. in concrete, B-Line B22I, 32I, or 52I. Select channel nuts suitable for strut and rod sizes.
3. Provide Drop-In, shell type anchors with an internally threaded, all-steel shell with expansion cone insert and flush embedment lip. Manufacture anchors from plated carbon steel, 18-8 stainless steel and 316 stainless steel. Install anchors with carbide tipped hammer drill bits made in accordance to ANSI B212.15-1994 specifications. Test anchors to ASTM E488 criteria and listed by ICC (formerly ICBO) and SBCCI. Provide anchors listed by the following agencies as required by the local building code: UL, FM. Select inserts to suit threaded hanger rod sizes, Redhead Multi-Set.

2.05 ACCESSORIES

A. Hanger Rods shall be threaded both ends or continuous threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

B. Provide shields that are 180 degree galvanized sheet metal, 12 inch minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line B3151.

C. Pipe protection saddles shall be formed from carbon steel, 1/8 inch minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.

2.06 FINISHES

A. Indoor Finishes
   1. Coat hangers and clamps for support of bare copper piping with copper colored epoxy paint, B-Line Dura-Copper®. Use additional PVC coating of the epoxy painted hanger where necessary.
   2. Zinc plate hangers for other than bare copper pipe in accordance with ASTM B633 OR provide an electro-deposited green epoxy finish, B-Line Dura-Green®.
   3. Provide pre-galvanized strut channels in accordance with ASTM A653 SS Grade 33 G90 or provide an electro-deposited green epoxy finish, B-Line Dura-Green®.

B. Outdoor and Corrosive Area Finishes
   1. Hot dip galvanize hangers and struts located outdoors after fabrication in accordance with ASTM A123. Provide all hanger hardware as hot dip galvanized or stainless steel. Zinc plated hardware is not acceptable for outdoor or corrosive use.
   2. Provide hangers and strut manufactured of type 304 stainless steel with stainless steel hardware where located in corrosive areas.

PART 3 - EXECUTION

3.01 PIPE HANGERS AND SUPPORTS

A. Adequately support pipe by pipe hanger and supports specified in PART 2 PRODUCTS. Allow for forces imposed by expansion joints, satisfy structural requirements and maintain proper clearances with respect to adjacent piping, equipment and structures. Size hangers for insulated pipes sized to accommodate insulation thickness.

B. Keep the different types of hangers to a minimum and provide hangers that are neat, without complicated bolting and with the number of parts of each hanger and its anchor kept to a minimum.

C. Make accurate weight balance calculations to determine the required supporting forces at each hanger or support location and the pipe weight load at each equipment connection.

D. Provide pipe hangers capable of supporting the pipe in all conditions of operation selected to allow free expansion and contraction of the piping, and prevent excessive stress resulting from transferred weight being induced into the pipe or connected equipment.

E. Painted or shop prime all hangers and supports that are not galvanized.

F. Support horizontal steel piping in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

NOMINAL PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	MAXIMUM SPACING (FEET)
1/2 to 1-1/4	3/8	6
1-1/2	3/8	9
2	3/8	10

G. Support horizontal copper tubing in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

NOMINAL PIPE SIZE (INCHES)	ROD DIAMETER (INCHES)	MAXIMUM SPACING (FEET)
1/2 to 3/4	3/8	5
1	3/8	6
1-1/4	3/8	6
1-1/2	3/8	8
2	3/8	8

Do not leave any pipe length unsupported between any two coupling joints.

H. Provide means of preventing dissimilar metal contact such as plastic coated hangers, copper colored epoxy paint, or non adhesive isolation tape- B-Line Iso-pipe. Galvanized felt isolators sized for copper tubing may also be used, B-Line B3195CT.

I. Install hangers to provide a minimum of 1/2 inch space between finished covering and adjacent work.

J. Place a hanger within 12 inches of each horizontal elbow.

K. Support vertical piping independently of connected horizontal piping. Support vertical pipes at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

L. Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers as specified in section 2.02 C. Space trapeze hangers according to the smallest pipe size, or install intermediate supports according to schedules in this Section.

M. Do not support piping from other pipes, ductwork or other equipment that is not building structure.

N. Where horizontal piping movements are greater than ½ inch, or where the hanger rod angularity from the vertical is greater than four degrees from the cold to hot position of the pipe, offset the hanger pipe and structural attachments in such a manner that the rod is vertical in the hot position.

O. In any part of the building which is steel-framed, attach hangers to the building structural steel beams. Where hangers do not correspond with the building structural steel beams, provide supplemental steel members continuously welded or bolted to the building structural steel beams. Provide two (2) coats of primer on the supplemental steel. In any parts of the building which is a concrete structure, attach hangers to the concrete structure by installing anchors into the concrete.

3.02 CONCRETE INSERTS

A. Secure pipe hangers attached to concrete structure and slabs with embedded inserts, anchor bolts or concrete fasteners. Use a safety factor of 5 in selection of all inserts and expansion bolts unless there are seismic requirements (See “Seismic Restraint” specification if applicable). In which case, the larger of the two loadings shall govern the design.

B. Provide inserts for placement in formwork before concrete is poured.

C. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

D. Where concrete slabs form finished ceilings, provide inserts to be flush with slab surface.

E. E. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch.

END OF SECTION 230529

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section describes the marking and identification materials for identifying mechanical equipment, ductwork and piping systems.

B. Mark and identify all mechanical equipment, ductwork and piping systems described herein, and as shown and specified in the Contract Documents.

1.02 REFERENCES

A. ANSI A13.1 - Scheme for the Identification of Piping Systems.

B. Z53.1 - Safety Color Code for Marking Physical Hazards.

C. OSHA 29 CFR 1910 - Subpart J, General Environmental Controls

1.03 SUBMITTALS

A. Identification Scheme - Submit scheme of identification codes.

B. Steam Trap Schedule - Submit steam trap schedules listing proposed steam trap number, location, type, sizes and service.

C. Valve Schedules - Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Samples - Submit samples of tags, attachments, labeled and identified.

E. Equipment Schedules - Submit mechanical equipment schedules, listing proposed equipment numbers, and their location and function.

F. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Seton

B. Bunting

C. W.H. Brady Company

2.02 VALVE TAGS

A. Provide valve tags for all valves installed for this project. Valve tags shall be constructed of brass with stamped letters and service designation tag size minimum 1-1/2 inches (38 mm) diameter with smooth edges, brass S hook.

B. Valve tags shall be permanently stamped and marked with a service designation, normal valve position, and an identifying number as large as possible. Each valve shall have a separate and distinct number coordinated with the service designations shown on the Drawings and the Owners existing valve numbering system. Coordinate with the Architect/Engineer and Owner before finalizing the valve tag numbering system.

2.03 PIPE MARKERS

A. All accessible piping installed indoors for this project, insulated and uninsulated shall be identified with wraparound pipe markers. Pipe markers shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. “Accessible” piping shall include exposed piping, and piping located above lay-in ceilings. Markers shall include system name, flow arrow, and color code and pipe diameter.

B. All piping installed outdoors for this project, insulated and uninsulated, shall be identified with wraparound pipe markers. Pipe markers shall be factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. The marker shall be printed with weather-resistant ink.

C. Where pipes are too small or not readily accessible for application of pipe markers, a brass identification tag at least 1 ½ inches in diameter, with depressed ½ inch high black letters and numerals, shall be securely fastened at locations specified for pipe markers.

D. See pipe marker schedule for size requirements of pipe markers.

2.04 MECHANICAL EQUIPMENT MARKERS

A. Identify all mechanical equipment, bare or insulated, installed in the rooms or on the roof, by means of lettered and numbered nameplate (not stenciled) identifying the equipment and service. Refer to the Drawings for equipment identifications. Nameplates shall be aluminum with permanent 1 ½ inch high white letters on a black background, mechanically affixed and installed in a readily visible location on the equipment. Coordinate the final equipment designation with the Owner.

B. In addition to markers, all mechanical equipment shall be furnished with the manufacturer’s identification plate showing the name of equipment, manufacturer’s name and address, date of purchase, model number and performance data.

2.05 DUCT WORK IDENTIFICATION

A. Provide full air distribution system identification at each side of a wall penetration, in a mechanical room, at all changes in direction and at no more than 50 foot intervals. Provide arrows identifying direction of flow.

B. Fire damper or Smoke damper access points shall be permanently identified on the exterior by a label having letters not less than 0.5 inch in height reading: SMOKE DAMPER or FIRE DAMPER.

C. Identification shall be preprinted labels.

D. Letter Size: 1-1/2 inches in height.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Apply piping system markers and valve tags in the following locations:
   1. Adjacent to each valve and fitting.
   2. At each branch location and riser take-off
   3. At each side of a pipe passage through floors, walls, ceiling and partitions.
   4. At each pipe passage to and from underground areas.

5. Every 20 feet on all horizontal and vertical pipe runs.

B. Provide arrow markers showing direction of flow incorporated into or adjacent to each piping system marker. Use double-headed arrows if flow is in both directions.

C. Apply all piping system markers where view is unobstructed; markers and legends shall be clearly visible from operating positions.

D. Apply all tags and piping system markers in accordance with the manufacturer's instructions. Do not attach tags to valve handle such that the normal or emergency operation of the valve will be hindered.

3.02 VALVE CHART

A. Provide valve and steam trap chart identifying each valve's and steam trap's number, size of valve and service.

B. Frame the chart and locate the schedule in the Mechanical Equipment Room. (Aluminum Frame with plastic window).

C. Provide a compact disc that has the valve and steam trap chart schedule in a spreadsheet format. The spreadsheet software to be used for the schedule shall be identified by the Owner.

3.03 LAY IN CEILING TILES AND ACCESS DOORS

A. Provide a lettered and numbered nameplate for each access door indicating the mechanical equipment that the door provides access too.

B. Where VAV boxes, hot water reheat coils, or other mechanical devices are installed above a lay-in ceiling tile system, provide and install color coded thumb tabs to mark the location of the equipment above the ceiling.

3.04 SCHEDULES

A. Pipe Marker Letter Size Schedule:

Outside diameter of insulation or pipe Inches	**Letter height Inches**	**Color field Inches**
3/4 to 1-1/4	1/2	8
1-1/2 to 2	3/4	8

END OF SECTION 230555

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section specifies requirements for testing, adjusting, and balancing of all air and hydronic fluid distribution systems, including the equipment and devices associated with each system.

B. The work includes setting speed and flow, adjusting equipment and devices installed for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the mechanical installations specified in other Sections of the Specifications.

1.02 RELATED WORK

A. Drawings and general provisions of the Contract, including General Conditions, any Supplemental Conditions and Division 1 Specification Sections, govern the work of this section.

1.03 SUBMITTALS

A. Submit proof that the testing, adjusting and balancing agency meets the requirements of Section 1.04 “Quality Assurance”, and all other specified requirements.

B. Prior to performing the work, submit sample blank forms of the test reports that will be submitted by the entity performing work of this Section, indicating all data and parameters included.

C. Submit certified test reports, signed by the authorized representative of the testing and balancing agency. Certify the reports to be proof that the systems have been tested, adjusted and balanced in accordance with the selected reference standards (NEBB or AABC); are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at completion of the testing, adjusting and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Submittal of test report shall be in the following format:
   1. Draft Report: Upon completion of testing, adjusting and balancing procedures, prepare draft reports on the approved forms. Draft report may be handwritten, but must be complete, factual, accurate and legible. Organize and format draft reports in the same manner specified herein for the final reports. Submit two complete sets of draft reports. Only one complete set of draft reports will be returned.
   2. Final Report: Upon verification and approval of draft reports, prepare final reports, type written and organized and formatted as described herein. Submit two complete sets of final reports.
      a. Report Format: Submit reports using the standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted and balanced. Include schematic systems diagrams. Enclose the report contents in a 3-ring binder. Divide the contents into the below listed divisions, separating them by divider tabs with titles descriptive of the contents:
         1) General Information and Summary.
         2) Air Systems.
         3) Hydronic Systems.
      b. Report Contents: Provide the following minimum information, forms and data:
         1) General Information and Summary: Identify the testing, adjusting and balancing Agency, Contractor, Owner, Architect/Engineer, and Project on the inside cover sheet. Include addresses, and contact names and telephone numbers. Include a certification sheet containing the seal and name, address, telephone number and signature of the Agency’s responsible certified Test and Balance Engineer.

Include in this division a listing of the instrumentation used for the procedures, along with the proof of calibrations.

2) Include in the remainder of the reports the appropriate forms containing, as a minimum, the information indicated on the standard report forms prepared by AABC or NEBB, for each item of equipment and system. Prepare a schematic diagram for each item of equipment and system, to accompany each respective report form.

c. Calibration Reports: Submit proof that all required instrumentation has been calibrated to tolerances specified in the referenced standards within a period not exceeding six months prior to conducting the test procedures.

d. Existing Systems: Where existing systems are to be added to or modified include in the report results of operational tests taken prior to modifications including but not limited to existing fan and pump curves, pressure readings and flow measurements. Include in the report copies of the equipment and motor nameplate data along with equipment performance curves indicating operating points prior to any modifications and, where existing equipment is retained, operating points after system balance. Where terminals are adjusted or modified include terminal performance curves/data and final readings.

1.04 QUALITY ASSURANCE

A. Test, adjust and balance systems and equipment by using competent mechanics regularly employed by a testing, adjusting and balancing Subcontractor whose primary business is the testing, adjusting and balancing of building mechanical systems. The testing, adjusting and balancing Subcontractor shall be a business established for a minimum of 10 years.

B. The testing, adjusting, and balancing Subcontractor shall be certified by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).

C. Instrumentation type, quantity, and accuracy shall be as described in AABC's "National Standards for Field Measurement and Instrumentation, or Total System Balance, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."

D. All instrumentation shall be calibrated at least every 6 months or more frequently if required by the instrument manufacturer.

1.05 PERFORMANCE REQUIREMENTS

A. Comply with all applicable Federal, State and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below for procedures, measurements, instruments and test reports for testing, adjusting and balancing work:
   1. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
   2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
   3. National Environmental Balancing Bureau (NEBB)
   4. Associated Air Balance Council (AABC)

B. Set the air delivery or intake of each diffuser, grille and register to be as designed or within five percent of the air flow rates shown on the Drawings.

C. Set the fan air flow rate and static pressure rise across the fan to be within 10 percent above the design value at design speed.

1.06 JOB CONDITIONS

A. Require the testing and balancing specialist to review his work with the respective manufacturers of the equipment and devices involved, and coordinate and schedule all work.

B. Furnish and install balancing dampers, pressure taps, gauges, valves, and other components as required for a properly balanced system, whether or not specified herein or shown on the Drawings, all at no additional cost to the Owner. Make all adjustment or replacement parts recommended by the testing and balancing specialist in strict accordance with the respective equipment manufacturer's recommendations.

C. Coordinate with the control manufacturer's representative to set the adjustment of the automatically operated dampers and control valves to operate as required.

1.07 GENERAL

A. The Owner will occupy the building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

B. Complete all tests specified herein to the satisfaction of the Architect/Engineer before final acceptance.

C. The Architect/Engineer, or his representative, is the sole judge of the acceptability of the tests. The Architect/Engineer may direct the performance of any such additional tests, as he deems necessary in order to determine the acceptability of the systems, equipment, material and workmanship. No additional payment will be made for any test required by the Architect/Engineer.

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Obtain design drawings and specifications and become thoroughly acquainted with the design intent.

B. Obtain copies of approved shop drawings of all air handling and hydronic equipment, air outlets (supply, return and exhaust), manual valves, automatic valves and the temperature control diagrams, including intended sequence of operations.

C. Existing Systems: Where existing systems are to be added to or modified perform operational tests prior to modifications including but not limited to existing fans and pumps curves, pressure readings and flow measurements.
   1. Obtain copies of the equipment and motor nameplate data along with equipment performance curves indicating operating points prior to any modifications. Where terminal units are to be adjusted or modified obtain performance data for these units.

D. Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned, and is operable. Do not proceed with testing, adjusting and balancing until unsatisfactory conditions have been corrected in a manner approved by the testing and balancing specialist.

E. Examine the air systems to see that they are free from obstructions. Determine that all dampers and registers are open, moving equipment is lubricated, clean filters are installed, and automatic controls are functioning; and perform other inspections and maintenance activities necessary for proper operation of the systems.

F. Examine the hydronic systems to see that they are free from abnormal obstructions, and that all piping, valves and equipment have been properly made fully operational. Determine that all equipment and control systems are performing correctly by functional testing.

G. Where existing systems are to be modified or added to ensure that all strainers and filters are clean and any operational problems that will prevent system balance have been brought to the attention of the Owner and repaired.

3.02 TESTING, ADJUSTING AND BALANCING

A. Notify the Owner 48 hours in advance of starting any tests. Do not perform any tests until acknowledgment of notification and approval has been received from the Owner.

B. Provide all necessary instruments and personnel for the tests. If, in the opinion of the Architect/Engineer, the results of such tests show that the Work has not complied with the requirements of the Contract Documents, make all additions or changes necessary to put the system in proper working condition and pay all expenses for all subsequent tests which are necessary to determine whether the Work is satisfactory. Any additional work or subsequent tests shall be carried out at the convenience of the Architect/Engineer.

C. Test all packaged equipment in strict accordance with the equipment manufacturer's requirements.

D. Perform any and all other tests that may be required by the local municipality or other governing body, board or agency having jurisdiction.

E. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

F. Actuate all safety devices in a manner that clearly demonstrates their workability and operation.

G. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of test procedure.

H. Perform tests and compile test data for all air systems and hydronic systems.

I. Include a schematic diagram locating the air inlets, outlets, fans, equipment, dampers and regulating devices for air systems, and a schematic diagram for location of balancing valves, flow indicators, equipment, and devices for hydronic systems.

J. All instruments used shall be provided by the entity performing the Work of this Section, and shall be accurately calibrated and maintained in good working order.

K. Air Systems

Perform the testing, adjusting and balancing of air systems in accordance with the detailed procedures outlined in the referenced standards; including but not be limited to the following:

1. Test, record and adjust fan rpm to design requirements.
2. Test and record motor full load amperes.
3. Make a pitot tube traverse of main supply ducts and obtain design flow rate at fans.

4. Test and record system static pressure, velocity pressure and total pressure.
5. Test and adjust system for design supply, transfer and return air flow rate.
6. Test and adjust system for minimum and maximum design flow rates of outside air.
7. Test and record return air temperatures.
8. Test and record coil and fan leaving air temperatures.
9. Adjust all main supply, return, relief, and exhaust air ducts to proper design flow rate.
10. Adjust all zones to proper design flow rate for supply, return, transfer, relief and exhaust air.
11. Test and adjust each diffuser, grille and register.
12. Identify each grille, diffuser and register as to location and area on the schematic diagram.
13. Identify and list in the final report size, type and manufacturer of diffusers, grilles and registers and all tested equipment. Use manufacturer's data on all equipment to make required calculations for testing, adjusting and balancing. Include design required velocity and test resultant velocity, required flow rate and test resultant flow rate after adjustment as part of readings and tests of diffusers, grilles and registers.
14. Adjust all diffusers, grilles and registers to minimize drafts in all areas.
15. Permanently mark all dampers after air balance is complete so that they can be restored to their correct position, if disturbed later.
16. Seal openings in ductwork for pitot tube insertion with snap-in plugs after air balance is complete.

L. Hydronic Systems
   1. Perform the testing, adjusting and balancing of hydronic systems in accordance with the detailed procedures outlined in the referenced standards; and including but not limited to the following:
      a. Preliminary procedure prior to balancing:
         1) Examine water in system and determine if water has been treated and cleaned.
         2) Check expansion tank to determine that it is not air bound and the system is completely full of water.
         3) Purge all air vents of water systems, check automatic air vents and determine if they are operating properly. Repair or replace any air vents that are not operating properly.
         4) Coordinate with control manufacturer for required cooling and heating temperature controls and corresponding, automatic valve operation settings.
         5) Open all normally open valves to full open position. Set automatic valves to full coil flow.
         6) Complete air balance before final water balance begins.
         7) Check water pumps for pump rotation and for proper flow rate delivery against manufacturer's pump curves.
         8) Set all balancing valves for required flow delivery at mains and branch mains to cooling and heating elements.
         9) Upon completion of flow readings and adjustments of balancing valves, mark all settings and record data, so that they can be restored to their correct "balanced" position, if disturbed later.
      b. Include the following as part of the final balancing:
         1) After required cooling and heating temperature controls and automatic valve operation settings are made, recheck pump flow requirements and readjust system as required.
         2) Record pressure drop through coil at set flow rate of coil for full cooling and for full heating. Set pressure drop across bypass valve to match coil pressure drop.
         3) Record and check the following items at each cooling and heating element:
         4) Inlet water temperatures and static pressure at connections.
         5) Leaving water temperatures and pressure drop of each coil.
         6) Flow rate through coil with control valve stroked manually wide open.

7) Record operating suction and discharge pressures of each pump and final total dynamic head and rated amperage versus actual amperage of pump motors.
8) Record entering and leaving water temperatures and flow through all equipment and devices.
9) Check and record all flow rates at all locations in the piping system with flow meters.
10) Upon completion of air and hydronic systems testing, patch insulation, ductwork and housings, using materials identical to those removed.
11) Perform final testing, adjusting and balancing during summer season for air conditioning systems and during winter season for heating systems, including operation when outside conditions are within 5 degrees F wet bulb temperature of maximum summer design condition, and within 10 degrees F dry bulb temperature of minimum winter design condition.
12) Retest, adjust, and balance systems subsequent to system modifications. Resubmit test results.

END OF SECTION 230594

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the insulation, jackets and accessories for piping as scheduled in Part 3 of this Section and as shown on the Drawings.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping

B. Section 078413 - Through Penetration Firestopping for HVAC Systems

C. Section 079201 - Non Fire Rated Sleeves and Seals

D. Section 232000 - Pipe, Valves, and Fittings

E. Section 232300 - Refrigerant Piping

1.03 REFERENCES

A. National Fire Protection Association (NFPA):
   1. NFPA 255 - Surface Burning Characteristics of Building Materials.

B. Greenguard

C. 2015 International Energy Conservation Code

D. 2015 International Mechanical Code

E. Underwriters Laboratories, Inc. (UL):
   1. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

F. American Society for Testing and Materials (ASTM):
   1. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   3. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
   5. ASTM C335 - Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
   6. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
   7. ASTM C518 - Standard Test Method for Steady-State Heat Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   8. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
   9. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
   10. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.
   11. ASTM C 552 - Standard Specification for Cellular Glass Thermal Insulation
   12. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
   13. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

14. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing.
15. ASTM C 591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
16. ASTM C 610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
17. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
18. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
19. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
20. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
21. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
22. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
23. ASTM E96 - Standard Test Method for Water Vapor Transmission of Materials.

1.04 DEFINITIONS

A. Greenguard: Greenguard Environmental Institute

B. IAQ: Indoor Air Quality

C. EPA: Environmental Protection AgencyA

D. WHO: World Health Organization

E. ASJ: All Service Jacket

F. SSL: Self-Sealing Lap

G. FSK: Foil-Scrim-Kraft; jacketing

H. PSK: Poly-Scrim-Kraft; jacketing

I. PVC: Polyvinyl Chloride

J. FRP: Fiberglass Reinforced Plastic

K. Cold Service Piping/ Surfaces: Pipes or surfaces where the normal operating temperature is 60 degrees F or lower.

L. Hot Service Piping/ Surfaces: Pipes or surfaces where the normal operating temperature is 105 degrees F or higher.

1.05 SUBMITTALS

A. Product data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing products specified with minimum 3 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 3 years documented experience.

B. Materials:
   1. Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255 and UL 723.
   2. Insulation for duct, pipe and equipment for above grade exposed to weather outside building shall be certified as being self-extinguishing for 1" thickness in less than 53 seconds when tested in accordance with ASTM D1692.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer’s identification, product density, and thickness.

B. Follow manufacturer’s recommended storage and handling practices.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of each product (tapes, adhesives, mastics, cements, insulation, etc.).

B. Maintain temperature before, during, and after installation for a minimum of 24 hours.

C. Supply fiberglass products that assure excellent IAQ (Indoor Air Quality) performance through Greenguard Certification.

D. Mold: Carefully inspect any insulation that has been exposed to water. If it shows any sign of mold growth remove it from the Site. If the material is wet but shows no sign of mold, dry rapidly and thoroughly. If it shows signs of facing degradation from wetting remove it from the Site.

PART 2 - PRODUCTS

2.01 FIBER GLASS INSULATION

A. Approved Manufacturers:
   1. Knauf Insulation
   2. Johns Manville Corporation
   3. Owens Corning Corporation
   4. CertainTeed Corporation

B. Fiber glass insulation meeting ASTM C547, ASTM C585, and ASTM C795; rigid molded, noncombustible.

C. Factory applied vapor barrier jacket: ASJ/SSL conforming to ASTM C1136 Type I and ASTM E96, secured with self-sealing longitudinal laps and butt strips.

2.02 FIBER GLASS INSULATION JACKETS AND ACCESSORIES

A. Field-Applied Jackets and Fitting Covers

1. PVC - 25/50 or Indoor/Outdoor, UV-resistant fittings, jacketing and accessories, white or colored. Fitting cover system consisting of pre-molded, high-impact PVC materials with fiber glass inserts. Approved Manufacturer: Proto Corporation.
   a. Thickness: 10 mil.
   b. Closures: stainless steel tacks, matching PVC tape, or PVC adhesive per manufacturer's recommendations.
2. ASTM B209 formed aluminum, 0.016-inch thick in smooth, corrugated, or embossed finish with factory-applied moisture barrier. Approved Manufacturer: Childers.
   a. Overlap: 2-inch minimum.
   b. Fittings: 0.016-inch thick die-shaped with factory-applied moisture barrier.
   c. Metal jacket bands: 3/8-inch wide, 0.015-inch thick aluminum or 0.010-inch thick stainless steel.
3. ASTM A666, Type <<302; 304; 316>> stainless Steel, 0.010-inch thick in smooth, corrugated, or embossed finish with factory-applied moisture barrier. Approved Manufacturer: Childers.
   a. Overlap: 2-inch minimum.
   b. Fittings: 0.016-inch thick die-shaped with factory-applied moisture barrier.
   c. Metal jacket bands: 3/8-inch wide, 0.010-inch thick stainless steel.
4. Laminated Self-Adhesive Water and Weather Seals - Permanent acrylic self-adhesive System; weather resistant, high puncture and tear resistance; meeting or exceeding requirements of UL 723; applied in strict accordance with manufacturers' recommendations.

B. Fitting Insulation
   1. Pre-formed fiberglass, preformed perlite, mitered fiberglass, mitered perlite or calcium silicate in lieu of PVC systems. Protect fittings with field-applied fitting covers.

C. Tapes
   1. Vapor barrier type, self-sealing, non-corrosive, fire-retardant. Approved Manufacturer: Compac Corporation

2.03 ELASTOMERIC INSULATION

A. Approved Manufacturers:
   1. Armacell LLC
   2. K-Flex USA, Inc.

B. Flexible, tubular (Type 1) or sheet/roll form (Type 2) closed-cell elastomeric insulation complying with ASTM C534 <<Grade 1 - Standard (temperature range -297°F to 220°F); Grade 2 - High Temperature (to 350°F); Grade 3 - Contains no halogens>>; use molded tubular material wherever possible.

2.04 ELASTOMERIC INSULATION ACCESSORIES

A. Adhesives:
   1. Air dried, waterproof vapor barrier contact adhesive, compatible with insulation for joining of seams and butt joints.

B. Finishes:
   1. Provide a weather and UV resistant protective finish for outdoor applications in accordance with the manufacturer's recommendations.

2.05 HIGH DENSITY JACKETED INSULATION INSERTS FOR HANGERS AND SUPPORTS

A. For use with Fiberglass Insulation:
   1. Cold Service Piping:

a. Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.

2. Hot Service Piping:
   a. Calcium Silicate: Minimum density 15 pcf, K of 0.50 at 300 degrees F; ASTM C 533.
   b. Perlite: Minimum density 12 pcf, K of 0.60 at 300 degrees F; ASTM C 610.

B. For Use with Flexible Elastomeric Foam Insulation: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as specified or required.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that all piping is tested and approved prior to insulation installation.

B. Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

3.02 INSTALLATION (GENERAL)

A. Install all materials using skilled labor regularly engaged in this type of work. Install all materials in strict accordance with manufacturer's recommendations, building codes, and industry standards.

B. Locate insulation and cover seams in the least visible location. Extend all surface finishes in such a manner as to protect all raw edges, ends and surfaces of insulation.

C. On cold surfaces where a vapor retarder must be maintained, apply insulation with a continuous, unbroken moisture and vapor seal. Insulate and vapor seal all hangers, supports, anchors, or other projections secured to cold surfaces to prevent condensation.

D. Insulated pipes conveying fluids below ambient temperature; insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. For hot piping conveying fluids <<140°F>> or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

F. For hot piping conveying fluids over <<140°F>>, insulate flanges and unions at equipment.

G. Maintain continuous pipe insulation through walls, ceiling or floor openings, or sleeves except where firestop or firesafing materials are required.

H. Install insulation neatly, accurately and without voids, in accordance with manufacturer's instructions and NIAC National Commercial and Industrial Insulation Standards.

I. Insulate fittings, valves and flanges using premolded covers with precut insulation inserts.

J. Insulate piping using insulation of type and thickness scheduled in this Section.

K. Install metal shields between hangers or supports and the piping insulation. Install rigid insulation inserts as required between the pipe and the insulation shields. Fabricate inserts to be of equal thickness to the adjacent insulation and vapor seal as required. Insulation inserts shall be no less than the following lengths:

1½" to 2½" IPS	10" long

3" to 6" IPS	12" long
8" to 10" IPS	16" long
12" and over IPS	22" long

L. Pipe exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor) to be finished with PVC jacket and fitting covers, aluminum jacket, or stainless steel jacket.

M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.

N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with <<aluminum; stainless steel>> jacket with seams located on bottom side of horizontal piping. Coordinate insulation installation with heat-tracing installation and testing. Insulate piping after tracing or heat distribution tape has been installed and tested for continuity.

3.03 INSTALLATION (FIBER GLASS)

A. Provide a continuous vapor retarder on piping operating below ambient temperatures. Seal all joints, seams and fittings.

B. Firmly butt and secure ends with appropriate butt-strip material. On high-temperature piping, double layering with staggered joints when recommended by the insulation manufacturer. When double layering, the inner layer should not be jacketed.

C. Insulated pipes conveying fluids below ambient temperature:
   1. Provide vapor barrier jackets, factory-applied or field-applied; secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
   2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

D. Insulated pipes conveying fluids above ambient temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

E. Exterior Applications:
   1. Jacket piping and fittings exposed to the elements using aluminum or stainless steel jackets with a factory applied moisture barrier. Hold firmly in place with a friction type Z lock or a minimum 2” overlap joint. Seal all joints completely along the longitudinal seam and install so as to shed water. Seal all circumferential joints by use of preformed butt strips; minimum 2" wide or a minimum 2" overlap. Overlap butt strips to the adjacent jacketing a minimum ½-inch and completely weather seal. Install a 6" to 10" unsealed slide joint every 25 to 30 lineal feet to allow for the thermal expansion of the pipe and jacketing. In addition, apply a thin bead of silicone grease in the overlap to prevent water migration while allowing the joint to slide. Install an unsealed slide joint where distance between fittings exceeds 8 lineal feet.
   2. Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness ad adjoining pipe, and finish with glass mesh reinforced vapor

barrier cement. Cover with <<aluminum; stainless steel>> jacket with seams located on bottom side of horizontal piping.

F. Cold Piping Insulation:
   1. On below freezing applications and in high abuse areas protect the ASJ jacket with a PVC vapor retarding outer jacket. Seal exposed ends of the insulation with a vapor retarder mastic installed per the manufacturer's recommendations. Apply vapor seals at butt joints at every fourth pipe section joint and at each fitting to isolate any water incursion.
   2. On chilled water systems operating in conditions of: RH of 90% and above, follow the same guidelines as described above for below freezing applications.

3.04 INSTALLATION (ELASTOMERIC)

A. Piping:
   1. Install pipe insulation by slitting tubular sections and applying onto piping or tubing. Alternately, slide unslit sections over the open ends of piping or tubing. Adhere and seal all seams and butt joints using adhesive.
   2. Push insulation onto the pipe, never pull. Stretching of insulation may result in open seams and joints.
   3. Tape the ends of the tubing before slipping the insulation over the new pipes to prevent dust from entering the pipe.
   4. Clean cut all edges. Do not leave rough or jagged edges of the insulation. Use proper tools such as sharp non-serrated knives.
   5. On cold piping, adhere insulation directly to the piping at the high end of the run using a two-inch strip of adhesive on the inner diameter of the insulation and on the pipe. Coat all exposed end cuts of the insulation with adhesive. Adhere all penetrations through the insulation and termination to the substrate to prevent condensation migration.
   6. Use sheet insulation on all pipes larger than 6-inch diameter. Do not stretch insulation around the pipe. On pipes larger than 12-inch diameter, adhere insulation directly to the pipe on the lower 1/3 of the pipe. On pipes greater than 24-inch diameter, completely adhere insulation.
   7. Stagger seams when applying multiple layers of insulation.

B. Valves, Flanges and Fittings:
   1. Insulate all fittings with the same insulation thickness as the adjacent piping. Adhere all seams and mitered joints with adhesive. Sleeve screwed fittings and adhere with a minimum 1" overlap onto the adjacent insulation.
   2. Insulate valves, flanges, strainers, and Victaulic couplings using donuts covered with sheet or oversized tubular insulation.

C. Hangers:
   1. Support piping system using high density inserts with sufficient compressive strength. Apply elastomeric foam insulation with the same or greater thickness than the pipe insulation to pipe supports. Seal all joints with adhesive.
   2. Standard and split hangers - Insulate piping supported by ring hangers with the same insulation thickness as the adjacent pipe. Seal all seams and butt joints with adhesive. Sleeve ring hangers using oversized tubular insulation. On cold piping, extend insulation up the hanger rod a distance equal to four times the insulation thickness. Insulation tape may be used to a thickness equal to the adjacent insulation thickness.
   3. Clevis hangers or other pipe support systems - Install saddles under all insulated lines at unistrut clamps, clevis hangers, or locations where insulation may be compressed due to the weight of the pipe. Insert and adhere wooden dowels or blocks of a thickness equal to the insulation to the insulation between the pipe and the saddle.
   4. Pre-insulated pipe hangers can be used to prevent compression of insulation at standard split, clevis hangers or other pipe support systems. Adhere a pair of non-skid pads to the

clamps to minimize the movement. In addition, to prevent loosening of the clamps, use an antivibratory fastener, such as a nylon-locking nut.

D. Exterior Applications:
   1. Paint all outdoor exposed piping with two coats of UV resistant finish. Prior to applying the finish, wipe the insulation with denatured alcohol. Do not tint the finish.
   2. Locate seams for all outdoor exposed piping on the lower half of the pipe.

3.05 PIPING INSULATION MATERIAL SCHEDULE

SYSTEM OR SERVICE	LOCATION	INSULATION TYPE	JACKET
HEATING HOT WATER	INSIDE	FIBER GLASS	ALL SERVICE JACKET
CONDENSATE DRAINS	INSIDE	ELASTOMERIC	
HVAC REFRIGERANT LINES	INSIDE	ELASTOMERIC	
HVAC REFRIGERANT LINES	OUTSIDE	ELASTOMERIC	EXTERIOR COATING

3.06 MINIMUM PIPING INSULATION THICKNESS (IN.)

FLUID OPERATING TEMP RANGE (°F)	SYSTEMS IN TEMP RANGE	INSUALATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (IN.)				
		CONDUCTIVITY BTU*IN./(H*SQ. FT.*°F)	MEAN RATING TEMP (°F)	<1	1 TO < 1-1/2	1-1/2 TO < 4	4 TO < 8	=8
201-250		0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200		0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140		0.21-0.28	100	1.0	1.0	1.5	1.5	1.5
40-60		0.21-0.27	75	0.5	0.5	1.0	1.0	1.0
< 40		0.20-0.26	50	0.5	1.0	1.0	1.0	1.5

END OF SECTION 230700

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This section describes the insulation, jackets and insulating accessories for sheet metal ductwork as scheduled in Part 3 of this Section and as shown on the Drawings.

1.02 REFERENCES

A. National Fire Protection Association (NFPA):
   1. NFPA 255 - Surface Burning Characteristics of Building Materials.

B. Greenguard

C. 2015 International Energy Conservation Code

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

E. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

F. Underwriters Laboratories, Inc. (UL):
   1. UL 723 - Surface Burning Characteristics of Building Materials.

G. American Society for Testing and Materials (ASTM):
   1. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   3. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   4. ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
   5. ASTM C612 - Specification for Mineral Fiber Block and Board Thermal Insulation.
   6. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
   7. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
   8. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
   9. ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
   10. ASTM E84 - Surface Burning Characteristics of Building Materials.
   11. ASTM E96 - Water Vapor Transmission of Materials.

1.03 DEFINITIONS

A. Greenguard: Greenguard Environmental Institute

B. IAQ: Indoor Air Quality

C. EPA: Environmental Protection Agency

D. WHO: World Health Organization

E. ASJ: All Service Jacket

F. SSL: Self-Sealing Lap

G. FSK: Foil-Scrim-Kraft; jacketing

H. PSK: Poly-Scrim-Kraft; jacketing

I. PVC: Polyvinyl Chloride

J. FRP: Fiberglass Reinforced Plastic

K. Cold Piping/Ductwork/Surfaces: Pipes or surfaces where the normal operating temperature is 60 degrees F or lower.

1.04 SUBMITTALS

A. Product data: To include product description, manufacturer's installation instructions, types and recommended thicknesses for each application, and location of materials.

B. Provide samples and mock-ups of systems as required.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient conditions required by manufacturers of tapes, adhesives, mastics, cements, and insulation materials.

B. Follow manufacturer’s recommended handling practices.

C. Supply fiberglass products that assure excellent IAQ (Indoor Air Quality) performance through Greenguard Certification.

D. Mold: Carefully inspect any insulation that has been exposed to water. If it shows any sign of mold growth remove it from the Site. If the material is wet but shows no sign of mold, dry rapidly and thoroughly. If it shows signs of facing degradation from wetting remove it from the Site. Discard air handling insulation used in the air stream if exposed to water.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturer: Company specializing in manufacturing Products specified with minimum 3 years documented experience.
   2. Installer: Company specializing in performing the Work of this Section with minimum 3 years documented experience.

B. Materials:
   1. Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255 and UL 723.
   2. Certify insulation for duct, pipe and equipment for above grade exposed to weather outside building as being self-extinguishing for 1" thickness in less than 53 seconds when tested in accordance with ASTM D1692.

PART 2 - PRODUCTS

2.01 FIBERGLASS DUCT WRAP

A. Flexible Fiber Glass Blanket meeting ASTM C 553 Types I, II and III, and ASTM C 1290; Greenguard compliant.

B. Factory Applied Vapor Retarder Jacket: FSK or PSK conforming to ASTM C 1136 Type II.

C. Maximum service temperature of 250º F (Faced) or 350° F (Unfaced).

D. Density:
   1. Concealed areas: Minimum 0.75 PCF.
   2. Exposed areas: Minimum 1.0 PCF.

E. Approved Products:
   1. Friendly Feel Duct Wrap by Knauf

2.02 FIBERGLASS RIGID BOARD

A. Rigid Fiber Glass Board insulation meeting ASTM C 612 Type IA and IB.

B. Mean temperature by ASTM C 177 and a maximum service temperature of 450º F.

C. Factory Applied Vapor Retarder Jacket: ASJ conforming to ASTM C 1136 Type I, or FSK or PSK conforming to ASTM C 1136 Type II.

D. Density:
   1. Concealed areas: Minimum 3 PCF
   2. Exposed areas: Minimum 6 PCF

E. Approved Products:
   1. Insulation Board by Knauf

2.03 INTERNAL DUCT LINING

A. Conforming to ASTM C 1071 Type 1 and NFPA 90A & 90B.

B. Noise Reduction Coefficient (NRC): ASTM C 423 Type A Mounting, 0.40 or higher for ½" product, 0.60 or higher for 1" product.

C. Rated for a maximum air velocity of 6000 Feet per minute.

D. Approved Products:
   1. Textile Duct Liner with HydroshieldÔ Technology by Knauf.

2.04 FIBERGLASS INSULATION ACCESSORIES

A. Aluminum Jacket - 0.016-inch (0.406 mm) thick in smooth, corrugated, or embossed finish with factory applied moisture barrier. Overlap 2-inch (50 mm) minimum.

B. Laminated Self-Adhesive Water and Weather Seals - apply per manufacturers' recommendations.

C. Tapes - Vapor barrier type, self-sealing, non-corrosive, fire-retardant. Approved Manufacturer: Compac Corporation

D. Adhesives - Approved Manufacturer: Foster

E. Mastic - Approved Manufacturer: Foster

F. Vapor Barrier Coating - Approved Manufacturer: Foster

2.05 SHEET WATERPROOFING MEMBRANE

A. Prefabricated, self-adhering, sheet-type waterproofing membrane shall be FlexClad-400 by MFM Building Products Corp. or approved equal.

B. Description:
   1. Top Layer: Stucco-embossed, UV-resistant aluminum weathering surface.
   2. Middle Layer: Multiple layers of high-density cross-linked polymer film.
   3. Bottom Layer: Uniform layer of rubberized asphalt adhesive, protected by disposable silicone release paper.

C. Color: As selected by Architect/Engineer.

D. Material Thickness: ASTM D 1970, 40 Mils Nominal

E. Flexibility: ASTM D 1970, Pass.

F. Vapor Permeance: ASTM E 96, 0 perms.

G. Nail Sealability: ASTM D 1970, Pass.

H. Heat Aging: ASTM D 794, Pass.

I. Tear Resistance: ASTM D 1424, Average: 660 grams.

J. Ultimate Elongation MD: ASTM D 412, 434 percent.

K. Ultimate Elongation CMD: ASTM D 412, 246 percent.

L. Low Temperature Flexibility: 1,000,000 Cycles at -10 Degrees F, 1,200 Cycles at -20 Degrees F, No cracking.

M. Flame Spread Index: ASTM E 84, 0.

N. Smoke Density Index: ASTM E 84, 5.

O. Wind-Driven Rain: SFBC TAS-110-95, 100 mph, No leakage or failure.

P. UV Stability: Excellent.

Q. Accessories: MFM Spray Adhesive

2.06 FIRE RATED BLANKET (KITCHEN HOOD EXHAUST DUCT)

A. Thermal Material: 2192°F rated core blanket, manufactured from calcium magnesium silicate.

B. Fully encapsulated thermal material in fiberglass reinforced aluminum/polypropylene scrip (FSP).
   1. Encapsulation FSP marked with UL Classification Mark.
   2. Encapsulation FSP marked with ICC-ES report number ESR 2213.
   3. Collars supplied in 6 inch wide by 25 feet long rolls.

C. Product Characteristics:
   1. Thickness: 1-1/2 inch.
   2. Nominal Density: 6 pcf.

3. R-Value: 7.35 per layer when tested in accordance with ASTM C 518 at 75°F.
4. Flame Spread: <25 when tested in accordance with ASTM E 84.
5. Smoke Spread: <50 when tested in accordance with ASTM E 84.

D. Approved Products:
1. FireMaster FastWrap XL by Thermal Ceramics.

2.07 FIRE RATED BLANKET INSULATION ACCESSORIES

A. Glass Filament Tape: Minimum ¾ inch wide - used to temporarily secure blanket until permanent attachment using steel banding and/or steel insulation pins.

B. Aluminum Foil Tape: Minimum 3 inches used to seal cut edges.

C. Carbon Steel or Stainless Strapping Material Minimum: ½ inch wide and 0.015 inch thick.

D. Steel Insulation Pins: Minimum 12 gage, length sufficient to penetrate through duct wrap insulation.

E. Insulation Clips: Galvanized steel, minimum 1-1/2 inches round or square.

F. Through Penetration Firestop Sealants:
1. Packing Material: Remove encapsulation material from wrap, use core blanket (white) as penetration packing material.
2. Firestop sealants per applicable building code report and/or laboratory design listings.

G. Grease and HVAC Duct Access Doors:
1. Thermal Ceramics FastDoor XL Access doors

2.08 LOUVER BLANK OFF PANELS

A. Facing: 0.032 inch thick aluminum on both sides.

B. Perimeter Frame: 0.050 inch thick-formed aluminum channels.

C. Core: Expanded polystyrene (EPS), R value of 8

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that all ductwork is tested and approved prior to insulation installation.

B. Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

3.02 DUCTWORK REQUIRING INSULATION

A. Insulate Ductwork as specified in the DUCTWORK INSULATION SCHEDULE.
1. Insulate any additional ductwork or plenums indicated to be insulated on the Drawings.

3.03 INSTALLATION (GENERAL)

A. Install all materials using skilled labor regularly engaged in this type of work. Install all materials in strict accordance with manufacturer's recommendations, building codes, and industry standards.

B. Locate insulation and cover seams in the least visible location. Extend all surface finishes in such a manner as to protect all raw edges, ends and surfaces of insulation.

C. On cold surfaces where a vapor retarder must be maintained, apply insulation with a continuous, unbroken moisture and vapor seal. Insulate and vapor seal all hangers, supports, anchors, or other projections secured to cold surfaces to prevent condensation.

D. Install insulation neatly, accurately and without voids, in accordance with manufacturer's instructions and NIAC National Commercial and Industrial Insulation Standards.

E. Install ductwork hanger supports on the outside of the insulation. Where vertical ducts are supported to the building structure, insulate the ductwork supports to prevent condensation.

F. Insulate ductwork using insulation of the type and thickness scheduled at the end of this Section.

G. If specified insulation board thickness does not cover ductwork standing seams and reinforcing angles, insulate them by adhering a grooved strip of fiberglass board with a thickness at least 1 ½ inches greater than the height of the seam or angle covered over the standing seam or angle.

3.04 FIBERGLASS INTERNAL DUCT LINING

A. Apply Duct Lining in strict accordance with the latest edition of SMACNA's "HVAC Duct Construction Standard Metal & Flexible" and NAIMA's "Fibrous Glass Duct Liner Standard".

B. Select length of mechanical fasteners in accordance with the manufacturer's recommendation as listed on each product. Install mechanical fasteners perpendicular to the duct surface, and such that the pin does not compress the liner more than ?" relative to the nominal thickness of the insulation.

C. Adhesive shall conform to ASTM C 916. Apply adhesive to the sheet metal with a 90% minimum coverage. Coat all exposed edges of the duct liner with the same adhesive. Repair all rips and tears using an adhesive that conforms to ASTM C 916.

D. Cover all internal duct areas with duct liner. Firmly butt transverse joints with no gaps and coat with adhesive. Overlap and compress longitudinal corner joints.

E. When air velocities are 4000 to 6000 FPM, apply metal nosing to all upstream transverse edges to additionally secure the insulation.

3.05 FIBERGLASS WRAP INSULATION

A. Apply external duct wrap per insulation schedule even where internally lined.

B. Install Duct Wrap to obtain specified R-value using a maximum compression of 25%.

C. Firmly butt all joints.

D. Overlap the longitudinal seam of the vapor retarder a minimum of 2 inches.

E. Where vapor retarder performance is required, repair all penetrations and damage to the facing using pressure-sensitive foil tape or mastic prior to system startup.

F. Use pressure-sensitive foil tapes a minimum 3 inches wide and apply by moving pressure using a squeegee or other appropriate sealing tool.

G. Additionally secure Duct Wrap to the bottom of rectangular ductwork over 24 inches wide using mechanical fasteners on 18-inch centers. Do not over-compress insulation during installation.

H. Overlap unfaced Duct Wrap a minimum of 2 inches and fasten using 4-inch to 6-inch nails or skewers spaced 4 inches apart, or secured with a wire/banding system. Do not damage the Duct Wrap.

3.06 FIBERGLASS BOARD INSULATION

A. Fit insulation by scoring, cutting and mitering to fit the contour of the ductwork.

B. Attach insulation to ductwork in thickness scheduled by brushing adhesive uniformly on all sides of ductwork covering 100 percent of ductwork surface. Press insulation into place, making complete contact with adhesive. Butt edges of insulation board tightly together without gaps.

C. Additionally, hold insulation in place by impaling on pins welded to all four sides of the ductwork. Locate and weld pins a minimum 12 inch on center with a minimum of 2 rows per side of duct and no less than 3 inches from the edges of the ductwork. Secure insulation to pins with 1 inch diameter hold-down washers. As an alternate to welded pins, provide “Gripnail” mechanical surface fasteners by Gripnail Corporation using pneumatic hammer designed for this work.

D. Seal all joints, seams, breaks, and punctures in facing with adhesive and cover with 3 inch wide sealing tape. Flash supports with vapor barrier coating.

E. For rectangular ducts and plenums exposed to weather, pitch ductwork or insulation board minimum ¼ inch per foot to prevent rainwater from accumulating on top of duct or plenum. Cover insulation board with Sheet Waterproofing Membrane.

3.07 SHEET WATERPROOFING MEMBRANE

A. Surface Preparation:
   1. Prepare surfaces in accordance with manufacturer’s instructions.
   2. Ensure tops of ducts have sufficient slope to eliminate ponding water.
   3. Ensure bottoms of ducts have foil-faced rigid insulation boards installed.
   4. Ensure surfaces are clean and dry.
   5. Remove dirt, dust, oil, grease, hand oils, processing lubricants, moisture, frost, and other contaminants that could adversely affect adhesion of waterproofing membrane.
   6. Prime metal, concrete, and masonry surfaces with primers approved by waterproofing membrane manufacturer.

B. Application:
   1. Apply waterproofing membrane in accordance with manufacturer’s instructions on all exterior insulated ductwork and at locations indicated on the Drawings.
   2. Apply membrane to clean, dry, primed metal ductwork and foil-faced rigid insulation boards. Do not apply over wet or non-rigid insulation.
   3. Apply membrane in accordance with manufacturer’s air, material, and surface temperature requirements.
   4. Apply firm, uniform pressure with hand roller to entire membrane to ensure proper adhesion. Concentrate pressure at seams and on underside of ductwork.
   5. Apply membrane to ducts in accordance with manufacturer’s instructions.
   6. Apply membrane shingle fashion to shed water over, not against laps.
   7. Do not terminate membrane on bottom of duct.
   8. Apply minimum 3-inch laps and minimum 6-inch end laps for ductwork applications.
   9. Embed membrane to bottom of ducts over 24 inches wide in light continuous layer of adhesive applied to insulation face.

10. Apply membrane to bottom of insulated ducts over 36 inches wide using mechanical attachment, in addition to adhesive, in accordance with manufacturer's instructions. Install pints on 12-inch centers with rows staggered.
11. Apply adhesive to areas where special adhesion requirements exist, including duct bottoms, flashings, transitions, joints, elbows, valves, tees, and other fittings.

C. Protection:
1. Protect applied waterproofing membrane and fabric flexible duct connections from damage during construction.

3.08 FIRE RATED BLANKET

A. Install insulation in direct contact with the ductwork in accordance with the manufacturer's instructions and referenced standards.

B. Install 2 layers of FireMaster FastWrap XL for zero clearance and a 1 and 2 hour commercial kitchen grease duct application per ASTM E 2336.
1. Consult with manufacturer of proposed substitutions for required thickness to maintain a 2-hr fire rating with a zero clearance to combustibles.

C. Install 1 layer of FireMaster FastWrap XL for a 1 and 2 hour air ventilation duct enclosure per ISO 6944-1985.

D. Where exhaust duct penetrates firewall install ductwrap as per the manufacturer's instructions for through penetrations.

E. Locate doors on 20-foot centers on straight runs of ductwork and at each change of direction. Position doors on the side of duct a minimum of 1.5 inches above the bottom of the duct.

3.09 DUCTWORK INSULATION SCHEDULE

A. Fiber Glass Insulation Schedule:

Ductwork System	Type	Minimum R-Value
Supply Ducts and Plenums, Concealed	Fiberglass Duct Wrap	6
Return Ducts and Plenums, Concealed	Fiberglass Duct Wrap	6
Supply and Return Ducts and Plenums, Exposed Other Than in the Space Served	Fiberglass Rigid Board	6
Ducts Located Outdoors	Fiberglass Rigid Board	8
Unused Portions of Louvers	Louver Blank Off Panels	As Specified
Ductwork 20 Feet Upstream and Downstream of Air Handling Units and Supply and Return Fans, Located Indoors	Fiberglass Internal Duct Lining	Note 1
Ductwork 20 Feet Upstream and Downstream of Air Handling Units and Supply and Return Fans, Located Outdoors	Fiberglass Internal Duct Lining	Note 1
General Exhaust Ducts Except as Noted	Uninsulated	NA

NOTE 1 - Ductwork to be provided with 1-inch internal lining in addition to externally applied insulation in accordance with the table above.

B. Interior Concealed Range Hood and Elevated Temperature Exhaust Ducts

Ductwork System	Type	Thickness (In)
Kitchen Hood Exhaust Ducts	Fire Rated Blanket	Two layers 1-1/2” Each

END OF SECTION 230719

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work specified as part of this Section consists of the integration of equipment controls supplied as part of manufactured items, materials and equipment required by the Drawings and under Divisions 23 and 26 to achieve operational and coordinated Sequences of Operation as Specified. Work shall include management of the system start up and operational check out, coordination of functions of controllers supplied as part of equipment packages, sizing of control valves and damper operators for dampers, interconnection of systems, provision and installation of all accessory devices required for complete system operation including dampers, control valves and actuators not provided as part of equipment, coordination of start up and testing and demonstration of the operation of Sequences of Operation to the Owner and his representatives.

1.02 RELATED SECTIONS

A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are a part of these Specifications and shall be used in conjunction with this Section as a part of the Contract Documents. Consult them for further instructions pertaining to this work. The Contractor is bound by the provisions of Division 00 and Division 01.

B. The following Sections constitute related work:
   1. Section 230010 - General Mechanical Requirements
   2. Equipment and Systems specified under Division 23
   3. Division 26

1.03 QUALITY ASSURANCE

A. System Installer Qualifications
   1. The Integrator shall have a minimum of five years experience in the integration of systems of a similar nature to those of this Project.
   2. The Integrator shall have an office within 50 miles of the project site and provide 24-hour response in the event of a customer call.

B. Codes and Standards: Meet requirements of all applicable standards and codes, except when more detailed or stringent requirements are indicated by the Contract Documents, including requirements of this Section.
   1. Underwriters Laboratories: Products shall be UL-916-PAZX listed.
   2. National Electrical Code - NFPA 70.

C. All products used in this installation shall be new, currently under manufacture, and shall have been applied in similar installations for a minimum of 2 years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner's representative in writing prior to bid date. Spare parts shall be available for at least 5 years after completion of this Contract.

1.04 SUBMITTALS

A. Submit at the time of bid the name and qualifications of the firm that will be responsible for the Integration function along with the qualifications of the specific personnel proposed. The Owner and Architect/Engineer may choose to interview the personnel proposed for the project.

B. Contractor shall provide shop drawings and manufacturer’s standard specification data sheets on all materials and hardware to be provided. No work may begin on any segment of this project until the Architect/Engineer and Owner have reviewed submittals for conformity with the

Drawings and Specifications. All shop drawings shall be provided to the Owner electronically as .dwg or .dxf file formats.

C. Submit a written sequence of operation for each system indicating which functions are to be controlled by controls provided as part of manufactured equipment and which functions will be under control of devices provided as part of this Section.

D. Submit interconnecting wiring diagrams for all systems. These diagrams may rely on diagrams for controls of manufactured equipment provided that the interface points are clearly identified and copies of the manufactured item's control diagrams are submitted for information as part of the submittal package.

E. Submit any additional information or data which is deemed necessary to determine compliance with these specifications or which is deemed valuable in documenting the system to be installed.

F. Submit the following within 30 days of contract award:
   1. A work plan and schedule for the start up and check out of all systems including time requirements and resources required from all Sub-Contractors involved.
   2. A complete list of equipment to be used indicating quantity, manufacturer and model number.
   3. A schedule of all control valves including the valve size, model number (including pattern and connections), flow, CV, pressure rating, and location.
   4. A schedule of all control dampers. This shall include the damper size, pressure drop, manufacturer and model number.
   5. Provide manufacturers cut sheets for major system components. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submitted piece of literature and drawings shall clearly reference the specification and/or drawing that the submittal is being submitted to cover.
   6. The submittals required under this Section shall be considered as For Information Only. Review by the Architect/Engineer shall not relieve the Contractor from the responsibility of providing fully operational systems.

1.05 WARRANTY

A. Warrant all work as follows:
   1. Labor & materials for control system specified shall be warranted free from defects for a period of twelve (12) months after final completion acceptance by the Owner. Control System failures during the warranty period shall be adjusted, repaired, or replaced at no charge or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during customary business hours.
   2. At the end of the final start-up/testing, if equipment and systems are operating in a manner satisfactory to the Owner and Architect/Engineer, the Owner shall sign certificates certifying that the control system's operation has been tested and accepted in accordance with the terms of this Specification. The date of Owner's acceptance shall be the start of warranty.

PART 2 - PRODUCTS

2.01 STANDARD OF QUALITY AND PERFORMANCE

A. Products specified are not intended to form a complete scope of supply. They are intended to set a level of quality for items that the Contractor may need to supply to implement a complete Sequence of Operation. Products of a comparable quality and performance may be submitted for approval by the Architect/Engineer.

2.02 MOTORIZED DAMPERS

A. Dampers shall be modulating double-acting opposed blade or parallel blade dampers as required, designed and tested in accordance with AMCA 500. Obtain and verify the location, size and pressure rating of each damper prior to fabrication and delivery. Verify the layout of equipment and ductwork before dampers are fabricated. Pressure drop shall not exceed 0.03 inches water gauge static pressure at 1000 fpm in the fully-open position, and shall be rated for at least 2000 fpm average velocity. Damper shut-off pressure rating shall exceed the fan maximum total head-pressure.

B. Dampers shall be constructed of extruded aluminum or at least No. 16 gauge galvanized steel, with each blade being not more than 8 inches; wide damper frame channel shall be at least 5 inches deep. Each blade end shall have a 3/8 inch stainless steel or plated steel shaft rotating in self-lubricating bearings mounted in a damper channel frame. Blades mounted vertically shall be supported by thrust bearings. Control shaft shall be at least ½ inch diameter.

C. Flat-steel damper blades shall be made rigid by folding the edges. Blades shall have interlocking edges and shall be provided with EPDM or neoprene compressible seals at point of contact. Foam seals are not acceptable. Provide compression-type stainless steel jamb seals continuously along blade edges.

D. Each damper shall be assembled in the manufacturer's shop as a complete unit. Dampers, when closed, shall be guaranteed by the manufacturer not to leak in excess of 20 cfm per square foot at 4 inches w.g. static pressure. Provide dampers with operators having sufficient power to limit leakage to the rate specified.

E. Damper seals shall be suitable for an operating range of minus 20 degrees F (or 20 degrees F below the heating outside design temperature, whichever is lower) at the lower end to 200 degrees F at the upper end.

F. A complete damper assembly shall have blades no longer than 48 inches and no higher than 48 inches. Where greater length or height is required, the assembly shall be made of a combination of sections. Dampers shall be sized for the required air velocity and pressure classification.

G. Approved Manufacturers Arrow Damper & Louver or approved equal.

2.03 ELECTRONIC DAMPER/VALVE ACTUATORS

A. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

B. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing.
   1. Damper actuators shall fail normally open or closed as described on the Drawings or as follows:
      a. Outdoor Air Intake - normally closed.
      b. Air Exhaust - normally closed.
      c. Other applications - as as required by the Sequence of Operation.

C. All rotary spring return actuators shall be capable of both clockwise and counter clockwise spring return operation.

D. Proportional actuators shall accept a 0-10 VDC or 0-20 ma control signal and provide a 2-10 VDC or 4-20 ma operating range.

E. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC or more than 8 W for DC applications. Actuators operating on 120 VAC or 230 VAC shall not required more than 11 VA.

F. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 60 in-lb. torque capacity shall have a manual crank for this purpose.

G. Actuators shall be provided with a conduit fitting and a minimum 1 meter electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

H. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation

I. Actuators shall be Underwriters Laboratories Standard 873 listed.

J. Actuators shall be designed for a minimum of 60,000 full stroke cycles at the actuator's rated torque.

K. Provide a single damper actuator when dampers are less than 4 feet in width. Otherwise provide two damper actuators (one on each side of the ductwork).

2.04 CONTROL VALVES

A. Control valves shall be two-way or three-way type for two-position or modulating service as required.

B. Close-off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
   1. Water Valves:
      a. Two-way: 150% of total system (pump) head.
      b. Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.

C. Valve Failure Position:
   1. Valves shall fail normally open or closed as indicated on the Drawings or as follows:
      a. Heating coils in air handlers - normally open.
      b. Other applications - as scheduled or as required by Sequence of Operation.
   2. Zone valves shall be sized to meet the control application and they shall maintain their last position in the event of a power failure.

D. Water Valves:
   1. Body and trim materials shall be as specified in “Pipe, Valve & Fittings” specification. Equal percentage ports for modulating service.
   2. Sizing Criteria:
      a. Contractor shall verify sizing criteria with manufacturer.

2.05 TEMPERATURE SENSORS

A. Temperature sensors shall be Resistance Temperature Device (RTD) or Thermistor.

B. Duct sensors shall be rigid or averaging as required. Averaging sensors shall be a minimum of 5 feet in length.

C. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed.

D. Space sensors shall be equipped with set-point adjustment, override switch, display, and communication port.

E. Provide matched temperature sensors for differential temperature measurement. Differential accuracy shall be within 0.2 degrees F.

F. The space temperature, setpoint, and override confirmation shall be annunciated by a digital display for each zone sensor. The setpoint shall be selectable utilizing buttons.

2.06 HUMIDITY SENSORS

A. Room Humidity sensors shall have an accuracy of ±1% 25°C from 10% to 80% RH with One-point adjustment calibration. The operating temperature range shall be -10° to 150°F max.

B. Duct sensors shall have a sensing range of 20% to 80% with accuracy of ±1% R.H. Duct sensors shall be provided with a sampling chamber.

C. Outdoor air humidity sensors shall have a sensing range of 20% to 95% R.H. and shall be suitable for ambient conditions of -40 degrees F to 170 degrees F.

D. Humidity sensor's drift shall not exceed 1% of full scale per year.

2.07 STATIC PRESSURE SENSORS

A. Sensor shall have linear output signal. Zero and span shall be field-adjustable.

B. Sensor sensing elements shall withstand continuous operating conditions plus or minus 50% greater than calibrated span without damage.

C. Water pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Sensor shall be complete with 4-20 ma output, required mounting brackets, and block and bleed valves. Mount in location accessible for service.

D. Water differential pressure sensor shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over-range limit (DP) and maximum static pressure shall be 3,000 psi. Transmitter shall be complete with 4-20 ma output, required mounting brackets, and five-valve manifold. Mount in a location accessible for service.

2.08 LOW LIMIT THERMOSTATS

A. Safety low limit thermostats shall be vapor pressure type with an element 20 ft minimum length. Element shall respond to the lowest temperature sensed by any one foot section.

2.09 FLOW SWITCHES

A. Flow-proving switches shall be either paddle or differential pressure type, as shown on the Drawings or as specified.

B. Paddle type switches (water service only) shall be UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum). Adjustable sensitivity with NEMA 1 Type enclosure unless otherwise specified:

C. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 Type enclosure, with scale range and differential suitable for intended application, or as specified.

D. Current sensing relays may be used for flow sensing or terminal devices.

2.10 RELAYS

A. Control relays shall be UL listed plug-in type with dust cover. Contact rating, configuration, and coil voltage suitable for application.

B. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus or minus 200% (minimum) from set-point shown on plans. Contact rating, configuration, and coil voltage suitable for application. Provide NEMA 1 Type enclosure when not installed in local control panel.

2.11 TRANSFORMERS AND POWER SUPPLIES

A. Control transformers shall be UL listed, Class 2 current-limiting type, or shall be furnished with over-current protection in both primary and secondary circuits for Class 2 service.

B. Unit output shall match the required output current and voltage requirements. Current output shall allow for a 50% safety factor. Output ripple shall be 3.0 mV maximum Peak-to-Peak. Regulation shall be 0.10% line and load combined, with 50 microsecond response time for 50% load changes. Unit shall have built-in over-voltage protection.

C. Unit shall operate between 0 degrees C and 50 degrees C.

D. Unit shall be UL recognized.

2.12 LOCAL CONTROL PANELS

A. All indoor control cabinets shall be fully enclosed NEMA 1 or NEMA 4 rating as required. Provide cabinet with hinged door, key-lock latch, and removable sub-panels. A single key shall be common to all field panels and sub-panels.

B. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

C. Provide on/off power switch with over-current protection and main air gauge for control power sources to each local panel.

PART 3 - EXECUTION

3.01 GENERAL WORKMANSHIP

A. Install equipment, piping, wiring/conduit parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

C. Install all equipment in readily accessible location as defined by Chapter 1 Article 100 part A of the NEC. Control panels shall be attached to structural walls unless mounted in equipment

enclosure specifically designed for that purpose. Panels shall be mounted to allow for unobstructed access for service.

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.

E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.02 WIRING

A. All control and interlock wiring shall comply with the national and local electrical codes and Division 26 of these Specifications. Where the requirements of this Section differ with those in Division 26, the requirements of this Section shall take precedence.

B. Do not install Class 2 wiring in conduit containing Class 1 wiring. Do not use boxes and panels containing high voltage for low voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

C. Control wiring located in a plenum space that is not installed in a conduit shall be plenum rated.

D. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to wire connections shall be at a terminal blocks, or with a crimped connector. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

E. Maximum allowable voltage for control wiring shall be 120V. Provide and install step down transformers.

F. All wiring shall be installed as continuous lengths, where possible. Any required splices shall be made only within an approved junction box or other approved protective device.

G. Maintain fire rating at all penetrations in accordance with other Sections of this Specification and local codes.

H. Size of conduit and size and type of wire shall be the design responsibility of the Contractor, in keeping with the manufacturer's recommendations and the NEC.

I. Locate control and status relays in designated enclosures only. These relays may also be located within packaged equipment control panel enclosures. These relays shall not be located within Class 1 starter enclosures.

J. Follow manufacturer's installation recommendations for all communication and network cabling. Network or communication cabling shall be run separately from other wiring.

K. Adhere to Division 26 requirements for installation of raceway.

L. Maintain an updated (as-built) wiring diagram with terminations identified at the job site.

M. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3feet in length and shall be supported at each end. Flexible metal conduit less than 1/2" electrical trade size shall not be used. In areas exposed to moisture liquid tight, flexible metal conduits shall be used.

3.03 INSTALLATION OF SENSORS

A. Install sensors in accordance with the manufacturer's recommendations.

B. Mount sensors rigidly and adequate for the environment within which the sensor operates.

C. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.

D. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Install duct static pressure tap with tube end facing directly down-stream of air flow.

F. Sensors used in mixing plenums, and hot and cold decks shall be of the averaging type. Averaging sensors shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip.

G. All pipe mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat conducting fluid in thermal wells.

H. Wiring for space sensors shall be concealed in building walls. EMT conduit is acceptable within mechanical and service rooms.

I. Install outdoor air temperature sensors on north wall complete with sun shield at designated location.

3.04 FLOW SWITCH INSTALLATION

A. Install using a thread-o-let in steel pipe. In copper pipe use C x C x F Tee, no pipe extensions or substitutions allowed.

B. Mount a minimum of 5 pipe diameters upstream and 5 pipe diameters downstream or 2 feet which ever is greater, from fittings and other obstructions.

C. Install in accordance with manufacturers' instructions.

D. Assure correct flow direction and alignment.

E. Mount in horizontal piping - flow switch on top of the pipe.

3.05 ACTUATOR INSTALLATION

A. Mount and link control damper actuators per manufacturer's instructions.

B. To compress seals when spring return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.

C. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

D. Valves - Actuators shall be mounted on valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following manufacturer's recommendations.

3.06 WARNING LABELS

A. Affix plastic labels on each starter and equipment automatically controlled. Label shall indicate the following:

C A U T I O N

This equipment is operating under automatic control and may start at any time without warning.

3.07 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 2 inches of termination with a cable identifier and other descriptive information.

B. Permanently label or code each point of field terminal strips to show the instrument or item served.

C. Identify control panels with minimum 1-cm letters on laminated plastic nameplates.

D. Identify all other control components with permanent labels. Identifiers shall match record documents. All plug-in components shall be labeled such that removal of the component does not remove the label.

3.08 CLEANING

A. The Contractor shall clean up all debris resulting from his or her activities daily. The contractor shall remove all cartons, containers, crates, etc. under his control as soon as their contents have been removed. Waste shall be collected and placed in a location designated by the Construction Manager or General Contractor.

B. At the completion of work in any area, the Contractor shall clean all of his/her work, equipment, etc., making it free from dust, dirt and debris, etc.

C. At the completion of work, all equipment furnished under this Section shall be checked for paint damage, and any factory finished paint that has been damaged shall be repaired to match the adjacent areas. Any metal cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.09 PROTECTION

A. The Contractor shall protect all work and material from damage by his/her work or workers, and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.10 FIELD QUALITY CONTROL

A. All work, materials and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this Section.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship. All visible piping and or wiring runs shall be installed parallel to building lines and properly supported.

C. Contractor shall arrange for field inspections by local and/or state authorities having jurisdiction over the work.

3.11 ACCEPTANCE

A. The control systems will not be accepted as meeting the requirements of completion until all tests described in this Specification have been performed to the satisfaction of both the Engineer and Owner.

B. The full range of operation for all Sequences of Operation shall be demonstrated. Where sequences are dependent on season or outside conditions these conditions may be simulated for the purpose of demonstration if approved by both the Architect/Engineer and the Owner. If simulations cannot be acceptably created the Contractor shall perform the demonstration during the proper period.

C. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the Completion requirements if stated as such in writing by the Owner's representative. Such tests shall then be performed as part of the warranty.

END OF SECTION 230991

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Work specified as part of this Section consists of the work required to achieve operational and coordinated Sequences of Operation as described. Work includes coordination of functions of controllers supplied as part of equipment packages, sizing of control valves, interconnection of systems, provision and installation of all accessory devices required for complete system operation including devices not provided as part of equipment, coordination of start up and testing and demonstration of the operation of Sequences of Operation to the Owner and his representatives.

B. The control system operation of all equipment shall be subject to the operational modes, conditions and logic described in this Section and the controlled equipment manufacturer's recommendations.

C. Training of the Owner's personnel in the operation, trouble shooting, adjustment and repair of all system controls.

1.02 RELATED SECTIONS AND WORK

A. Division 26

B. Owner's Fire Alarm System (FAS)

PART 2 - PRODUCTS

NOT USED.

PART 3 - EXECUTION

3.01 GENERAL

A. General
   1. Conform to the requirements of the Owner's standards for all electrical work and devices.
   2. System and system components shall be BACNet compatible.
   3. All space sensors and thermostats shall have an lcd display indicating their set point, the condition sensed and the mode of operation they are responding to

3.02 SEQUENCE OF OPERATION - DUCTLESS SPLIT SYSTEM, DSEU/DSCU-1, DSEU/DSCU-2

A. General:
   1. Each ductless split system shall be provided with a wall mounted digital thermostat.

B. Cooling:
   1. The cooling set point temperature shall be 75 degrees F (adjustable). Upon a demand for mechanical cooling, the associated condensing unit shall be energized and the cooling coil shall be controlled to maintain space temperature.

C. Heating:
   1. The heating set point temperature shall be 70 degrees F (adjustable). When the space temperature falls below the set point temperature the heating unit shall stage on in order to maintain the set point temperature.

3.03 SEQUENCE OF OPERATION - ELECTRIC CEILING HEATER, ECH-1

A. General:
1. Each ceiling heater shall be provided with a remote, wall mounted digital thermostat.

B. Heating:
1. The heating set point temperature shall be 70 degrees. When the space temperature falls below the set point temperature, the heater shall turn on in order to maintain the set point temperature.

3.04 SEQUENCE OF OPERATION - AIR SCRUBBER, AS-1

A. General:
1. The Air Scrubber shall be interlocked with a wall switch, provided by others.

3.05 SEQUENCE OF OPERATION - EXHAUST FANS, EF-1 & EF-4

A. General:
1. The exhaust fan shall be interlocked with gas detection controller GD-1 and shall operate when commanded by GD-1.

3.06 SEQUENCE OF OPERATION - EXHAUST FANS, EF-2 & EF-3

A. General:
1. The exhaust fan shall be controlled by a lightswitch provided by electrical.

3.07 SEQUENCE OF OPERATION - ELEVATOR EXHAUST FAN EF-5

A. General:
1. The exhaust fan shall be controlled by a remote temperature sensor by factory in the elevator shaft. The fan shall be commanded to run when the temperature in the elevator shaft is at or above 85 degrees Fahrenheit.

3.08 SEQUENCE OF OPERATION - CIRCULATOR PUMP, CP-1

A. General:
1. The circulator pump shall be interlocked with the boiler controls and with thermostats serving HWUH's in New Apparatus Bay 118. The pump shall run anytime either thermostat is below the setpoint 68 degree F (adj.) and shall have a user definable (adj.) delay on stop.

3.09 SEQUENCE OF OPERATION - PACKAGED ROOFTOP UNIT, RTU-1, RTU-2, RTU-3

A. Run Conditions - Scheduled:
1. The unit shall run according to a user definable time schedule in the following modes:
a. Occupied Mode: The unit shall maintain
b. A 75 degree F (adj.) cooling set point
c. A 70 degree F (adj.) heating set point.
1) Unoccupied Mode (night setback): The unit shall maintain
(a) A 85 degree F (adj.) cooling set point.
(b) A 60 degree F (adj.) heating set point.
2. Alarms shall be provided as follows:
a. High Zone Temp: If the zone temperature is greater than the cooling set point by a user definable amount (adj.).

b. Low Zone Temp: If the zone temperature is less than the heating set point by a user definable amount (adj.).

B. Zone Set point Adjust:
1. The occupant shall be able to adjust the zone temperature heating and cooling set points at the zone sensor.

C. Supply Fan:
1. The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. To prevent short cycling, the supply fan shall have a user definable (adj.) minimum runtime.
2. Alarms shall be provided as follows:
a. Supply Fan Failure: Commanded on, but the status is off.

D. Cooling Stages:
1. The controller shall measure the zone temperature and stage the cooling to maintain its cooling set point. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.
2. The cooling shall be enabled whenever:
a. Outside air temperature is greater than 60 degree F (adj.).
b. AND the economizer (if present) is disabled or fully open.
c. AND the zone temperature is above cooling set point.
d. AND the supply fan status is on.
e. AND the heating is not active.

E. Gas Heating Stages:
1. The controller shall measure the zone temperature and stage the heating to maintain its heating set point. To prevent short cycling, there shall be a user definable (adj.) delay between stages, and each stage shall have a user definable (adj.) minimum runtime.
2. The heating shall be enabled whenever:
a. Outside air temperature is less than 65 degree F (adj.).
b. AND the zone temperature is below heating set point.
c. AND the supply fan status is on.
d. AND the cooling is not active.

F. Economizer:
1. The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a set point 2 degree F less than the zone cooling set point. The outside air dampers shall maintain a minimum adjustable position of 20% (adj.) open whenever occupied.
2. The economizer shall be enabled whenever:
a. Outside air temperature is less than 65 degree F (adj.).
b. AND the outside air enthalpy is less than 22% (adj.).
c. AND the outside air temperature is less than the return air temperature.
d. AND the outside air enthalpy is less than the return air enthalpy.
e. AND the supply fan status is on.
3. The economizer shall close whenever:
a. Mixed air temperature drops from 45 degree F to 40 degree F (adj.).
b. OR on loss of supply fan status.
c. OR freezestat (if present) is on.
4. The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off. If Optimal Start Up is available, the mixed air damper shall operate as described in the occupied mode except that the outside air damper shall modulate to fully closed.

G. Minimum Outside Air Ventilation - Fixed Percentage:
   1. The outside air dampers shall maintain a minimum position (adj.) during building occupied hours and be closed during unoccupied hours.

H. Dehumidification:
   1. The controller shall measure the return air humidity and override the cooling sequence to maintain return air humidity at or below 60% rh (adj.). Dehumidification shall be enabled whenever the supply fan status is on.

I. Prefilter Status:
   1. The controller shall monitor the prefilter status.
   2. Alarms shall be provided as follows:
      a. Prefilter Change Required: Prefilter differential pressure exceeds a user definable limit (adj.).

J. Mixed Air Temperature:
   1. The controller shall monitor the mixed air temperature and use as required for economizer control (if present) or preheating control (if present).
   2. Alarms shall be provided as follows:
      a. High Mixed Air Temp: If the mixed air temperature is greater than 90 degree F (adj.).
      b. Low Mixed Air Temp: If the mixed air temperature is less than 45 degree F (adj.).

K. Return Air Humidity:
   1. The controller shall monitor the return air humidity and use as required for economizer control (if present) or humidity control (if present).
   2. Alarms shall be provided as follows:
      a. High Return Air Humidity: If the return air humidity is greater than 70% (adj.).
      b. Low Return Air Humidity: If the return air humidity is less than 35% (adj.).

L. Return Air Temperature:
   1. The controller shall monitor the return air temperature and use as required for economizer control (if present).
   2. Alarms shall be provided as follows:
      a. High Return Air Temp: If the return air temperature is greater than 90 degree F adj.).
      b. Low Return Air Temp: If the return air temperature is less than 45 degree F (adj.).

M. Supply Air Temperature:
   1. The controller shall monitor the supply air temperature.
   2. Alarms shall be provided as follows:
      a. High Supply Air Temp: If the supply air temperature is greater than 120 degree F (adj.).
      b. Low Supply Air Temp: If the supply air temperature is less than 45 degree F (adj.).

3.10 SEQUENCE OF OPERATION - KITCHEN EXHAUST FAN KEF-1/MAKE-UP AIR UNIT MUA-1

A. For more information regarding the Sequence of Operations for the Kitchen Hood System, refer to spec section "233813-Kitchen Hood Systems."

END OF SECTION 230993

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section describes the pipe, valves, fittings, and joining materials for use with the piping systems described in this Section and as shown on the Drawings.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 079201 - Non-Fire Rated Sleeves and Seals

C. Section 230529 - Pipe Hangers and Supports

D. Section 230555 - Mechanical System Identification

E. Section 230700 - Pipe Insulation

F. Section 232007 - Piping Specialties

1.03 ABBREVIATIONS

A. The following are standard abbreviations:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene-terpolymer rubber.
   3. NRS: Nonrising stem.
   4. OS&Y: Outside screw and yoke.
   5. PTFE: Polytetrafluoroethylene plastic.
   6. SWP: Steam working pressure.
   7. TFE: Tetrafluoroethylene plastic.
   8. NPS: Nominal Pipe Size

1.04 SUBMITTALS

A. Product Data: For each type of valve indicated: Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Product data on pipe, fittings, gaskets, and bolts. Include dimensions, specifications, and manufacturer. Provide pipe and valve application schedule.

C. Provide product data, including but not be limited to dimensions, specifications, manufacturer, installation and operation instructions, temperature and pressure ratings, end connections, and required clearances on piping specialties included in this Specification.

D. Welder Certifications - Furnish the names of pipe welders and welding operators employed by the Contractor to perform the Work who have been qualified to use the welding procedures which have been qualified in accordance with the specified pressure piping codes or AWS or NFPA standards.

E. Shop Drawings
   1. Where deviations from the Drawings and Specifications are proposed for any reason, submit shop drawings identifying proposed deviations showing layout of all piping, fittings,

materials, dimensions, and fabrication and installation details. Submit a comparison table of the specified features and ratings of the specified item and those of the proposed deviation to allow a direct comparison.

2. The review of deviations will be for pressure drop only. The review will not address clearances or accessibility. No dimensional or coordination check will be made.
3. The Contractor has the sole responsibility to review the Drawings, coordinate piping fabrication, and provide clearances and access for installation, maintenance and balancing of this Work, and Work of other trades. Unless specifically dimensioned, Drawings indicate approximate locations only. The Contractor has the sole responsibility to locate and route the piping.
4. Submit all layout shop drawings on not less than ¼ inch equals 1 foot scale drawings.

1.05 REFERENCES

A. Division 1 - Quality Control: Requirements for references and standards.

B. AGA Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.

C. ANSI C111 - Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

D. ASME B16.3 - Malleable Iron Threaded Fittings.

E. ASME B16.5 - Steel Pipe Flanges and Flanged Fittings

F. ASME B16.9 - Factory-Made Wrought Steel Buttwelding Fittings

G. ASME B16.15 - Cast Bronze Threaded Fittings

H. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

I. ASME B16.22 - Wrought Copper and Bronze Solder Joint Pressure Fittings.

J. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

K. ASME B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings.

L. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

M. ASME B16.39 - Pipe Unions, Malleable Iron Threaded

N. ASME-B31.1 - Power Piping.

O. ASME B31.2 - Fuel Gas Piping.

P. ASME B31.5 - Refrigeration Piping.

Q. ASME B31.9 - Building Service Piping.

R. ASME B36.10M - Welded and Seamless Wrought Steel Pipe

S. ASME SEC IV - Construction of Heating Boilers.

T. ASME SEC IX - Welding and Brazing Qualifications.

U. ASTM A47 - Ferritic Malleable Iron Castings

V. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

W. ASTM A74 - Cast Iron Soil Pipe and Fittings.

X. ASTM A105 - Forgings, Carbon Steel, for piping components.

Y. ASTM A126 - Gray Iron Castings for Valves, Flanges, and Pipe Fittings

Z. ASTM A181 - Forgings, Carbon Steel, for General Purpose Piping

AA. ASTM A197 -Cupola Malleable Iron

AB. ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

AC. ASTM A307 - Carbon Steel Bolts and Studs, 60,000 psi Tensile

AD. ASTM B32 - Solder Metal.

AE. ASTM B42 - Seamless Copper Pipe.

AF. ASTM B62 - Composition Bronze or Ounce Metal Castings

AG. ASTM B75 - Seamless Copper Tube

AH. ASTM B88 - Seamless Copper Water Tube.

AI. ASTM B306 - Copper Drainage Tube (DWV).

AJ. ASTM B584 - Copper Alloy Sand Castings for General Applications

AK. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

AL. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

AM. AWS A5.8 - Specification for Brazing Filler Material

AN. AWWA C651 - Disinfecting Water Mains.

AO. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.

AP. NFPA 30 - Flammable and Combustible Liquids Code

AQ. NFPA 54 - National Fuel Gas Code.

AR. NSF 61 - Domestic Water Pipe, Valves, and Fittings.

AS. Mechanical Code of New York State-Latest Edition

AT. Plumbing Code of New York State-Latest Edition

AU. Fuel Gas Code of New York State-Latest Edition

AV. FM - Factory Mutual Compliance

AW. UL - Underwriter's Laboratory Compliance

1.06 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 hand wheels or stems as lifting or rigging points.

D. Protect all flange faces with wood, plastic or soft metal to prevent damage to parts.

E. Protect all pipe threads from damage with plastic plugs or caps.

F. Mark and identify all piping materials in accordance with the Reference Standards specified herein.

PART 2 - PRODUCTS

2.01 GENERAL

A. When two or more valves of the same type are used in the same service, furnish all valves of this type from the same manufacturer.

B. Specific manufacturer's model numbers are cited in the following Piping Material Schedules to establish the desired quality and performance for each type valve or material. Equivalent products by other approved manufacturers are also acceptable. Approval shall be subject to review by the Architect/Engineer.

2.02 HEATING HOT WATER PIPING

Item	Pipe Size	Description	Manufacturer/ Model No.
Pipe	2 inches and smaller	Type L, hard drawn copper tubing, ASTM B88	Mueller Industries
	2 ½ inches and larger	Schedule 40, seamless steel, ASTM A 53 Grade B	Wheatland
Joints	2 inches and smaller	Lead-free solder, ASME B32; Water Soluble Flux, ASTM B-813	J.W. Harris-Bridgit
	2 ½ inches and larger	Welded Connections	

Item	Pipe Size	Description	Manufacturer/ Model No.
Fittings	2 inches and smaller	Cast copper alloy or wrought copper ASME B16.18 or ASME B16.22	Nibco
	2 ½ inches and larger	Standard Weight, Seamless steel, butt welded, ASTM A234	Weldbend
Flanges	2 ½ inches and larger	150#, forged steel, weld neck, bore to match pipe ID, ASTM A181	Weldbend
Bolts	All sizes	Alloy Steel, Hex Head Bolts and Nuts, ASTM A307 Grade B	
Unions	2 inches & smaller	Wrought copper, solder unions, ASME B16.22	Nibco
Dielectric Unions	2 1/2 inches & smaller	Dielectric Type, Copper to Steel	Watts Regulator Series 3000
Gaskets	All Sizes	Spiral wound metallic gaskets	Flexitallic Style LS/LSI
Ball Valves	2 inches & smaller	Two-piece, full-port, soldered ends, bronze body, type 316 stainless-steel vented ball and stem, reinforced TFE seats, 150 psig SWP and 600-psig CWP ratings. MSS SP-110, ASTM B 584 Alloy C84400, ASME B1.20.1	Nibco S-585-70-66
Check Valves	2 inches & smaller	Class 125, Y-pattern swing type, soldered connections, bronze body with TFE seat disc. MSS-SP80, ASTM B 62	Nibco S413-Y
	2 ½ inches & larger	Class 125, swing-type, flanged connections, cast iron body with bronze trim, non asbestos gasket. MSS-SP71, ASTM A-126 Class B	Nibco F918-B
Butterfly Valves	2 ½ inches & larger	Full-lug type with ductile-iron body, one-piece Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat. Valve sizes 2 ½" through 6" shall have lever lock operator; valve sizes 8" and larger shall have weatherproof gear operator. MSS SP-67	Nibco LD-2000-3/5

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Unless otherwise shown, route piping in the most direct manner parallel to building lines in accordance with the Drawings. Group piping whenever practical at common elevations.

B. Accurately align, support and connect piping without forcing.

C. Locate piping so that access to and clearance around equipment, and minimum piping headroom of 7 feet is maintained, except where otherwise shown.

D. Space piping so that insulation and flanges, if any, have at least 1 inch clearance after maximum movement.

E. Where pipe elevations are not shown, pitch supply and return lines to positive drain points and/or coils.

F. Provide accessible flanges or union connections on the supply and return connections of terminal equipment and other items which must be disconnected for maintenance. Where unions are furnished as an integral part of the equipment, additional unions are not required unless required for access to or removal of components. Arrange equipment piping connections so that maintenance can be made without removing large sections of pipe or relocating the equipment.

G. In Domestic Water Systems, connect branch lines to the top of the line. For all other liquid systems, connect branch lines to the bottom or lower half of the line, preferably the bottom.

H. Connect branch lines in steam service and compressed air to the top or upper half of the line, preferably the top.

I. Use fittings for all changes of direction. Bending of steel pipe is not permissible.

J. Clean all piping materials before installation to remove grease, loose dirt, mill scale and other foreign matter.

K. Provide air vents at all high points of water piping, and valved drains at all low points of water piping for complete venting, draining and flushing of the piping system. Locate and provide air vents at multiple high points that are necessary to prevent air binding in the piping system. Install additional air vents and drains if directed by the Architect/Engineer, at no cost to the Owner. As a minimum provide drains and air vents
   1. In each section of piping separated by valves.
   2. On all coils.
   3. For each riser, where riser or runout to riser has a valve installed.
   4. In low point of piping to each down fed convector or radiator.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Provide loops, pipe offsets and anchors.

M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

N. Install gate or ball valves for shut-off and to isolate equipment, parts of systems, or vertical risers.

O. Sleeve pipes passing through partitions, walls and floors.

P. Identify piping under provisions of “Mechanical System Identification” Specification.

Q. Provide escutcheons at all locations where piping installed exposed to view penetrates wall, partitions, floors and ceilings.

R. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

S. Install flexible connectors at inlet and discharge connections of pumps and other vibration producing equipment.

T. Install strainers on the supply side of each control valve, pressure regulating valve, solenoid valve, trap, and elsewhere as indicated.

U. For pressurized liquid piping systems installed horizontally make reductions in pipe sizes using eccentric reducer fitting installed with the level side up to allow air venting.

V. For all nipples up to and including six inches in length provide extra-heavy shoulder type. For all nipples over six inches in length provide corresponding material, quality and thickness as the pipe on which they are used. Do not use close nipples. Provide nipples with designation mark of the manufacturer conforming to the ASTM pipe specifications for system served.

W. Make connections to all cooling and heating units with single or multiple cooling or heating coils in accordance with the manufacturer's instructions and labeling on equipment

X. For pressures over 15 psig, use nipples and caps instead of plugs for permanent closures. Plugs in equipment provided by equipment manufacturers are acceptable.

Y. Do not install piping above electrical panels. Route piping around panels.

3.02 COPPER TUBING CONNECTIONS

A. Provide soldered or brazed in accordance with Part 2 of this Section.

B. Make soldered and brazed connections in accordance with the procedures in the current edition of the Copper Tube Handbook of the Copper Development Association.

C. Qualifications of brazers, brazing procedures, and performance of brazers and brazing operators are required in compliance with the requirements of ASME B31.1, ASME B31.9, and the Boiler and Pressure Vessel Code, Section IX. Keep records and certifications required by the code on file and available for inspection.

D. Make solder joints on all copper water piping with 95/5 solder. Absolutely no lead-based solder will be accepted.

E. Clean joints thoroughly before soldering.

F. Remove excess solder and flux with a cloth or brush to leave a uniform clean fillet.

G. For refrigeration copper tubing connections, comply with ASME B31.5. Make brazed joints on all refrigeration piping.

3.03 CONNECTIONS OF DISSIMILAR METALLIC MATERIALS

A. Isolate connections between dissimilar metallic materials using dielectric connections. Use dielectric unions or flanges that provide a complete isolation of the two ends, including bolts for flanges, using materials suitable for the design pressure, temperature and fluid contained.

3.04 VALVES

A. Provide valves of the same size as the pipe in which they are installed, unless shown otherwise on the Drawings. At pumps, match valve size to pipe size and not pump connection size.

B. Install valves with the stem on or above the horizontal. Install valves with the stem horizontal if requirements of headroom, access or chain operation must be met.

C. Pack valves and adjust glands before final acceptance.

D. Install valve extension stems or chain operators where the center of valve hand wheels is more than 6 feet-6 inches above the floor and valve is 2 ½" and larger. Prove chain hooks where required to prevent fouling of chains on equipment and to clear walkways. Terminate chains approximately 3 feet-6 inches above the floor. Provide worm gear operators or impact hand wheels for all valves 6 inches and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation and a protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation.

F. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

G. Locate valves for easy access and provide separate support where necessary.

H. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb

I. Install butterfly valves with stems horizontal to allow support for the disc and the cleaning action of the disc.

J. 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.

K. Install balancing valves with lengths of straight pipe upstream and downstream of valve as per manufacturer's instructions such that calibrated accuracy is maintained As a minimum provide straight lengths as per the following table;

REQUIRED STRAIGHT LENGTHS

Valve Size	Upstream (In Pipe Diameters)	Downstream (In Pipe Diameters)
½"-3"	3	1

L. Chain wheel Actuators- Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Sprocket rim with Chain guides: Ductile Iron (Aluminum for applications exposed to weather), of type and size required for valve.
   2. Brackets: Type, number, size, and fasteners required to securely mount actuator on valve.
   3. Chain: Stainless steel, of size required to fit sprocket rim.
   4. Manufacturers:
      a. Babbitt Steam Specialty Co.
      b. Roto Hammer Industries

3.05 CONTROL VALVE INSTALLATION

A. Install all control valves so that the stem position is not more than 60 degrees from the vertical up position.

B. Install valves in accordance with the manufacturer's recommendations.

C. Install control valves so that they are accessible and serviceable, and such that actuators may be serviced and removed without interference from structure or other pipes, ducts and/or equipment.

D. Install isolation valves at control valves such that control valve body may be serviced without draining the supply/return side piping system. Install unions at all connections to screwed type control valves.

3.06 PRESSURE TESTING, FLUSHING AND CLEANING

A. Pressure test piping systems in accordance with applicable codes and as described herein.

B. Pressure testing - Schedule pressure testing so that it may be witnessed by the Architect/Engineer, Owner, or their representative. Perform tests in accordance with the following procedures:
   1. Before testing, complete the installation of each pipe line, including final supports, hangers and anchors. Perform testing before insulation or paint is applied for examination during the test. Clean piping and equipment of metal cuttings and foreign matter as they are installed.
   2. Codes - Pressure test piping to assure integrity of material and workmanship in accordance with the applicable ASME Code for pressure piping (B31) and New York State Code.
   3. Protection of Equipment - Protect equipment, instruments and piping specialties which are not included in the test by either disconnecting from the piping and blanking off the end of the pipe with a blind flange, plug or cap, or isolating by insertion of a line blind or spool piece as required. Disconnect pneumatic control lines and close all openings.
   4. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   5. Piping may be tested in sections or circuits as required for the progress of the work.
   6. Provide all systems to be pressurized with the appropriate gauges, certified calibrated by the manufacturer, and pressure-relieving devices.
   7. Install relief valve set at a pressure no more than 1/3 higher than the test pressure, to protect against damage by expansion of liquid or other source of overpressure during the test. Do not allow test pressure to exceed maximum pressure for any vessel, pump, valve, or other component in system under test.
   8. Records - Provide records of all tests showing line designation, test pressure, ambient temperature, date of test, retests and signature of witness.

C. Hydrostatic Test Procedures - Perform hydrostatic testing in accordance with ASME B31.9.
   1. Perform test using the pressure indicated under “Pressure Testing Schedule”
   2. After hydrostatic test pressure has been applied for at least two hours, examine piping, joints, and connections for leakage while maintaining test pressure. Repeat hydrostatic test until there are no leaks.
   3. Repair leaks as specified under “Repair of Line Leaks”

D. Service Testing - Perform service testing in accordance with ASME B31.9.
   1. For gases and steam and condensate service not over 15 psig, and for nontoxic, noncombustible, nonflammable liquids at pressures not over 100 psig and temperatures not over 200 degrees F a system test with the service fluid is acceptable. This exemption does not apply to natural gas piping.
   2. Bring the piping system up to operating pressure gradually with visual examination at a pressure between one-half and two-thirds of design pressure. Make a final examination at operating pressure.
   3. Repair leaks as specified under “Repair of Line Leaks”
   4. Repeat service test until there are no leaks.

E. Repair of Line Leaks - Comply with the following procedures for repair of leaks. In each case retest after repairs are made.
   1. Soldered/Brazed Joints - Remove solder/brazing alloy and reapply with proper flux.
   2. Flanged Joints - Check to determine flange end alignment and that all bolts are uniformly tightened with the required torque. If leak persists, depressurize the line, remove gasket, examine flange end face, and insert new gasket.

3. Threaded Joints - Tighten joint to a required torque. If leak does not stop, replace pipe and/or fittings. Do not use pipe dope, cement or seal weld to stop pipe leaks.
4. Gasketed Joints - Remove existing gasket and insert new gasket.
5. Welded Steel Joints - Repair pipe in accordance with applicable ASME B31 code.
6. Leaks in Material - Leaks located in pipe or fitting material require the replacement of that section of pipe or fitting and a repeat of the entire system using the complete procedure required for that system. Caulking, welding or epoxy is not permitted. Repair all damage caused by leaks.

F. Flushing - Complete pressure testing requirements prior to flushing. Performance of the flushing may be witnessed by the Architect/Engineer, Owner, or their representative, provide ample notification to all parties in advance of flushing any system. Perform system flushing in accordance with the following procedures:
   1. Flush all main and branch steam and liquid piping systems after pressure testing is complete with new potable water while draining the system at all low points. Isolate all connected equipment and flush individually.
   2. Flushing for piping and equipment will be considered complete when water samples taken at all low points indicate clear discharge-with no visible solids. If not clear, continue flushing and sampling until discharge is clear.

G. Cleaning - Complete flushing requirements prior to cleaning. Performance of the cleaning may be witnessed by the Architect/Engineer, Owner, or their representative, provide ample notification to all parties in advance of cleaning any system. Perform system cleaning in accordance with the following procedures:
   1. Clean all steam and condensate lines by blowing them out with live steam. Discharge steam and condensate from each main and branch safely to atmosphere for a minimum of five minutes.
   2. Clean all compressed air, instrument air, and fuel oil lines with oil-free dry compressed air at design pressure through each section so that they are blown free of dirt and debris.
   3. Clean domestic water lines by flushing with water until effluent is visibly as clean as the flushing medium.
   4. Clean hot water/chilled water lines as described below:
      a. When flushing discharge is clear, fill piping systems with water and sufficient approved alkaline cleaning material to remove dirt, oil and grease. Include all connected equipment in the cleaning.
      b. Vent system and place in operation, with automatic controls operating at set point temperature or an operating temperature designated by the Architect/Engineer. Circulate the solution through the system for a minimum of 4 consecutive hours.
      c. After 4 hours, drain system and flush with clean water until the pH at the farthest drain matches the clean water input. Keep strainers unplugged during the cleaning operations. Refill system with clean water.
   5. Clean temporary pump strainers and strainers at coils, etc. every 2 hours periodically during cleaning procedures. Do not remove temporary strainers until all cleaning steps are completed and the operation of the system indicates that the system is free of all foreign matter.
   6. Blow out all piping and equipment after cleaning and final flushing is completed and the system is drained with clean dry instrument air for a minimum of 15 minutes or until all water is expelled from the system. Upon completion seal the system by closing all drains and vents.
   7. Following the Architect/Engineers approval of the above flushing and cleaning procedures, immediately fill each system and chemically treat and monitor in accordance with the “Chemical Treatment Systems” specifications.

H. Pressure Testing Schedule:

Service	Test Type	Design Operating Pressure (psig)	Test Pressure (psig)
Heating Hot Water Supply and Return	Hydrostatic		1.25 times maximum working pressure

3.07 PAINTING

A. Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Paint in accordance with the requirements of the “Painting” Specification Section.

END OF SECTION 232000

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.

B. Condensate Drain.

1.02 RELATED SECTIONS

A. Section 230529 - Pipe Hangers and Supports

B. Section 230555 - Mechanical System Identification

C. Section 230700 - Piping Insulation.

1.03 REFERENCES

A. Section 014500 - Quality Control: Requirements for references and standards.

B. ASTM D 1784 - Rigid Vinyl Compounds.

C. ASTM D 1785 - PVC Plastic Pipe, Schedule 40

D. ASTM D 2466 - PVC Plastic Fittings, Schedule 40

E. ASTM D 2665 - PVC Drain, Waste, and Vent Pipe and Fittings

F. ASTM D 2564 - Solvent Cements for PVC Pipe and Fittings

G. ASTM D 2321 - Underground Installation of Thermoplastic Pipe (non-pressure applications)

H. ASTM F 1668 - Procedures for Buried Plastic Pipe

I. ASTM F 1866 - Fabricated PVC DWV Fittings

J. NSF Standard 14 - Plastic Piping Components and Related Materials.

K. NSF Standard 61 - Drinking Water System Components - Health Effects.

1.04 SUBMITTALS FOR REVIEW

A. Section 013300 - Submittals: Procedures for submittals.

B. Product Data: Provide data on pipe materials, pipe fittings, and accessories. Provide manufacturers catalog information.

1.05 QUALITY ASSURANCE

A. Perform Work in accordance with State of New York and Town code.

B. Identify pipe with marking including size, ASTM material classification and ASTM specification.

1.06 REGULATORY REQUIREMENTS

A. Perform Work in accordance with the State of New York and the Town code.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Section 016500 – Product Delivery, Storage, and Handling: Transport, handle, store, and protect products.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Section 014536 – Environmental Quality Control: Moisture control affecting products on site.

PART 2 - PRODUCTS

2.01 CONDENSATE DRAIN PIPING (DIAMETER LESS THAN OR EQUAL TO 1")

A. PVC Schedule 40 Pressure Pipe and Fitting System.

B. Pipe and fittings shall be manufactured from virgin rigid PVC (polyvinyl chloride) vinyl compounds with a Cell Class of 12454 per ASTM D 1784.

C. PVC Schedule 40 pipe shall be iron pipe size (IPS) conforming to ASTM D 1785.

D. PVC Schedule 40 fittings shall conform to ASTM D 2466.

E. Pipe and fittings shall be manufactured as a system and be the product of one manufacturer.

F. Pipe and fittings shall conform to National Sanitation Foundation (NSF) Standard 61 or the health effects portion of NSF Standard 14.

G. Testing with or transport/storage of compressed air or gas in PVC pipe or fittings shall not be permitted.

H. Buried pipe shall be installed in accordance with ASTM F 1668 and ASTM D 2774.

I. Solvent cement joints shall be made in a two step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564.

J. Primer shall conform to ASTM F 656.

K. The system shall be protected from chemical agents, fire stopping materials, thread sealant, plasticized vinyl products, or other aggressive chemical agents not compatible with PVC compounds.

L. The system is intended for pressure drainage applications where the temperature will not exceed 140°F.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Section 013100 - Project Management and Coordination: Verification of existing conditions before starting work.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and the requirements of the Plumbing Code of New York State.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls. Effect changes in size with reducing fittings.

C. Install piping to maintain headroom, conserve space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to fittings. Refer to Section 230700.

F. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 083100 - Access Doors and Panels.

G. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

H. Sleeve pipes passing through partitions, walls and floors.

I. Identify piping under provisions of Section 230555.

3.04 APPLICATION

A. Install unions downstream at equipment or apparatus connections.

3.05 ERECTION TOLERANCES

A. Section 014500 - Quality Control: Tolerances.

B. Establish invert elevations, slopes for drainage to ¼ inch per foot minimum. Maintain gradients.

3.06 FIELD QUALITY CONTROL

A. Drainage System: Test plug all system openings with the exception of the system's highest point. Fill system with water to the point of overflow and subject the highest point to 10-foot head of water. The system shall be considered tight if the pressure is held for not less than 30 minutes without signs of leakage.

END OF SECTION 232001

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide variable speed pump control systems as specified herein, as shown of the Drawings and as needed for a complete and proper installation.

1.02 SUBMITTALS

A. Product Data
   1. Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.

B. Shop Drawings
   1. Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loading, required clearances and methods of assembly of components.

C. Wiring Diagrams
   1. Submit manufacturer's electrical requirements for power supply wiring to HVAC pumps. Submit manufacturer's wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data
   1. Submit maintenance data and parts lists for each type of pump, control, and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, shop drawings and wiring diagrams in maintenance manual; in accordance with requirements of Division 1.

E. Warranty
   1. Submit warranty for each pump with complete description of the warranty procedures.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications

B. Firms regularly engaged in manufacture of centrifugal pumps with characteristics, sizes and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

C. Codes and Standards
   1. HI Compliance: Design, manufacture and install HVAC pumps in accordance with HI "Hydraulic Institute Standards".
   2. UL Compliance: Design, manufacture and install HVAC pumps in accordance with UL 778 "Motor Operated Water Pumps".
   3. UL and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

D. Certification, Pump Performance

E. Supply name plate data on pumps and drives: Each pump shall be provided with the following data : GPM, FT of Head, HP and actual Voltage.

1.04 DELIVERY, STORAGE AND HANDLING

A. Handle HVAC pumps and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged HVAC pumps or components; replace with new.

B. Store HVAC pumps and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading HVAC pumps and moving them to final location.

PART 2 - PRODUCTS

2.01 VERTICAL CLOSED COUPLED PUMPS

A. Pumps shall be Taco Model VR-15 or approved equal. The pumps shall be single stage end suction rear pull out design. The seal shall be serviceable without disturbing the piping connections. The capacities and characteristics shall be as called for in the plans/schedules.

B. Pump casing shall be constructed of ASTM A48 class 30 cast iron. The pump casing/volute shall be rated for 175 psi working pressure for all jobs. The pump flanges shall be matched to suit the working pressure of the piping components on the job, with either ANSI Class 125 flanges or ANSI class 250 flanges. The pump casing shall be drilled and tapped for gauge ports on both the suction and discharge connections and for a drain port at the bottom of the casing. The casing shall have an additional tapping on the discharge connection to allow for the installation of a seal flush line. The pump cover shall be drilled and tapped to accommodate a seal flush line which can be connected to the corresponding tapping on the discharge connection, or to an external source to facilitate cooling and flushing of the seal faces.

C. All casings shall be flanged. Threaded casings not allowed unless extra unions and fittings are provided with that pump to allow servicing.

D. The pump shall have a factory installed vent/flush line to insure removal of trapped air from the casing and mechanical seal cooling. The vent/flush line shall run from the seal chamber to the pump discharge.

E. The impeller shall be ASTM B584-836/875 bronze and hydraulically balanced. The impeller shall be dynamically balanced to ANSI Grade G6.3 and shall be fitted to the shaft with a key. The impeller shall be cast by the hydraulically efficient lost foam technique to ensure repeatability of high quality.

F. The pump shall incorporate a dry shaft design to prevent the circulating fluid from contacting the shaft. The pump shaft shall be AISI 1045 carbon steel with field replaceable bronze SAE 660 shaft sleeve. In order to improve serviceability and reduce the cost of ownership the shaft sleeve must be slip on (press on not allowable) and must be easily replaced in the field.

G. The pump shall be fitted with a single mechanical seal, with EPT elastomers and Carbon/Ceramic faces, rated up to 250ºF. This seal must be capable of being flushed externally via a tapping in the pump cover adjacent to the seal cavity. The entire pump line shall use no more than three different sizes of seals.

H. The pump shall be close coupled to a NEMA standard JM frame motor.

I. In order to both simplify and reduce the total cost of ownership, the manufacturer shall standardize on no more than three sizes of mechanical seals through out the entire range of the family of pumps. The manufacturer shall not use multiple part numbers for the same part.

2.02 PUMP LOGIC CONTROLLER

A. The controller operation shall operate the system using a tested and proven program that safeguards against undesirable or damaging conditions including:
   1. Motor overload
   2. Pump flow surges
   3. Hydraulic cycling (hunting)
   4. End of curve unstable operation: The pump logic controller, through a factory pre-programmed algorithm, shall be capable of protecting the pumps from hydraulic damage due to operation beyond their published end-of-curve. This feature requires a flow meter for activation. The operator interface shall include an owner adjustable flow set point to set the parameters for this routine

B. The pump logic controller shall be capable of starting, unloading, and stopping pumps based on a system performance program that will minimize energy consumption , provide reliable performance and bumpless transitions.

C. The integrated logic controller shall be capable of running four different hydronic optimization sub-routines:
   1. Setup one: This subroutine shall allow the pump package to track a quadratic system curve and will optimize a secondary distribution loop. It shall use a technology that allows the pump, drive, and motor package to translate the hydronic data from both a pump and system curve and translate it to electrical data. This allows the drive to know exactly where it is in the hydronic world
   2. Setup two: This subroutine shall allow two pumps to run as backup for each other and shall alternate the pumps based on a real time clock.
   3. Setup three: This subroutine shall allow the package to run in a customer defined flow rate. The package will always seek to run at the user defined flow even with fouling causing system changes. It shall use a technology that allows the pump, drive, and motor package to translate the hydronic data from both a pump and system curve and translate it to electrical data. This allows the drive to know exactly where it is in the hydronic world.
   4. Setup four: This subroutine shall incorporate a traditional external sensing and control platform. It shall allow the option of controlling the pumps with three zones of differential pressure or central plant differential temperature. This optional setup shall allow the owner the option of external sensing without adding an external controller. This feature shall be equal to Taco System Logic (TSL) or equal

D. The control platform shall include a subroutine equal to the Taco Self-Sensing Series with ProBalance™. This subroutine shall allow for the automatic balancing of secondary system distribution pumps. The package shall automatically run system distribution pumps to a user defined duty point and will recognize that duty point and hold the pumps at a speed that matches the actual installed system quadratic system curve. The package will then use this data to set up a new duty point as the max point for the quadratic control curve. Use of external balancing devices or contractors will not be needed.

E. The package shall serve as a flow metering device and will display pump flow at the user interface.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which HVAC pumps are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer.

3.02 INSTALLATION

A. General
   1. All pumps shall be fitted with a discharge multi-purpose balancing valve or other means of providing system balance, isolation, and check feature for reverse flow. The valve shall be straight or angle pattern and shall be field convertible between the two. The valve shall be ductile iron and rated for 250 psi working pressure for all jobs. The valve flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class125 psi flanges or ANSI class 250 flanges. The valve shall include the following components; non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation. Valve shall be serviceable under full system pressure. The valve shall be a Taco model MPV Plus Two multi-purpose valve or equivalent.
   2. All pump suctions to be fitted with a multifunction inlet suction diffuser fitting equal to that as manufactured by Taco, Inc. The suction guide body and cover plate shall be ductile iron and be rated for 250 psi for all jobs. The guide flanges shall be matched to suit the working pressure of the piping components on the job; with either ANSI class 125 flanges or ANSI class 250 flanges. The suction guide shall include the following components; full length S.S. straightening vanes, permanent S.S. strainer, disposable 16 mesh bronze start up strainer, blow down ports, and metering ports. For those pumps where an inlet guide fitting is not installed, there should be five pipe diameters of straight undisturbed flow going into the pump suction. The fitting shall be a Taco model SD inlet suction elbow or equivalent.
   3. All pumps shall be fitted with one 4 ½" dial pressure gauge piped to the inlet and outlet pump flanges. The gauge is to be isolated from each flange via ¼" ball valve. This gauge is to be used to take the differential across the pump unless otherwise indicated.
   4. Contractor shall install pump in accordance with the manufacturer's instructions. Contractor shall level each pump.
   5. Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors.
   6. Pumps shall NOT be run dry to check rotation.
   7. Change start-up strainers to permanent strainer upon acceptance of the job. Provide a blowdown valve on each strainer and terminate with hose thread or extend blowdown line to nearest floor drain.

B. Electrical Wiring
   1. Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Contractor.
   2. Provide the control wiring between field-installed controls, indicating devices, and pump control panels and the control wiring specified in HVAC Controls specification.
   3. Interlock wiring between pumps; and between pumps and field-installed control devices which are not factory installed.

C. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-16 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment manufacturer.

3.03 TEST AND BALANCE

A. Refer to the "Balancing System" Section.

3.04 ADJUSTING AND CLEANING

A. Check alignment, and where necessary, realign shafts of motors and pumps within tolerances recommended by the manufacturer and in presence of manufacturer's service representative and the Engineer.

B. Lubricate pumps before start-up. Start-up in accordance with manufacturer's instructions and in presence of manufacturer's service representative.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 232123

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Requirements of the following Division 23 Sections apply to this section:
   1. Section 230010 - General Mechanical Requirements.
   2. Section 230529 - Pipe Hangers And Supports
   3. Section 230555 - Mechanical System Identification
   4. Section 230700 - Pipe Insulation

1.02 SUMMARY

A. This Section includes refrigerant piping used for air conditioning applications. This Section includes:
   1. Piping, tubing, fittings, and specialties.
   2. Special duty valves.
   3. Refrigerants.

B. Products installed but not furnished under this Section include pre-charged tubing, refrigerant specialties, and refrigerant accessories furnished as an integral part of or separately with packaged air conditioning equipment.

1.03 SUBMITTALS

A. Product data for the following products:
   1. Each type of valve specified.
   2. Each type of refrigerant piping specialty specified.

B. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and proximity to equipment.

C. Brazer's Certificates signed by Contractor certifying that brazers comply with requirements specified under "Quality Assurance" below.

D. Maintenance data for refrigerant valves and piping specialties, for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 23.

1.04 QUALITY ASSURANCE

A. Qualify brazing processes and brazing operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications".

B. Regulatory Requirements: Comply with provisions of the following codes:
   1. ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.
   2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.

C. Mechanical Code of New York State

1.05 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof piping supports, and roof penetrations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the Work include, but are not limited to, the following:

B. Refrigerant Valves and Specialties:
1. Alco Controls Div, Emerson Electric
2. Danfoss Electronics, Inc
3. EATON Corporation, Control Div
4. Henry Valve Company
5. Parker-Hannifin Corporation, Refrigeration and Air Conditioning Division
6. Sporlan Valve Company

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the below specified pipe and fitting materials are used.

B. Copper Tubing: ASTM B 280, Type ACR, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing. Tubing shall be factory cleaned, ready for installation, and have ends capped to protect cleanliness of pipe interiors prior to shipping.

C. Copper Tubing: ASTM B 88, Type L, hard-drawn straight lengths, and soft-annealed coils, seamless copper tubing.

2.03 FITTINGS

A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern for hard drawn and soft copper.

2.04 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver)

2.05 VALVES

A. General: Complete valve assembly shall be UL-listed and designed to conform to ARI 760.

B. Globe: 450 psig maximum operating pressure, 275 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass wing cap and bolted bonnet; replaceable resilient seat disc; plated steel stem. Valve shall be capable of being repacked under pressure. Valve shall be straight through or angle pattern, with solder-end connections.

C. Check Valves - Smaller Than 7/8 inch: 500 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast brass body, with removable piston, Teflon seat, and stainless steel spring; straight through globe design. Valve shall be straight through pattern, with solder-end connections.

D. Check Valves - 7/8 inch and Larger: 450 psig maximum operating pressure, 300 deg. F maximum operating temperature; cast bronze body, with cast bronze or forged brass bolted bonnet; floating piston with mechanically retained Teflon seat disc. Valve shall be straight through or angle pattern, with solder-end connections.

E. Solenoid Valves: 250 deg. F temperature rating, 400 psig working pressure; forged brass, with Teflon valve seat, two-way straight through pattern, and solder end connections. Provide manual operator to open valve. Furnish complete with NEMA 1 solenoid enclosure with 1/2 inch conduit adapter, and 24 volt, 60 Hz. normally closed holding coil.

F. Hot Gas Bypass Valve: adjustable type, sized to provide capacity reduction beyond the last step of compressor unloading; and wrought copper fittings for solder end connections.

2.06 REFRIGERANT PIPING SPECIALTIES

A. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.

B. Strainers: 500 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.

C. Moisture/liquid Indicators: 500 psig maximum operation pressure, 200 deg. F maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.

D. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit, including gaskets. Standard capacity desiccant sieves to provide micronic filtration.

E. Flanged Unions: 400 psig maximum working pressure, 330 deg. F maximum operating temperature; two brass tailpiece adapters for solder end connections to copper tubing; flanges for 7/8 inch through 1-5/8 inch unions shall be forged steel, and for 2-1/8 inch through 3-1/8 inch shall be ductile iron; four plated steel bolts, with silicon bronze nuts and fiber gasket. Flanges and bolts shall have factory-applied rust-resistant coating.

F. Flexible Connectors: 500 psig maximum operating pressure; seamless tin bronze or stainless steel core, high tensile bronze braid covering, solder connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inch in length.

2.07 REFRIGERANT

A. Refrigerant No. 410A, in accordance with ASHRAE Standard 34.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine rough-in for refrigerant piping systems to verify actual locations of piping connections prior to installation.

3.02 PIPE APPLICATIONS

A. Use Type L, or Type ACR drawn copper tubing with wrought copper fittings and brazed joints above ground, within building. Use Type K, annealed temper copper tubing for 2 inch and smaller without joints, below ground and within slabs. Mechanical fittings (crimp or flair) are not permitted.

B. Install annealed temper tubing in pipe duct. Vent pipe duct to the outside.

C. If other than Type ACR tubing is used, clean and protect inside of tubing as specified in Article "CLEANING" below.

3.03 PIPING INSTALLATIONS

A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration."

B. Install piping in as short and direct arrangement as possible to minimize pressure drop.

C. Install piping for minimum number of joints using as few elbows and other fitting as possible.

D. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.

E. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.

F. Insulate suction lines. Liquid line are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.

G. Do not install insulation until system testing has been completed and all leaks have been eliminated.

H. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.

I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

J. Slope refrigerant piping as follows:
   1. Install horizontal hot gas discharge piping with 1/2" per 10 feet downward slope away from the compressor.
   2. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
   3. Liquid lines may be installed level.

K. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.

L. Use fittings for all changes in direction and all branch connections.

M. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

N. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

O. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

P. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

Q. Locate groups of pipe parallel to each other, spaced to permit applying insulation and servicing of valves.

R. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inch and larger shall be sheet metal.

S. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity. Refer to Division 7 for special sealers and materials.

T. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

U. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

V. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver.

W. Install moisture/liquid indicators in lines larger than 2-1/8 inch OD, using a bypass line.

X. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to compressors and evaporators.

Y. Install flexible connectors at the inlet and discharge connection of compressors.

3.04 HANGERS AND SUPPORTS

A. General: Hanger, supports, and anchors are specified in Division 23 Section "PIPE HANGERS AND SUPPORTS." Conform to the table below for maximum spacing of supports:

B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.

C. Support horizontal copper tubing in accordance with MSS SP-69 Tables 3 and 4, excerpts of which follow below:

NOMINAL PIPE SIZE (Inches)	ROD DIAMETER (Inches)	MAXIMUM SPACING (Feet)
1/2 to 3/4	3/8	5
1	3/8	6
1-1/4	3/8	6
1-1/2	3/8	8
2	3/8	8

D. Support vertical runs at each floor.

3.05 PIPE JOINT CONSTRUCTION

A. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

B. WARNING: Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.

C. CAUTION: When solenoid valves are being installed, remove the coil to prevent damage. When sight glasses are being installed, remove the glass. Remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties before brazing. Do no apply heat near the bulb of the expansion valve.

D. Fill the pipe and fittings during brazing, with an inert gas (i.e., nitrogen or carbon dioxide) to prevent formation of scale.

E. Heat joints using oxy-acetylene torch. Heat to proper and uniform brazing temperature.

3.06 VALVE INSTALLATIONS

A. General: Install refrigerant valves where indicated, and in accordance with manufacturer's instructions.

B. Install globe valves on each side of strainers and driers, in liquid and suction lines at evaporators, and elsewhere as indicated.

C. Install a full sized, 3-valve bypass around each drier.

D. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at the top.

E. Electrical wiring for solenoid valves is specified in Division 26. Coordinate electrical requirements and connections.

F. Thermostatic expansion valves may be mounted in any position, as close as possible to the evaporator.

G. Where refrigerant distributors are used, mount the distributor directly on the expansion valve outlet.

H. Install the valve in such a location so that the diaphragm case is warmer than the bulb.

I. Secure the bulb to a clean, straight, horizontal section of the suction line using two bulb straps. Do not mount bulb in a trap or at the bottom of the line.

J. Where external equalizer lines are required make the connection where it will clearly reflect the pressure existing in the suction line at the bulb location.

K. Install pressure regulating and relieving valves as required by ASHRAE Standard 15.

3.07 EQUIPMENT CONNECTIONS

A. The Drawings indicate the general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow servicing and maintenance.

3.08 FIELD QUALITY CONTROL

A. Inspect, test, and perform corrective action of refrigerant piping in accordance with ASME Code B31.5, Chapter VI.

B. Repair leaking joints using new materials, and retest for leaks.

3.09 CLEANING

A. Before installation of copper tubing other than Type ACR tubing, clean the tubing and fitting using following cleaning procedure:
   1. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through the tubing by means of a wire or an electrician's tape.
   2. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
   3. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
   4. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

3.10 ADJUSTING AND CLEANING

A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

B. Clean and inspect refrigerant piping systems in accordance with requirements of Division-23 General Mechanical Requirements

C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

3.11 COMMISSIONING

A. Charge system using the following procedure:
   1. Install core in filter dryer after leak test but before evacuation.
   2. Evacuate refrigerant system with vacuum pump; until temperature of 35 deg F is indicated on vacuum dehydration indicator.
   3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
   4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
   5. Break vacuum with refrigerant gas, allow pressure to build up to 2 psi.
   6. Complete charging of system, using new filter dryer core in charging line. Provide full operating charge.
   7. Train Owner's maintenance personnel on procedures and schedules related to start-up and shut-down, troubleshooting, servicing, and preventative maintenance of refrigerant piping valves and refrigerant piping specialties.

B. Review data in Operating and Maintenance Manuals. Refer to Division 01 section "Project Closeout."

C. Schedule training with Owner with at least 7 days advance notice.

END OF SECTION 232300

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section describes the galvanized steel, flexible, and aluminum ductwork for HVAC duct systems in accordance with SMACNA Duct Construction Standards, except as otherwise specified.

B. The construction material for each ductwork system shall be as listed in the “Ductwork Material Schedule” at the end of this Section.

C. This Section also describes the fittings, access doors, hangers and supports, manual volume dampers and sealants for each ductwork system as required.

1.02 RELATED WORK

A. Section 230594 - Balancing of Air and Hydronic Systems.

1.03 REFERENCES

A. ASHRAE - Handbook Fundamentals; Latest Edition.

B. SMACNA - HVAC Duct Construction Standards Metal And Flexible (latest issue)

C. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

D. ASTM B 209 - Specifications for Aluminum and Aluminum-Alloy Sheet and Plate.

E. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

F. UL 555 S - Fire Dampers & Smoke Dampers.

G. NFPA 96 - Standard for Commercial Cooking Operations

H. New York State Mechanical Code.

1.04 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and New York State Mechanical Code standards.

1.05 SUBMITTALS

A. Ductwork shop drawings for approval:
   1. Coordinate layout duct drawings that differ from ductwork shown on the Drawings.
   2. The review of deviations will be for pressure drop only. The review will not address clearances or accessibility to maintain or balance the air systems. No dimensional or coordination check of the shop drawings will be made. The Contractor has the sole responsibility to review the Drawings, coordinate ductwork fabrication, and provide clearances and access for installation, maintenance and balancing of this work, and work of other trades. Unless specifically dimensioned, Drawings indicate approximate locations only. The Contractor has the sole responsibility to locate and route the ductwork.
   3. Deviations such as changing direction or transforming or dividing ductwork must maintain ductwork cross-sectional area and not exceed transformation taper of 15 degrees.
   4. Plans and section showing all equipment and accessories.

5. Minimum 3/8 in. scale, double line, showing sizes, transverse joints, transitions, elevations, clearances and accessories; sections where required.

B. Shop details and catalog cuts of:
1. Ductwork construction, including gauge and bracing schedule.
2. Supports.
3. Dampers.
4. Turning vanes.
5. Fire dampers.
6. Access doors.
7. Flexible connections.
8. Other accessories.

1.06 QUALITY ASSURANCE

A. Construct all ductwork in accordance with referenced SMACNA Standards, except as otherwise stated. Ductwork pressure classifications shall be in accordance with referenced SMACNA Standards, except as otherwise specified.

B. For all uninsulated ductwork casings and plenums located outdoors, the reinforcement members shall be galvanized steel or stainless steel.

C. Construction pressure classification of ductwork are shown on the Drawings. If not shown, the pressure classification shall be greater than or equal to the maximum operating static pressure (minimum 2" w.c. pressure classification).

D. All ductwork shall be free from pulsation, chatter, vibration and objectionable noise. If any of these defects appear after a system is in operation, correct by removing and replacing, or reinforcing the ductwork, at no additional cost to the Owner.

E. For all galvanized steel ductwork, zinc coating shall be minimum G90 per ASTM A 653.

PART 2 - PRODUCTS

2.01 GALVANIZED STEEL RECTANGULAR DUCTS AND FITTINGS

A. Construct ducts of galvanized sheet steel meeting ASTM A 653 with G90 coating designation, and in accordance with the latest SMACNA HVAC Duct Construction Standards Metal And Flexible and pressure classifications as stated on the Drawings (minimum 2" w.c. pressure classification).

B. No ducts shall be less than No. 22 U.S. Gauge.

C. Piping, conduit and structure shall not penetrate ductwork. Where this condition cannot be avoided and with the written permission of the Architect/Engineer, follow SMACNA HVAC Duct Construction Standards Metal and Flexible, except that sides of transition sections shall slope a maximum of 15 degrees.

D. Provide 90-degree full-radius elbows with a centerline radius 1.5 times the duct width in the plane of the bend.

E. For elbows with centerline radius less than 1.5 times the width of the duct in the plane of the bend, provide turning vanes.

F. Provide square throat elbows with manufactured turning vanes.

G. All dissimilar metals shall be connected with flanged joints made up with fiber or neoprene gaskets to prevent contact between dissimilar metals. Flanges shall be fastened with bolts protected by ferrules and washers made of the same materials as the gaskets.

H. For split fittings, the split shall be proportional to the air flow. Construct per SMACNA HVAC Duct Construction Standards- Metal and Flexible.

I. Transitions and Offsets shall follow SMACNA HVAC Duct Construction Standards Metal and Flexible, except that sides of transitions shall slope a maximum of 15 degrees.

J. All branch take-offs perpendicular to the main shall be a 45 degree entry.

K. Longitudinal seams shall be of the Pittsburgh Lock type outlined in the SMACNA HVAC Duct Construction Standards Metal and Flexible.

L. Duct transverse joints shall be selected and used consistent with the static pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions for proper assembly of ductwork outlined in the SMACNA HVAC Duct Construction Standards - Metal and Flexible. Transverse joints T-25a, T-25b (Ductmate) shall only be used. Metal clips will only be allowed (NO PVC). Ductmate shall not be used for the following (use transverse joints T-15 through T-24 in these cases):
   1. The Ductmate '45' system shall not be used for applications with duct gauges heavier than 10 or lighter than 22.
   2. The Ductmate '35' system shall not be used for applications with duct gauges heavier than 16 GA. or lighter than 26 GA.
   3. The Ductmate '25' system shall not be used for application with duct gauges heavier than 20 GA. or lighter than 26 GA.

2.02 TURNING VANES

A. Manufactured with same material as ductwork that it is installed in and to the same pressure classification as ductwork that they are installed in.

B. Provide turning vanes in all square duct elbows and as noted on the Drawings.

C. Vanes shall be single thickness Small Vane as detailed in SMACNA HVAC Duct Construction Standards Metal and Flexible.

D. Where a rectangular duct changes in size at a square-throat elbow fitting, use single thickness turning vanes with trailing edge extensions aligned with the sides of the duct.

2.03 ACCESS DOORS

A. For access doors for use in ductwork receiving Fire Rated Blanket Insulation see Ductwork Insulation Section for requirements. Fabricate all other access doors in accordance with SMACNA Duct Construction Standards Metal And Flexible and as indicated.

B. For HVAC duct systems, construct doors of the same material as the ductwork. Minimum size of access doors shall be 8 inches by 8 inches, unless shown otherwise.

C. Provide walkthrough doors where shown. These doors shall have a minimum clear width of 18 inches. Provide doors with 8 inch square double pane wire glass windows. Locate windows not to exceed 5 feet-6 inches to centerline above finished floor of installed casing. Walk-through doors shall be operable from both sides of the door.

D. Access doors shall be insulated same as duct.

E. Provide with continuous neoprene gaskets around perimeter of access doors for airtight seal.

F. Provide all access doors with cam lock latches.

G. Provide access doors with watertight gaskets in shower room exhaust ductwork. Doors shall be of extra-heavy stainless construction.

H. All access doors serving a fire damper shall be painted red and shall have a label with white letters not less than ½ inch high reading “FIRE DAMPER”. No external ductwork insulation shall conceal a fire damper access door unless there is a label attached to the insulation indicating the exact location of the access door.

I. Provide access doors in following locations:
   1. Heaters and coils in ducts: entering and leaving side.
   2. Automatic dampers: linkage side.
   3. Fire damper, on both sides of ducts.
   4. Smoke detection heads.
   5. On both sides of ducts where necessary to provide maintenance accessibility to equipment on either side.
   6. VAV boxes
   7. Heating and Cooling coils.
   8. Fan Plenums.
   9. In-Line Fans (suction and discharge sides)
   10. Other items requiring access for service/maintenance

J. Where duct access doors are concealed the Contractor shall furnish and pay for installation of access doors to be mounted in the fire rated walls and ductwork enclosures. The access doors must be fire resistive and minimum 6” larger on each side then the duct access door for the above mentioned applications.

2.04 MANUAL VOLUME DAMPER

A. Fabricate in accordance with SMACNA Duct Construction Standards Metal And Flexible, and as indicated.

B. Fabricate single blade dampers for duct sizes up to 6 inches in height.

C. Fabricate multi-blade damper of opposed blade pattern with maximum blade sizes of 4 inches for ducts above 6 inches in height. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

D. Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

E. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches, provide regulator at both ends.

F. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.

G. Volume damper shall be provided at each duct branch and also where shown on the Drawings. Volume dampers must be installed at each branch even if they are not shown on the Drawing.

H. Approved Manufacturers:
   1. Ruskin Mfr. Co.
   2. Arrow Damper & Louver.
   3. Imperial Damper Co.

2.05 BACKDRAFT DAMPERS

A. Dampers shall be low-leakage, parallel-blade type. Damper sizes shall be suitable for duct sizes noted on the Drawings. The dampers shall be suitable for a minimum 4000 fpm velocity.

B. Damper frames shall be minimum No. 12 gauge galvanized steel blades shall be minimum No. 16 gauge galvanized steel or Type 6063-T5 aluminum with press-fit ball bearings.

C. Dampers shall be complete with adjustable counterweights and linkage for duty at .20 inches w.g. and 3500 fpm.

D. Provide neoprene or silicone rubber blade seals.

E. Approved manufacturers - Ruskin Manufacturing Company.

2.06 DUCT TEST HOLES

A. Cut or drill temporary test holes in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent test holes shall be factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.07 DUCT HANGERS AND SUPPORTS

A. Provide trapeze, strap or angle iron hangers meeting SMACNA HVAC Duct Construction Standards Metal and Flexible.

B. Materials of hangers, supports and fasteners shall conform to the manufacturer’s load ratings.

C. Hangers, supports, upper attachments and inserts shall be hot-dip galvanized steel or stainless steel.

D. Fasteners for HVAC duct systems shall be hot-dip galvanized steel, cadmium-plated steel or stainless steel.

E. Secure ductwork hangers attached to concrete structures and slabs with embedded inserts, anchor bolts or concrete fasteners. A safety factor of 5 should be used in selection of all inserts and expansion bolts (if applicable safety factor shall be determined by analysis of seismic loads and the greater safety factor shall be used).

F. Provide hangers and supports not more than 12 inches from each face of a horizontal elbow.

G. Plenums shall be supported to permit personnel to enter the plenum. If no structural steel design is shown on the Drawings, it is the responsibility of the Contractor to provide the services of a licensed structural engineer in the in which the project is to be constructed to submit a structural design for review.

2.08 SEALANTS

A. Where ducts are not continuously welded or soldered, provide sealants and gaskets as required to meet the specified duct leakage allowance.

B. Provide Gaskets, Sealers, Mastics and Tapes as manufactured by Ductmate.

2.09 FIRE DAMPERS

A. Fabricate and install in accordance with NFPA 90A and UL Safety Standard 555, and AMCA Standard 500.

B. Fire Resistance: For penetrations through construction rated less than 3 hours, 1 ½ hours. For penetrations through construction rated for 3 hours or more, 3 hours.

C. Pressure Differential Rating: 4 in. w. g.

D. Velocity Rating: 2000 fpm

E. Fabricate curtain type dampers of galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades in air stream. Fabricate fire dampers for vertical and horizontal position.

F. Fabricate multiple blade fire dampers with 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

G. Fusible links, UL 33, shall separate at 165 degrees F.

H. Acceptable Manufacturers:
   1. Greenheck Model DFD 150, 200 and 350
   2. Ruskin Mfr. Co.
   3. Arrow Damper & Louver.
   4. Imperial Damper Co.

2.10 KITCHEN EXHAUST DUCTWORK (PRE-FABRICATED)

A. Furnish single-wall, factory built, grease duct for use with Type I kitchen hoods, which conforms to the requirements of NFPA-96. Products shall be ETL listed to UL-1978 and CAN/ULC-S662 for venting air and grease vapors from commercial cooking operations as described in NFPA-96.

B. The duct wall shall be constructed of .036 and .047 thick stainless steel and be available in diameters 8" through 24".

C. All supports, fan adapters, hood connections, fittings and expansion joints required to install grease duct shall be included.

D. Roof penetrations shall comply with listed clearance to combustibles. The grease duct will terminate at the fan adapter plate, will be fully welded to the fan adapter plate and the fan adapter plate will be fastened to the curb using a suitably sized fastener provided by others. See manufacturers installation instructions for more details.

E. Grease duct joints shall be held together by means of formed vee clamps and sealed with 3M Fire Barrier 2000+. Screws used to secure the vee clamps shall be of the hex-head type with

flanged stops and tapered "lead in" threads for easy starting. Nuts shall be retained by means of a free-floating cage to allow easy alignment.

F. Single-Wall Grease Duct shall be installed in accordance with the manufacturer's "Installation, Operation and Maintenance Manual", ETL listing and state and local codes.

G. Grease duct installed outside of the building shall be protected against accidental damage or vandalism.

H. Support vertically installed grease duct from the building structure using rigid structural supports. Anchor supports to the structure by welding or bolting steel expansion anchors or concrete inserts. Support horizontally installed grease duct from the building structure using above method. 1/2" Threaded rod and saddles may also be used for the support of horizontal grease duct.

I. Fans shall be supported independently from the grease duct sections. Protect grease duct from twisting or movement caused by fan torque or vibration.

J. Duct shall slope not less than one-fourth unit vertical in 12 units horizontal toward a grease reservoir. If a grease reservoir is not provided, slope shall be towards the hood.

2.11 KITCHEN EXHAUST DUCTWORK (BLACK IRON)

A. All longitudinal seams shall be continuously welded. Transverse joints made in the shop shall also be made with a continuous weld. Kitchen range exhaust ducts shall be constructed of and supported as follows:
   1. Ducts with a cross-sectional area up to and including 155 square inches shall be No. 16 gauge black iron.
   2. Ducts with a cross-sectional area over 155 square inches but less than 200 square inches shall be No. 14 gauge black iron.
   3. Ducts with a cross-sectional area equal to or greater than 200 square inches shall be No. 12 gauge black iron.

B. Ducts shall be installed without forming dips or traps.

C. Overlapping duct connections of either the telescoping or the bell type shall be used for welded field joints, not butt-weld connections. The inside duct section shall always be uphill of the outside duct section. The difference between inside dimensions of overlapping sections shall not exceed ¼ in. The overlap shall not exceed 2 in.

D. For cleanout access doors requirements see the Ductwork Insulation Section.

E. All elbows shall be radius type with centerline radius to 1-1/4 times the duct width.

F. Locate the ductwork with the minimum clearances to combustible material required by NFPA 96 Chapter 4, Duct systems.

G. Exhaust fans with ductwork connected to both sides shall have access doors for cleaning and inspection within 3 ft of each side of the fan.

H. Openings shall be provided at the sides or at the top of the duct, whichever is more accessible, and at changes of direction.

I. On horizontal ducts at least one 20 in. by 20 in. opening shall be provided for personnel entry. Horizontal ducting shall be secured sufficiently to allow for the weight of personnel entry into the

duct. Where an opening of this size is not possible, openings large enough to permit thorough cleaning shall be provided at 12-ft intervals.

J. Duct shall slope not less than one-fourth unit vertical in 12 units horizontal toward a grease reservoir. If a grease reservoir is not provided, slope shall be towards the hood.

2.12 ALUMINUM DUCTWORK

A. Construct ducts of minimum No. 20 gauge aluminum sheet meeting ASTM B 209, Series 3000 Alloy.

B. Construct ductwork as per “GALVANIZED STEEL RECTANGULAR DUCTS AND FITTINGS” section above unless otherwise noted in this section.

C. At shower room locations, pitch horizontal ductwork minimum ¼ inch per foot such that low point is at shower room.

2.13 STANDARD FLEXIBLE CONNECTIONS

A. Provide fabric flexible duct connections.

B. Fabric shall be UL approved, fire-retardant, closely-woven glass, double coated with neoprene, and a minimum of 4 inches wide.

C. Shall be installed at duct connections to all ceiling hung fans and where vibration will be transmitted through ductwork.

D. Approved Manufacturers:
1. “Ventglas” by Vent Fabrics, Inc.

2.14 HEAVY DUTY FLEXIBLE CONNECTIONS

A. Heavy Duty Flexible Connections shall be used in high pressure (greater than 2 in. w.c.), high temperature (greater than 150 degree F) air applications or where the gas is highly corrosive and the duct connector must be leak proof.

B. Flexible Connectors shall be flanged. If installed outdoors, all metallic components shall be stainless steel construction. Provide flexible connector materials of construction as recommended by the manufacturer for the pressure, temperature, and gas that is being used in air handler system.

C. Approved Manufacturers:
1. Mercer Rubber Company

2.15 FLEXIBLE DUCTS

A. Comply with SMACNA HVAC Flexible Duct Construction Standards and NFPA 90A.

B. Provide where indicated on the Drawings Flexmaster Type TL- M Flexible Metal UL181 Class I Air Duct.

C. The duct shall be constructed of .005" thick 3003-H14 aluminum alloy in accordance with ASTM B209.

D. The duct shall be spiral wound into a tube and spiral corrugated to provide strength and flexibility.

E. The internal working pressure rating shall be at least 10" w.g. positive and 10" w.g. negative with a bursting pressure of at least 2½ time the working pressure.

F. The duct shall be rated for a velocity of at least 5500 feet per minute.

G. The duct must be suitable for continuous operation at a temperature range of -40° F to +250° F.

H. Factory insulate the flexible duct with fiberglass insulation. The R value shall be at least 4.2 at a mean temperature of 75° F.

I. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with crosshatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure A.

J. Install flexible metal duct as per SMACNA HVAC Duct Construction Standards Metal and Flexible (Latest Edition).

K. Flexible ductwork shall only be installed where shown on the Drawings.

2.16 GALVANIZED STEEL ROUND DUCTS AND FITTINGS

A. Construct ducts of galvanized sheet steel meeting ASTM A 653 with G90 coating designation, and in accordance with the latest SMACNA HVAC Duct Construction Standards Metal and Flexible (Latest Edition).and pressure classifications as stated on the Drawings (minimum 2" w.c. pressure classification). When the ductwork pressure classification of these standards is exceeded, construct galvanized steel round exhaust ductwork in accordance with SMACNA Round Industrial Duct Construction Standards.

B. For ductwork through 60 inches in diameter, provide ducts of spiral lock-seam construction.

C. For ductwork over 60 inches in diameter, provide ducts of welded longitudinal seam construction.

D. For ductwork through 36 inches in diameter, use beaded sleeve transverse joints.

E. For ductwork over 36 inches in diameter, use gasketed-flanged Van Stone transverse joints. Gasket shall be “440 Gasket Tape” by Ductmate Industries, Inc.

F. For ductwork under a positive pressure through 96 in. diameter and 10 in. w. g. no reinforcing is required. For ductwork under a negative pressure in exposed areas use duct gauge that will minimize the use of reinforcing as appropriate for the pressures involved.

G. Draw band joints will not be permitted.

H. All elbows shall be constructed with a centerline radius equal to 1.5 times the duct diameter.

I. Provide matching galvanized steel fittings with continuously welded seams and joints.

J. All take-off connections to duct headers shall be made using tee (90 degrees), lateral (45 degrees), tee cross, lateral cross and “Y” branch fittings of the conical type. All fittings fabricated as separate fittings shall have continuous welds along all seams and joints.

K. The use of two-piece mitered, vaned elbows will be permitted only with specific written approval from the Architect/Engineer. Provide turning vanes as per SMACNA HVAC Duct Construction Standards Metal and Flexible.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

A. Install ductwork in accordance with applicable SMACNA Duct Construction Standards Metal And Flexible and approved submittals, and as shown on the Drawings. Duct sizes shown are inside clear dimensions. Where internal duct liners are used, duct sizes shown are inside clear of liner. For ductwork located outside, provide reinforcing sufficient to support wind and snow loads.

B. The Drawings indicate general locations of ducts. Make additional offsets or changes in direction as required at no additional cost to the Owner.

C. Wherever ductwork is divided, maintain the cross-sectional area.

D. Do not exceed 15-degree taper when constructing duct transitions.

E. Close the open ends of ducts during construction to prevent debris and dirt from entering.

F. Secure casings and plenums to curbs according to the requirements of the SMACNA HVAC Duct Construction Standards Metal and Flexible.

G. Make changes in direction with long radius bends.

H. All unused portions of HVAC supply air and exhaust louvers shall be blanked off with Louver Blank Off Panels, see Ductwork Insulation Section.

I. All welded and scratched galvanized steel surfaces shall be touched up with zinc-rich paint.

J. 2 Hr. rated wall penetration: Where small size duct (up to 6 inches x 6 inches) is penetrating a 2 Hr wall the duct shall be constructed of 16 gauge galvanized sheet metal.

K. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

L. Patch and repair all wall penetrations.

M. Insulation: Where Drawings and Specifications indicate that ducts are to be insulated make provisions for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. Metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished to be mounted on duct.

3.02 FITTING INSTALLATION

A. Use minimum of four sheet metal screws per joint.

B. Apply approved sealant on duct-to-duct joint before assembly. Apply additional sealant after assembly to make joint airtight.

3.03 HANGER AND SUPPORT INSTALLATION

A. Support ductwork hung from building structure using trapeze, strap or angle iron hangers conforming to SMACNA HVAC Duct Construction Standards Metal and Flexible. Provide supplemental structural steel to span joists where required.

B. Do not support ductwork from furring, hung ceilings, metal floor deck, metal roof deck or from another duct or pipe.

C. Do not hang lighting fixtures or piping from ductwork.

D. Do not use perforated band iron.

E. Support ductwork at each change in direction.

F. Where duct connects to or terminates at masonry openings or at floors where concrete curbs are not used, provide a continuous 1 ½ inch by 1 ½ inch by 3/16 inch galvanized steel angle support around the ductwork. Bolt and seal the supports to the building construction using expansion bolts and caulking compound. Seal shall be watertight at floor or wall and duct such that a spill will no pass down through the opening.

G. Fasten plenums and casings connected to concrete curbs using continuous 1 ½ inch by 1 ½ inch by ¼ inch galvanized steel angle support. Set the angle support in a continuous bead of caulking compound and anchor it to the curb with 3/8 inch diameter anchors on 16 inch centers. Terminate sheet metal at curb and bolt to angle support. Seal sheet metal to curb with a continuous bead of caulking.

H. For insulated ductwork, install hangers on the outside of the insulation. To maintain the insulation value, inset a piece of 1 inch thick, 6 pcf fiberglass board with a foil/scrim/kraft (FSK) jacket at these supports.

3.04 SEALING

A. Where ductwork is not continuously welded, soldered or gasketed, make seams and joints airtight with sealants.

B. Install the sealants in accordance with the sealant manufacturer’s instructions and recommendations.

C. Seal all ductwork seams, joints, fastener penetrations and fittings connections with sealants in accordance with SMACNA Seal Classifications as required by SMACNA Duct Pressure Classification. All ductwork, regardless of pressure classification, shall have a minimum Seal Class B.

D. Completely fill all voids when liquid sealing ductwork. Several applications may be necessary to fill voids caused by shrinkage or runout of sealant.

3.05 DUCT-MOUNTED DEVICES AND ACCESS DOORS

A. Install all dampers, coils, airflow measuring stations, humidifiers and other duct-mounted devices, specified in other sections of the specifications or as shown and provide transformations to dimensions as required. Install devices in accordance with manufacturer’s recommendations. Install dampers and coils a minimum of 4 feet away from changes indirection or transitions. Allow five (5) equivalent diameters of straight ductwork upstream and one (1) equivalent diameter of straight ductwork downstream of airflow measuring devices.

B. Install access doors in ductwork, plenums and where specified and as shown. Provide access doors for inspection and cleaning automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 18 x 18 inch size for shoulder access and as indicated. Install access doors in the bottom of the ductwork unless they are inaccessible in this location; then install the access doors in either the side or top of the ductwork, whichever is more accessible.

C. Provide fire damper at locations indicated, and where outlets pass through fire rated components and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway, duct connections, corrosion resistant springs, bearings, bushings and hinges.

D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Engineer.

E. Provide flexible connections immediately adjacent to equipment in ducts associated with motorized equipment. Cover connections to medium pressure fans with leaded vinyl sheet, held in place with metal straps.

F. Pilot Ports: Locate pilot ports for measuring airflow in each main supply duct at the downstream end of the straightest run of the main and before the first branch take-off. Form pilot ports by drilling 7/16 inches holes in the duct, lined up perpendicular to airflow on maximum 8-inch centers and at least three to a duct, evenly spaced. Holes to be plugged with plastic plugs. Provide access to these for future rebalancing.

3.06 CONTROL DAMPER INSTALLATION

A. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting. Duct openings shall measure 1/4" larger than damper dimensions and shall be square, straight, and level.

B. Individual damper sections, as well as entire multiple section assemblies, must be completely square and free from racking, twisting, or bending. Measure diagonally from upper corners to opposite lower corners of each damper section. Both dimensions must be equal ±1/8".

C. Follow manufacturer's instructions for field installation of control dampers. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.

D. Install extended shaft or jackshaft per manufacturer's instructions. (Typically, a sticker on the damper face shows recommended extended shaft location. Attach shaft on labeled side of damper to that blade.)

E. Damper blades, axles, and linkage must operate without binding. Before system operation, cycle damper after installation to assure proper operation. On multiple section assemblies, all sections must open and close simultaneously.

F. Provide a visible and accessible indication of damper position on the drive shaft end.

G. Support ductwork in area of damper when required to prevent sagging due to damper weight.

H. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.

I. Dampers that are to be installed with air flow measuring stations shall be installed in duct runs with a minimum amount of straight duct upstream and downstream of the damper to allow accurate flow readings by the air flow measuring station. The Contractor shall verify with the manufacturer the length of straight duct runs required.

3.07 DUCTWORK AND EQUIPMENT LEAK TESTING

A. Leak test each ductwork system within ten working days of ductwork installation and before ductwork is insulated and concealed.

B. All HVAC ductwork shall be tested. Follow general procedures and use apparatus as outlined in the SMACNA HVAC Air Duct Leakage Test Manual.

C. Test all ductwork at 100 percent of the pressure classifications indicated.

D. Air testing during erection shall include separate leakage air tests of air riser, horizontal distribution system, and, after all ductwork is installed and the central stations apparatus is erected, leakage testing of the whole system.

E. Use Appendix C in the SMACNA HVAC Air Duct Leakage Test Manual to determine allowable leakage rates for each duct section tested.

F. All devices, including access doors, airflow measuring devices, sound attenuators, damper casings, sensors, test ports, etc. that are furnished and/or installed in duct systems shall be included as part of the duct system leakage allowance. All joints shall be inspected and checked for audible leakage, repaired, if necessary, and retested. Duct leakage shall be limited to the following:

Average Size of Run Diameter or Equivalent	***A/100 ft. Run**
12 inches or less	10
20 inches or less	15
30 inches or less	25
40 inches or less	30
50 inches or less	30
* (A) = Permissible loss in cfm	

G. Total system leakage shall not exceed 10 percent of the scheduled design capacity of the system when tested as per SMACNA testing methods.

3.08 DUCTWORK AND EQUIPMENT LEAK TESTING - GREASE EXHAUST AND WATER LEAK PROOF DUCTWORK

A. Prior to use, covering or concealment of any ductwork perform a leakage test in the presence of the Owner and Authority Having Jurisdiction.

B. Perform a light test or other approved test to determine that all welded or brazed joints are liquid tight.

C. Light test shall be performed by passing a lamp having a power rating of not less than 100 watts through the entire section of duct to be tested.
   1. The lamp shall be open so as to emit light in all directions.

D. Repair any visible light leakage.

3.09 PAINTING

A. Upon completion of the installation, remove all protecting materials, thoroughly remove all scale and grease and leave in a clean condition for painting. Ductwork to be painted shall be as shown on the Drawings. Painting shall be in accordance with the requirements of the “Painting” Specification Section.

3.10 DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	DUCTWORK MATERIAL
Supply, Outside Air & Exhaust Ductwork	Galvanized Steel
Kitchen Exhaust	Black Iron
Shower Room Exhaust	Aluminum
Ductwork Exposed to Weather	Aluminum

END OF SECTION 233113

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Provide exhaust fans, as specified herein, of sizes and capacities scheduled and in locations shown on drawings.

1.02 REFERENCE CODES AND STANDARDS

A. AMCA 99 - Standards Handbook

B. AMCA 210 - Laboratory Methods of Testing Fans for Rating

C. AMCA 300 - Reverberant Room Method for Sound Testing of Fans

D. ASHRAE Handbook, HVAC Applications Volume “Sound and Vibration Control”

E. UL listed and labeled.

1.03 SUBMITTALS

A. Shop Drawings - Show fan layout, housing, materials, gauges, dimensions, weights and installation details

B. Product data - Manufacturer’s fan performance (data includes cfm, rpm, bhp, motor nameplate data, tip speed, outlet velocity and static pressure) and sound performance (data includes sound power level ratings by octave bands) as tested in accordance with AMCA Standards 210 and 300.

C. Fan performance curves - Submit curves for all fans with system performance shown, and for plus or minus 10 percent and plus or minus 20 percent change in fan rpm. Curves shall include plotted rpm, horsepower, cfm, static pressure, and fan surge line and operating point.

D. Certified AMCA Ratings - Submit ratings for air and sound performance.

E. UL Listing - Submit listing if specified.

1.04 QUALITY ASSURANCE

A. Factory balance each fan statically and dynamically, test run before shipment, and key fan wheel to fan shaft. Fans shall operate quietly and without pulsation or vibration. Conduct sound power level tests for each type fan at the factory in accordance with AMCA 300.

B. Fans shall operate in the stable range of their performance curves.

C. The fan external static pressures shown in the schedules are those required by the ductwork and apparatus, and do not include the internal and intake fan losses, inlet vanes or integral outlet dampers, inlet screens, outlet velocity heads or drive losses.

D. Factory performance test each fan assembled in or as part of apparatus specified to be performance tested. Test shall display scheduled performance characteristics, using certified, calibrated testing instruments provided by the manufacturer of the apparatus.

E. All fan performance ratings shall be based up on factory tests performed in accordance with AMCA 210. One fan of each type specified shall have actual factory performance tests performed prior to shipment. All fans shall be certified by AMCA and carry its seal.

PART 2 - PRODUCTS

2.01 CENTRIFUGAL DOWNBLAST FANS

A. Manufacturer:
   1. Greenheck
   2. Approved Equal

B. General Description:
   1. Downblast fan shall be for roof mounted applications
   2. Performance capabilities up to 14,500 cubic feet per minute (cfm) and static pressure to 2.75 inches of water gauge
   3. Fans are available in twenty sizes with nominal wheel diameters ranging from 8 inches through 30 inches (071 - 300 unit sizes)
   4. Maximum continuous operating temperature is 180 Fahrenheit (82.2 Celsius)
   5. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.

C. Wheel:
   1. Constructed of Composite
   2. Non-overloading, backward inclined centrifugal
   3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
   4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency

D. Motors:
   1. Electronically Commutated Motor
      a. Motor enclosure: TENV
      b. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors
      c. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
      d. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
      e. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
      f. Motor shall be a minimum of 85% efficient at all speeds

E. Housing:
   1. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum
   2. Shroud shall have an integral rolled bead for extra strength
   3. Shroud shall be drawn from a disc and direct air downward
   4. Lower windband shall have a formed edge for added strength
   5. Motor cover shall be drawn from a disc
   6. All housing components shall have final thicknesses equal to or greater then preformed thickness
   7. Curb cap shall have pre-punched mounting holes to ensure correct attachment
   8. Rigid internal support structure
   9. Leak proof

F. Vibration Isolation:
   1. Rubber isolators
   2. Sized to match the weight of each fan

G. Disconnect Switches:
   1. NEMA rated: NEMA 1: indoor application no water. Factory standard.
   2. Positive electrical shut-off
   3. Wired from fan motor to junction box installed within motor compartment

H. Options/Accessories:
   1. Birdscreen:
      a. Material Type: Galvanized
      b. Protects fan discharge

I. Roof Curbs:
   1. Type: GPI - Welded, straight sided curb with 2 inches of flashing flange and wood nailer
   2. Mounted onto roof with fan
   3. Material: N/A
   4. Insulation thickness:
   5. Flashing Flange: 2 inch

J. Dampers:
   1. Type: BD-90, Gravity
   2. Prevents outside air from entering back into the building when fan is off
   3. Balanced for minimal resistance to flow
   4. Galvanized frames with prepunched mounting holes

2.02 DIRECT DRIVE SIDEWALL MOUNTED PROPELLER FAN

A. Manufacturer:
   1. Greenheck
   2. Approved Equal

B. General Description:
   1. Fan arrangement shall be exhaust.
   2. Sidewall mounted applications.
   3. Performance capabilities up to 7,100 cubic feet per minute (cfm) and static pressure to 0.625 inches of water gauge
   4. Fans are available in eight sizes with nominal wheel diameters ranging from 8 inches through 24 inches (8 - 24 unit sizes)
   5. Maximum continuous operating temperature 130 Fahrenheit (54.4 Celsius)
   6. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

C. Wheel:
   1. Propeller shall be aluminum blade riveted to steel hub.
   2. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft.
   3. Statically and dynamically balanced in accordance to AMCA Standard 204-05.
   4. The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency.

D. Motors:
   1. Motor Enclosure: Open drip proof - opening in the frame body and or end brackets

2. Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at the specific voltage and phase.
3. Motor shall be DC electronic commutation type motor (ECM) speciffically designed for fan applications. AC induction type motors are not acceptable.
4. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor.
5. Motor shall be controllable down to 20% of full speed (80% turndown). Speed shall be controlled by a potentiometer dial mounted at the motor.
6. Motor shall be a miniumum of 85% efficient at all speeds.
7. Accessible for maintenance.

E. Drive Frame:
1. Drive frame assemblies and fan panels shall be galvanized steel.
2. Drive frame shall have welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges and a deep formed one piece inlet venturi.

F. Disconnect Switches:
1. NEMA rated: Nema1.
2. Positive electrical shut-off.
3. Wired from fan motor to junction box.

G. Options/Accessories:
1. Dampers:
a. Type: WD-320, 115 VAC.
b. Prevents outside air from entering back into the building when fan is off.
c. Balanced for minimal resistance to flow.
d. Galvanized frames with prepunched mounting holes.

H. Mounting:
1. Fan panel will be mounted vertically directing the air horizontally out of the building. Motors and drives will be accessible from the interior of the building.

2.03 DIRECT DRIVEN BACKWARD INCLINED CENTRIFUGAL INLINE FANS

A. Manufacturer:
1. Greenheck
2. Approved Equal

B. General Description:
1. Base fan performance at standard conditions (density 0.075 Lb/ft3)
2. Performance capabilities up to 5,025 cubic feet per minute (cfm) and static pressure to 2.0 inches of water gauge
3. Fans are available in thirteen sizes with nominal wheel diameters ranging from 8 inches through 16 inches (60 - 160 unit sizes)
4. Normal operating temperature up to 130 Fahrenheit (54.4 Celsius)
5. Applications include: intake, exhaust, return, or make-up air systems
6. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number

C. Wheel:
1. Non-overloading, backward inclined centrifugal wheel
2. Constructed of Aluminum
3. Statically and dynamically balanced in accordance to AMCA Standard 204-05
4. The wheel cone and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency

5. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone

D. Motors:
   1. Electronically Commutated Motor
      a. Motor enclosure: Open drip proof
      b. Motor to be a DC electronic commutation type motor (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors
      c. Motors are permanently lubricated, heavy duty ball bearing type to match with the fan load and pre-wired to the specific voltage and phase
      d. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor
      e. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal
      f. Motor shall be a minimum of 85% efficient at all speeds

E. Housing/Cabinet Construction:
   1. Square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars
   2. Housing and bearing supports shall be constructed of heavy gauge bolted and welded steel construction to prevent vibration and to rigidly support the shaft and bearing assembly.
   3. Galvanized Construction material

F. Housing Suppots and Drive Frame:
   1. Housing supports are constructed of structural steel with formed flanges
   2. Drive frame is welded steel which supports the motor

G. Disconnect Switches:
   1. NEMA rated: NEMA 1: indoor application no water. Factory standard.
   2. Positive electrical shut-off
   3. Wired from fan motor to junction box

H. Duct Collars:
   1. Square design to provide a large discharge area
   2. Inlet and discharge collars provide easy duct connection

I. Access Panels:
   1. Two sided access panels, permit easy access to all internal components
   2. Located perpendicular to the motor mounting panel

J. Options/Accessories:
   1. Dampers:
      a. Type: VCD-23, 115 VAC
      b. Galvanized frames with prepunched mounting holes
      c. Balanced for minimal resistance to flow
   2. Wiring Pigtail:
      a. Direct hook-up to the power supply
      b. Nine foot wiring extension

PART 3 - EXECUTION

3.01 GENERAL

A. Install fans, including all necessary structural supports and bracing as scheduled and located on the contract drawings in accordance with manufacturer's instructions and approved submittals.

B. Connect duct to fans to allow for straight and smooth air flow.

C. Provide flexible connections (minimum of 4") between fan and duct.

D. Install fan level: +/- 5 degrees vertical. Final installation shall be free of all leaks from both fan and associated ductwork.

3.02 START-UP, TESTING, DEMONSTRATION

A. Start-up fans after checkout to insure proper alignment and phased electrical connections.

B. Test fans individually and as part of system.

C. Insure fans are properly interlocked with supply fans and with control system.

D. Demonstrate operation to Owner and instruct maintenance personnel in operation of equipment.

END OF SECTION 233416

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Installation of a magnetic type source capture exhaust removal systems. Refer to plans for quantity of emergency response vehicles served by each system. These specifications outline the scope of work and minimum requirements for the complete installation of a vehicle exhaust removal system for the Mount Kisco Fire District. Any exceptions, no matter how slight, shall note in the bid stating “alternate being proposed”. The bidder shall take full responsibility for any additional costs an alternate system may present. Bidders are required to provide whatever documentation with their bid pertaining to any exceptions taken for the department to evaluate. This information must include the make and model of equipment proposed. It will be used to determine equivalents to the specifications. Failure to provide such documentation may be cause for rejection of bid. The Fire Company reserves the right to accept or reject any or all bids if it is in the best interest of the fire department.

B. The system(s) installed shall be suitable for a total of four (4) apparatus bays. Each bay shall utilize a track system that accommodates vehicles parked in tandem. Refer to drawings for quantity of vehicles parked in tandem at each bay location.

1.02 SECTION INCLUDES

A. Straight track systems.

B. Ductwork.

C. Exhaust fans.

D. Controllers.

1.03 REFERENCES

A. National Fire Protection Association (NFPA)

B. Air Movement and Control Association (AMCA)

C. International Mechanical Code (IMC)

D. American National Standards Institute (ANSI)

E. American Society of Mechanical Engineers (ASME)

F. National Electric Code (NEC)

G. Sheet Metal and Air Conditioning Contractors’ National Association (SMACNA)

H. Underwriters Laboratory (UL)

1.04 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Shop Drawings: Indicate dimensions, sizes, weights and point loadings, locations and sizes of field connections, and details on wall and roof penetrations.

C. Product Data: Provide manufacturers literature and data sheets indicating rated capacities, dimensions, weights and point loadings, accessories, electrical charac-teristics and connection requirements, wiring diagrams, and location and sizes of field connections.

D. Provide fan curves with specified operating point clearly plotted.

E. Submit sound power levels for both fan inlet and outlet at rated capacity.

F. Manufacturer's Installation Instructions: Indicate assembly and installation instructions.

G. Manufacturer’s Warranty.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 017820.

B. Operation and Maintenance Data: Include instructions for fan lubrication, motor and drive replacement, spare parts list, automatic start and automatic disconnect systems, and wiring diagrams.

1.06 QUALITY ASSURANCE

A. Fans
   1. Performance Ratings: Conform to AMCA 210.
   2. Sound Ratings: AMCA 301, tested to AMCA 300 shall not exceed 64 dB at 25 feet radius of unit.
   3. Fabrication: Conform to AMCA 99.

B. All major components shall be ISO 9001 certified.

C. Electrical controllers shall be UL listed.

1.07 WARRANTY

A. The vehicle exhaust system and component parts shall be warranted to be free from defects in material and workmanship for a period of two (2) years. A copy of the equipment manufacturer’s warranty must be submitted with the shop drawings.

B. Contractor/vendor shall provide annual inspection of the system for a period of two (2) years. Copy of the inspection report shall be supplied to the chief of the department and shall include any repairs or adjustments made.

1.08 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.01 TRACK SYSTEM

A. Shall be delivered and installed as a magnetic track system. The system shall be designed for vehicles with under carriage exhaust tailpipe configurations. System shall be capable of handling up to four apparatus per bay in tandem arrangement allowing the operator to attach

the system at the vehicle entrance and reach its designated rest position. The basis of design is as manufactured by Magnegrip or as an equal to the specifications to follow.

B. Operating Logic
   1. The operating logic of this system shall complete the following cycle. Upon the vehicles return to the apparatus floor of the fire station, a 5” dia. exhaust ventilation hose equipped with a magnetically controlled grabber nozzle shall be attached to vehicles exhaust tailpipe at the door opening. The method of securing the system to the vehicle shall be achieved via magnetic cuff. The design shall ensure virtually 100% source capture of the exhaust fumes at the tailpipe. Once the system has been secured to the vehicle’s tailpipe, the exhaust fan shall automatically and instantaneously be energized by the output pressure of exhaust from any motor vehicle to assure total collection of exhaust gases. The vehicle can now be positioned (backed in) in its designated parking position and the hose will follow.
   2. Upon emergency dispatch of the vehicle, the output pressure generated by any internal combustion engine shall again automatically energize the exhaust fan. As the vehicle leaves the apparatus floor, the flexible hose with grabber nozzle shall travel along the track and trolley system with the vehicle as it exits the station. The nozzle shall disconnect automatically and smoothly from the vehicle at a preset distance from the exiting door. The exhaust fan shall continue to run to evacuate the exhaust from the duct system and then shut down automatically.

C. Suction track Profile
   1. Shall be one piece continuous round profile equivalent to 6” round duct, with no splices, extruded profile in a minimum length of 19 feet. Construction shall serve as both a ducting system and trolley transport compartment. Track diameter shall be equivalent to 6” round duct and a minimum gauge thickness 0.175”. The bottom of track profile will have a continuous slot that will accept specially designed rubber sealing lips designed to seal the underside of the track profile under negative suction.

D. Track Material
   1. Shall be aircraft aluminum alloy type AA-06063. track shall be extruded as a one piece unit in a minimum of 19’ lengths.

E. Vertical Support/Bracing
   1. Shall be provided to securely mount entire length of track profile to building structure. Support legs shall be provided for every 10’ of track length. Supports shall be constructed of Aluminum alloy type AA-6063 to provide strength and keep total system weight to a minimum. Leg supports shall be a one piece construction and meet a minimum seismic 4 requirement. All leg supports shall have side bracing constructed from tubular zinc plated steel to provide stabilization of track system. Angle shall be completely adjustable to the leg support and mounted perpendicular to direction of track. Typical support angle shall be 45 degrees from center line of support.

F. Track Splicing Joint
   1. Shall be formed by an extrusion equal to the internal diameter of suction track profile. Splice shall be internally located and cover no less then half the circumference of the track profile. track splicing shall be safely secured by no less than 16 (Qty) 1 1/4" x 3/8" bolts, nuts and lock washers. Each of which shall pass directly through exterior track profile / splicing joint and be secured with internal locking washer and nut. Self tapping bolts/screws shall not be acceptable.

G. Middle track Duct Connection
   1. Shall be rectangular to 6" diameter round transition fitting fabricated from 20 gauge galvanized steel. Rectangular slot shall be 19" long by 1 3/4" high with 3/8 " external flange to slide into track profile.

H. Suction Trolley Assembly
   1. The trolley assembly shall be designed to transport the flexible hose assembly along with the vehicle as it enters and exits the station. The trolley shall be supported internal of the track profile. The trolley shall utilize sealed bearing loaded wheels formed to fit the internal track profile to support the trolley chassis and hose assembly. The trolley chasse shall be aluminum powder coated black finish. The chassis shall be fitted with a tapered cone equal to in size or exceeds in area (sq. inches) the diameter of the exhaust ventilation hose which it is attached to. The trolley assembly shall be equipped with rubber impact bumpers at both front and rear of chassis to eliminate metal to metal contact which would destroy or damage trolley assemblies.

I. Emergency Automatic Disconnect
   1. Shall be provided to enable the vehicle to back off the system through a rear exit door or when it may become necessary to depart from the normal path of exit, in the event of a malfunctioning of the over-head door which commonly allows exit of vehicles from station or if the front line responding vehicle in a series of two, malfunctions impeding the normal exit of the second vehicle.

J. Upper Hose Assembly
   1. The upper hose shall be 5” in diameter and manufactured for the sole purpose of venting high temperature exhaust gases, which are produced by internal combustion engines. Flexible hose shall be rated for 900 degrees (F) continuous, 1050 degrees (F) intermittent temperatures. The outside of the exhaust hose shall have a protective lamination the entire length of the hose to protect fire apparatus in the event vehicle and hose come in contact with each other.

K. Lower Hose Assembly
   1. Shall be a rigid 2 foot long section of hose identical in characteristics to the upper hose assembly. Lower hose shall support connection nozzle and reducing elbow in a rigid fashion as to allow for operator to place hose collection device onto tailpipe without bending. Lower hose is the only section of hose which shall release in the event of safety disconnect.

L. Safety Handle Disconnect Coupling
   1. Incorporated in the design of the system shall be a safety breakaway device enabling a physical disconnect between the exhaust system and the vehicle in the event of system malfunction or human error. The devise shall incorporate a handle for attaching the system to the vehicle without bending over. The coupling shall enable the lower two foot hose assembly to freely rotate 360 degrees. The device shall utilize a quick connect fitting so the lower hose can be snapped back into place without the use of any tools. The quick connect shall allow the lower hose to be manually disconnected and relocated to any other system should the vehicle be relocated. The device shall be reusable and have an adjustable release tension.

M. Hose Suspension Saddle
   1. The hose saddle shall be fabricated of steel with a heat resistant protective paint. The saddle shall support the hose and serve as the stress point during the system release. The design of saddle shall join two sections of hose together at its midpoint intersection and provide a smooth 93 degree transition.

N. Magnetic Nozzle and Transition Elbow
   1. The nozzle attachment shall be designed to mate up with the vehicle tailpipe in such a manor to prevent the operator from having to bend over to attach the nozzle.
   2. The nozzle shall allow a sealed connection to the end of the tailpipe which is to be outfitted with a conical male adaptor designed for mating up with the nozzle. The nozzle shall be

fabricated from zinc plated steel or stainless steel. The nozzle shall have the ability to add or subtract magnets from the nozzle thereby providing an adjustment capability for magnetic hold strength to the tailpipe conical adaptor. The manufacture shall offer the nozzle and tailpipe adaptor in 3", 3.5", 4", 5", & 6", & 7" diameters to accommodate all tailpipe diameters and configurations.

3. To ensure there is no leakage of exhaust, the magnetic connection shall be accomplished in such a manner that there is no gap between the vehicle tailpipe termination point and the nozzle connection to the tailpipe. The earth magnets shall be adjustable and easily removable for replacement. They shall be positioned to hold the nozzle connection to the tailpipe while the vehicle is entering and exiting the station without releasing. The nozzle shall incorporate a debris screen to prevent foreign objects from entering the system and a 67 degree transition to direct the exhaust gasses up the hose. The exterior of the nozzle shall be chrome plate for corrosion resistance and aesthetics.
4. The nozzle attachment shall be designed to mate up with the vehicle tailpipe in such a manor to allow a sealed connection to the end of the tailpipe while also inducing ambient air through a specialized tailpipe adaptor installed on the vehicle. The manufacture shall offer the nozzle and tailpipe adaptor in 3", 3.5", 4", 5", 6", & 7" diameters to accommodate all tailpipe diameters and configurations.

O. Vehicle Tailpipe Configuration
1. Tailpipes shall be at a 90° angle (perpendicular to apparatus) on passenger side of vehicle and shall not extend out any further than the apparatus body. There shall be a minimum clearance of 4" from the top of the pipe to the apparatus body. Tail pipes at a 45° angle of departure shall not be acceptable since exhaust blow back into station after the system release will be uncontrollable. All tailpipes shall be modified by the owner.

P. Safety Features
1. The system shall be designed and capable of capturing virtually 100% of the exhaust gas and particulate at the tailpipe. The system shall note detach itself from the apparatus during power failure.
2. A balancer shall be used to keep the hose off the floor and away from the vehicle. It shall be a self-adjusting weight balancer and provide a constant lifting force without locking in an extended position. Balancer shall have a stainless steel cable for the purpose of retracting the hose away from the vehicle upon release.

2.02 EXHAUST FAN

A. The blower unit shall be a AMCA type B, direct drive spark resistant blower capable of delivering 500 CFM per vehicle. Exhaust fan shall be tested in accordance to AMCA standard # 210 in an AMCA approved test facility.

B. Fan Housing and Impeller
1. The housing shall be of one piece construction fabricated from galvanized steel with epoxy powder coat paint inside and out. The design shall allow the user to remove the fan motor and impeller without removing the inlet or outlet duct connections. The impeller shall be fabricated from aluminum and be designed as a radial blade backward incline type wheel.

C. Fan Motor
1. Shall be UL listed and manufactured by a readily available nationally recognized motor manufacturer and meet EPAC standards.

D. Exhaust Blower
1. Shall provide a minimum of 500 CFM per vehicle at the properly calculated pressure loss of the system design.

E. Motor Type

1. Shall be a totally enclosed fan cooled or ventilated type with a readily available NEMA frame from 5 6 - 145 T.

F. Motor Bearings
   1. Shall be a totally enclosed self lubricated type.

G. Vibration Isolating
   1. Fan shall be manufactured as a complete assembly to assure the least possible vibration or movement. Fan wheel shall be both statically and dynamically balanced.

2.03 DUCTWORK

A. SMACNA class I conveying and must meet or exceed criteria for construction and performance as outlined in Round Industrial Duct Construction Standards for the designed operating pressure.

B. Materials of Construction
   1. Materials of construction, unless otherwise specified, for all duct and fittings shall be minimum G-30 galvanized sheet metal in accordance with ASTM-A525 and A527.

C. Duct Size
   1. All duct subject to positive or negative pressure shall be of round spiral pipe construction, with the range of available sizes not to exceed 14 inches in diameter.

D. Duct Gauge
   1. Duct gauge shall depend on diameter and a minimum operating pressure. Acceptable gauge and reinforcement requirements shall be in accordance with SMACNA guidelines. Bidder shall document their designed operating pressure on their design submission.

E. Duct Length
   1. Duct shall be provided in 10’ continuous lengths wherever possible. Except when interrupted by fittings, round spiral duct section shall not be less than 10 feet long.

F. Exhaust Fittings
   1. All exhaust fittings shall be round and have a wall thickness 2 gauges (one even gauge number) heavier than the lightest allowable gauge of the downstream section of duct to which they are connected. Branch entrances shall be factory fabricated fittings or factory fabricated duct /tap assemblies. Fittings shall be constructed so that air streams converge at angles of 45°.

G. Standard Welded Seams
   1. Standard seam joints shall be continuous welded on all fittings. All welded joints shall be coated with a protective paint, inside and out to prevent damage to galvanized surface.

H. Turning Elbows
   1. Shall be die stamped and used for all diameters and pressures.

I. Tapered Body Fittings
   1. Shall be used wherever particular fallout is anticipated, and where air flow is introduced to the transport duct manifold.

J. Exhaust Joint Construction
   1. All joint connections which are not continuous welded shall be supplied with a transition coupling from the downstream end only. Coupling shall be fully welded and shall provide a fitting size projection to fit inside a downstream fitting or another duct section. Couplings shall have a two inch minimum insertion length and shall be 2 gauge numbers (one even

gauge number) heavier than the duct to which they are connected. This along with a 600 high temperature silicon seal will constitute the primary mechanical seal.

K. Duct Conveying Velocity
   1. Shall be a minimum of 2000 - 3000 feet / minute transport velocity per UMC code. No exceptions.

L. Exhaust Rain Cap
   1. Shall be manufactured in accordance with EPA standard for free draft rain cap requirements. Included as an intricate part of this rain cap shall be a back draft damper to provide protection from rain and other inclement weather.

M. Exhaust Duct Penetration
   1. In all cases when making a wall penetration it should be clearly indicated in the bid drawing and be accomplished via use of a professional core drilling machine if possible. The core drilling shall be properly sized to reduce the diameter to the smallest possible size.

2.04 CONTROLLER

A. Shall be manufactured and delivered as an Operating System Three series controller(s), as manufactured by Magnegrip or as an equal to the specifications to follow.

B. Controller Logic
   1. Shall be designed to sense the output pressure which is normally generated by any internal combustion engine designed to propel any motor vehicle. The operating logic shall be designed to complete this cycle, at any point in time, when a collection device is connected to a motor vehicle's exhaust tail pipe and at which time the vehicle is manually or automatically energized by the operator. The controller shall automatically sense the engine's output pressure and energize the electrical contactors which will provide proper full load amperage to the exhaust system motor. The controller, through the use of a three minute fixed timer, shall keep the contactors energized for the three minute minimum fixed time.

C. Electrical controller shall be UL listed/approved and manufactured in accordance with Underwriters Laboratories standard UL-508 enclosed industrial control panels. The electrical trolley shall include a limited energy control circuit.

D. Electrical Enclosure
   1. Shall be NEMA 12 rated and UL listed as Type 12.

E. Enclosure Keylock
   1. Shall be provided and mounted in electrical enclosure to restrict access to internal components of controller by only authorized entry.

F. Control Transformer
   1. To be UL listed industrial control circuit transformer with primary and secondary fuse blocks. Transformer shall be provided with multitap primary 208V through 480V, AC, and 24V through 120V secondary.

G. Electrical Timer
   1. Shall be solid state, 3 minute fixed timer. Operating logic shall complete this cycle; Input voltage is applied to the timer at all times. Upon closure of a normally open isolated start switch, the load energizes and remains energized as long as the switch is closed. When the start switch opens, the timing cycle starts. At the end of the present time delay, the load de-energizes and the timer is ready for a new timing cycle. Timer shall be UL Recognized component under file number E65038.

H. Engine Start Switch
   1. Start switch shall be engine pressure sensing type capable of recognizing the output pressure of any type of motor vehicle. Electrical contact shall be dry type or not exceed 24V.

I. Push to Stop Button
   1. Shall be illuminated amber contact push button. This device shall meet UL Type 4X rating. Indicator light/start button shall be mounted on the enclosure cover and be identified by engraved ledger plate.

J. Wiring
   1. Wiring shall be run in wire channel to allow for easier identification of wiring circuit and appearance. All wiring circuitry shall meet UL listed for proper bending radiuses and terminations.

K. Terminal Block
   1. Shall be 600 V, UL rated, recognized and shall provide individual connection points for remote controls, power and motor connections.

L. Wiring Identification
   1. Shall be computer generated and identify all terminals, fuses, contactors, on both supply and termination points.

M. Labeling
   1. Shall be provided and secured permanently to the exterior of electrical controller, indicating the manufacturer, their address and telephone number. The cover shall have user instructions and any warnings or cautions required by Underwriter Laboratories.

N. Electrical Wiring Schematic
   1. Wiring schematic shall be provided with each electrical control box supplied. Wiring schematic shall show internal circuitry as well as all primary and secondary connections to the controller. This schematic shall be provided as a “D” print drawing to the department.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer’s instructions.

B. Do not operate fans for any purpose until ductwork is clean, bearings lubricated, and fan has been test run under observation.

C. Install fans with resilient mounting and flexible electrical leads. Fan shall be roof mounted and/or hung from structure above as indicated on the drawings. Exhaust shall discharge at a minimum 3’-0” above roof level.

D. Install flexible connections at fan inlet. Ensure metal bands of connectors are par-allel with minimum one inch (25 mm) flex between ductwork and fan while run-ning.

E. Furnish all labor and material necessary to modify the existing tail pipes to meet the manufacturers specifications. All modifications shall be completed using chromed materials.

F. Provide pitot tube openings where required for testing of systems, complete with metal cap with spring device or screw to ensure against air leakage.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Coordinate placement of roof, wall, and/or floor penetrations.

I. Provide overhead exhaust tracks and/or track systems at the locations shown on the contract drawings. Lengths shall be field verified with the owner to adequately meet the vehicle requirements.

J. All tracks shall terminate within 1’ of their respective overhead doors.

K. All roof work shall be performed by a qualified roofing contractor so as not to avoid any warranties that may exist.

L. A high velocity no loss stack head shall be installed to the output of the blower unit as per the American Conference of Governmental Industrial Hygienists recommended practices.

M. An Inline silencer shall be installed to the output of the Blower Unit to reduce Noise levels.

N. A galvanized steel enclosure with sound absorbing insulation shall be mounted around each fan assembly.

O. All exterior ductwork and enclosure shall be properly prepared and painted to blend into surrounding conditions.

P. All electrical control work as required for a complete and functional system.

Q. All district Vehicles shall be modified to accept the exhaust system.

R. All penetrations through concrete or block walls shall be core drilled.

S. System shall be tested and balanced in accordance with specification section 230594.

T. Inspect system for proper operation at completion of construction.

3.02 OPERATOR TRAINING

A. Shall be provided, one (1) training session per location. A minimum of 48 hours notice shall be required prior to the scheduling of this training session.

END OF SECTION 233418

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PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. This Section describes the air terminals as specified herein, with capacities, distribution patterns and connection sizes as scheduled on the Drawings.

B. Products listed in Part 2 of this Section include:
   1. Grilles and Registers.
   2. Ceiling Diffusers.

1.02 RELATED WORK

A. Section 233113: Sheet Metal Work

1.03 REFERENCES

A. ADC 1062 GRD - Test Code for Grilles, Registers and Diffusers

B. ASHRAE 70 - Method of Testing for Rating the Airflow Performance of Outlets and Inlets.

C. ASHRAE 113 - Method of Testing Room Air Diffusion

D. ASTM C423 - Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

E. ARI 880 - Air Terminals

F. ARI 885 - Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

G. NFPA 90A - Installation of Air Conditioning and Ventilation Systems

H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

I. Mechanical Code of New York State

1.04 QUALITY ASSURANCE

A. Air Terminals will not be accepted until acoustical test results have been submitted and approved.

1.05 SUBMITTALS

A. Product data - Submit catalog cuts and installation instructions for all products specified, including standard color samples.

B. Submit published manufacturer’s performance data for all of the different types of diffusers, registers and grilles, based on testing in accordance with ASHRAE Standard 70, latest edition.

C. Performance data - For each size and type of air terminal , submit the following:
   1. Inlet static pressure in inches w.g.
   2. Maximum and minimum airflow in cfm.
   3. Throw in feet at maximum cfm (and 25 percent of cfm) for terminal velocities of 50 and 100 fpm.

4. Noise Criteria (NC) curve at maximum air terminal cfm rating with blades in full-open and closed positions.

PART 2 - PRODUCTS

2.01 CEILING DIFFUSERS

A. Architectural Ceiling Diffusers:
   1. Furnish and install architectural ceiling diffusers of the sizes and capacities as shown on the Drawings.
   2. Manufacture the diffuser from corrosion-resistant steel or extruded aluminum as indicated on the Drawings.
   3. Construct the units of a stamped outer core and with the inner core having a plaque style face. Construct the face with a double skinned inner face panel with a hemmed edge. Manufacture the inner core assembly to be removable using a spring clip arrangement that permits quick, easy installation and removal.
   4. Manufacture diffusers with trim to allow for with face panel flush with the ceiling line into ceiling grids or for surface mount in other ceiling types.
   5. Provide an opposed blade radial volume damper, with an operating arm to adjust the damper without removing the core. Unit collar height; 1 ¼" in height.
   6. Provide an equalizing grid for field installation for each diffuser.
   7. Manufacturer: Nailor Industries Inc., Model Series UNI or approved equal.
   8. Coordinate color with Owner.

2.02 RETURN GRILLES

A. Furnish and install return grilles of the type and size as shown on the Drawings. Construct the grilles with 45 degree deflection fixed blades and frames that have reinforced mitered corners.

B. Provide an opposed blade damper operable from the face of the grille for grilles connected to ductwork.

C. Manufacture grilles with trim to allow for recessed mounting into ceiling grids or for surface mount in other ceiling types. Provide concealed mounting using concealed mounting straps or concealed screw holes in neck. Countersunk screw holes in the frame face are not acceptable or frame face-mounting screws.

D. Construct the units of extruded aluminum or corrosion resistant steel as shown on the Drawings.

E. Manufacturer: Nailor Industries Inc, Model Series 6145H-O or approved equal.

F. Coordinate color with Owner.

2.03 HEAVY DUTY ALUMINUM RETURN GRILLES

A. Furnish and install heavy duty return grilles of the type and size as shown on the Drawings. Construct the grilles with 0 degree deflection aluminum blades spaced on ½" centers and a heavy duty aluminum welded frame.

B. Provide an opposed blade damper operable from the face of the grille for grilles connected to ductwork.

C. Manufacture grilles with trim to allow for recessed mounting into ceiling grids or for surface mount in other ceiling types. Provide concealed mounting using concealed mounting straps or

concealed screw holes in neck. Countersunk screw holes in the frame face are not acceptable or frame face-mounting screws.

D. Construct the units of extruded aluminum or corrosion resistant steel as shown on the Drawings.

E. Nailor Industries Inc, Model Series 51FH-HD-OA or approved equal.

F. Coordinate color with Owner.

PART 3 - EXECUTION

3.01 DIFFUSER, REGISTER AND GRILLE APPLICATION

A. See the Drawings for types, sizes, materials and installation requirements.

3.02 INSTALLATION

A. Install diffusers, grilles and registers in locations shown on the Drawings.

B. Consult the Drawings for type of ceiling in which the terminals are to be installed and match air outlet edge trim to the requirements of the ceiling type in which they are installed.

C. Install equalizing grids flush with take-off collar connection to supply duct with vanes perpendicular to air flow approaching diffuser.

D. Install in accordance with manufacturer's published recommendations as well as applicable sections of SMACNA manual and as specified above.

E. Install ceiling mounted grilles and registers with the blade deflection facing away from the line of sight.

F. Coordinate with other work, including ductwork and ductwork accessories, as necessary to interface installation of air outlets and inlets with other work

END OF SECTION 233713

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PART 1 - GENERAL

1.01 PROVISIONS

A. Requirements of the General Mechanical Requirements of Division 23 and General Requirements of Division 1 applies to all work under this Section.

B. Throughout the specifications, types of materials may be specified by manufacturer's name and catalogue number in order to establish standards of quality and performance and not for the purpose of limiting competition.

1.02 WORK INCLUDED

A. Provide the following equipment as specified herein and in locations shown on drawings:
   1. Kitchen Hood and its appurtenances.

1.03 RELATED WORK

A. Section 233113: Sheet Metal Work

1.04 REFERENCES

A. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Operations

B. NFPA 17A - Standard for Wet Chemical Extinguishing Systems

C. UL - Underwriters Laboratories, Inc. (UL)

1.05 QUALITY CONTROL

A. The Kitchen Hood shall be constructed as UL listed and UL labeled, and shall bear the National Sanitation Foundation seal of Approval. The Kitchen Hood shall be built in accordance with NFPA # 96, and ASHRAE recommendations. The hood manufacturer shall provide on request, the necessary data that confirms compliance with above mentioned code authorities.

B. The Restaurant Fire Suppression System shall be constructed as UL listed and labeled and shall be constructed in accordance with NFPA # 96 and NFPA #17A.

C. All wiring and electrical equipment shall comply with NFPA 70, NEC.

1.06 SUBMITTALS

A. Submit shop drawings and product data to Engineer. Provide manufacturer’s data of the Hood design for this project. The data for the Hood shall also contain the data for the fire suppression system. Incomplete documents will be rejected.

PART 2 - PRODUCTS

2.01 COOKING EQUIPMENT KITCHEN HOOD

A. Acceptable manufacturers:

B. Econ-Air EX-2 Series with PSP Accessory or approved equal.

C. The exhaust only canopy hood shall be rated for all types of cooking equipment. The hood shall have the size, shape and performance specified on drawings.

D. Construction shall be type 430 stainless steel with a #3 or #4 polish where exposed. Individual component construction shall be determined by the manufacturer and ETL. Construction shall be dependent on the structural application to minimize distortion and other defects. All seams, joints and penetrations of the hood enclosure to the lower outermost perimeter that directs and captures grease-laden vapor and exhaust gases shall have a liquid-tight continuous external weld in accordance with NFPA 96. Hood shall be wall type with a minimum of four connections for hanger rods. Corner hanging angles have a 5/8" x 1-1/2" slot pre-punched at the factory, allowing hanging rods to be used for quick and safe installation.

E. Ventilator shall be furnished with U.L. classified high efficiency stainless steel baffle filters, supplied in size and quantity as required by ventilator. The filters shall extend the full length of the hood and the filler panels shall not be more than 6" in width.

F. The hood manufacturer shall supply complete computer generated submittal drawings including hood sections view(s) and hood plan view(s). These drawings must be available to the engineer, architect and owner for their use in construction, operation and maintenance.

G. Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator.

H. U.L. incandescent light fixtures and globes shall be installed and pre-wired to a junction box. The light fixtures shall be installed with a maximum of 4’0" spacing on center and allow up to a 100 watt standard light bulb.

I. The hood shall have:
   1. A double wall insulated front. The insulation shall have a flexural modulus of 475 EI, meet UL 181 requirements and be in accordance with NFPA 90A and 90B.
   2. An integral front baffle to direct grease laden vapors toward the exhaust filter bank.
   3. A built-in wiring chase provided for outlets and electrical controls on the hood face and shall not penetrate the capture area or require an external chaseway.
   4. Removable grease cup for easy cleaning.

J. The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper", ETL Sanitation Listed and built in accordance with NFPA 96. The hood shall be listed for 600°F cooking surfaces at 200 CFM/ft. The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper".

K. Refer to drawings for additional accessories.

2.02 ANSUL R-102 RESTAURANT FIRE SUPPRESSION SYSTEM

A. The restaurant fire suppression system shall be an automatic fire suppression system using a wet chemical agent for grease related fires.

B. The system shall be pre-engineered in accordance with UL guidelines.

C. The system shall be installed and serviced by personnel trained by the manufacturer.

D. The system shall be capable of protecting cooking appliances by utilizing either dedicated appliance protection and/or overlapping appliance protection.

E. The system shall consist of a regulated release assembly that includes a regulated release mechanism and a wet chemical storage tank housed within a single enclosure. Nozzles,

blow-off caps, detectors, cartridges, agent, fusible links, and pulley elbows shall be provided in the quantities needed for fire suppression system arrangements. Additional equipment shall include remote manual pull station, mechanical and electrical gas valves, pressure switches, and electrical switches for automatic equipment and gas line shut-off.

F. Wet Chemical Agent:
   1. The extinguishing agent shall be an aqueous solution of organic salts with a pH range between 7.8 - 8.2, designed for flame knockdown and foam securement of grease related fires.

G. Agent Tank:
   1. The agent tanks shall be installed in a stainless steel enclosure or wall bracket. The tank shall be constructed of stainless steel. The tank shall include an adaptor/tube assembly containing a burst disc union.

H. Regulated Release Mechanism:
   1. The regulated release mechanism shall be a spring-loaded, mechanical/pneumatic type capable of providing the expellant gas supply to the agent tank(s). It shall contain a factory installed regulator.
   2. It shall have automatic actuation by a fusible link detection system and remote manual actuation by a mechanical pull station.
   3. The regulated release mechanism shall contain a release assembly, regulator, expellant gas hose, and agent storage tank housed in a stainless steel enclosure with cover. The enclosure shall contain knock-outs for conduit. The cover shall contain an opening for a visual status indicator.
   4. The regulated release mechanism shall be compatible with mechanical gas shut-off devices; or, when equipped with a field or factory-installed switch, it shall be compatible with electric gas line or appliance shut-off devices.

I. Regulated Actuator Assembly:
   1. When more than two agent tanks are required, the regulated actuator shall be available to provide expellant gas for additional tanks. It shall be connected to the cartridge receiver outlet of the regulated release mechanism providing simultaneous agent discharge. The regulator actuator assembly shall contain a regulated actuator, regulator, expellant gas hose, and agent tank housed in a stainless steel enclosure with cover. The enclosure shall contain knockouts to permit installation of the expellant gas line.

J. Discharge Nozzles:
   1. Each discharge nozzle shall be tested and listed with the R-102 system for the specific application. Nozzle tips shall be stamped with the flow number designation. Each nozzle shall have a metal or rubber blow-off cap to keep the nozzle tip orifice free of cooking grease build-up.

K. Distribution Piping:
   1. Shall be Schedule 40 black iron, chrome-plated, or stainless steel pipe conforming to ASTM A120, A53, or A106.

L. Detectors:
   1. Shall be the of the fusible link style designed to separate at a specific temperature.

M. Cartridges:
   1. Shall be a sealed steel pressure vessel containing either carbon dioxide or nitrogen gas. The cartridge seal shall be designed to be punctured by the releasing device supplying the required pressure to expel wet chemical agent from the storage tank.

N. Agent Distribution Hose:

1. Kitchen appliances manufactured with or resting on casters (wheels/rollers), which have the Fire Suppression System hard piped, shall include a UL Listed agent distribution hose as a component of the suppression system. Hose assembly shall include a restraining cable kit.

O. Pull Station Assembly:
   1. The Fire Suppression System shall include a remote pull station for manual system actuation. The pull station shall be designed to include a built-in guard for pull handle protection. The pull station shall be red in color.

P. The Ansul system shall be manufactured by Tyco Fire Suppression & Building Products or approved equal.

2.03 KITCHEN HOOD CONTROLS

A. EMS Series control system by CaptiveAire.

B. Controls shall be listed by ETL (UL 508A).

C. The Energy Management System (EMS) shall be capable of saving energy during idle cooking periods. The EMS shall be designed to automatically reduce exhaust and supply airflow quantities while ensuring hood performance is maintained. The EMS shall use high and low speeds that shall be adjusted by variable frequency drives. A temperature switch in the exhaust duct shall control airflow set points and modulate the fans during cooking operation to maximize energy savings. A 100% airflow override button shall be supplied with an adjustable timer.

D. The control interface shall include (1) fan switch, (1) hood light switch, (1) 100% airflow override push button and indicator lights. Indicator lights shall include a "power" light, a "fans on" light, and a "100% airflow override" light. The control interface shall be screen printed on stainless steel and be able to be installed on the face of the hood, face of the utility cabinet, or on the face of the control enclosure.

E. The control enclosure shall be NEMA 1 rated and listed for installation inside of the exhaust hood utility cabinet. The control enclosure may be constructed of stainless steel or painted steel.

F. Variable frequency drives shall allow full adjustment of high speed and low speed airflows for proper kitchen balance. Drives shall contain motor thermal overload protection and control inputs for up to 7 preset speeds. Acceleration and deceleration times shall be fully adjustable as well as fan speed at each of the 7 different inputs. Drives shall also allow for a minimum and maximum frequency set-point. Drives are capable of controlling up to 5 HP each.

G. Adjustable temperature switch shall be mounted in the exhaust hood riser. One sensor shall be installed per exhaust fan. The temperature sensor shall be of the digital Resistance Temperature Detector (RTD) type. Temperature probe shall be constructed of Stainless Steel. Temperature switch shall be factory set at 130°F for 600°F cooking applications and 90°F for 400°F cooking applications. The temperature sensor shall be fully modulating and shall adjust on temperature changes. The riser mounted temperature sensor shall constantly monitor the exhaust air temperature and work in conjunction with a panel mounted temperature controller to modulate the system based on the temperature.

H. The timer shall contain one instantaneous contact and one delayed contact. Time shall be adjustable from .05 seconds to 30 days. Timer is energized with the 100% Airflow Override button. When button is depressed, time starts and fans go to high speed. Upon timeout, fans return to low speed or speed dictated by temperature switch.

I. The EMS shall be provided with a factory pre-wired panel capable of controlling up to four inverter duty motors. The control panel shall be factory pre-wired to shut down the supply fans in a fire condition.

2.04 ROOF MOUNTED, BELT DRIVE, UPBLAST CENTRIFUGAL EXHAUST FAN

A. Spun aluminum centrifugal roof exhausters are engineered to discharge grease laden vapors, fumes and other contaminants vertically away from the building.

B. All models shall be ETL Listed and comply with UL705 (electrical) and UL762 Standards and CSA Std C22.2, No 113. Fan shall bear the AMCA certified ratings seal for sound and air performance.

C. Housing: The fan windband shall be constructed of heavy gauge aluminum and shall be spun on an automatic lathe to provide consistent dimensions. Horizontal and vertical internal supports shall be used to securely fasten the windband to the discharge apron to provide rigidity for hinging and added strength to reduce shipping damage. The discharge apron shall have a rolled bead for added strength.

D. Base: The base shall be constructed of galvanized steel for improved rigidity. Base corners shall be welded to provide strength and support for hinging and cleaning and to prevent leakage into the building.

E. Wheel: The fan wheel shall be centrifugal backward inclined and non-overloading. Wheels shall be balanced in two planes and done in accordance with AMCA standard 204-96, Balance Quality and Vibration Levels for Fans. The wheel blades shall be aerodynamically designed to minimize turbulence, increase efficiency and reduce noise. The wheel blades shall be welded to the wheel inlet cone. In the event that balancing weights are required they shall be riveted to the blades or wheel. The wheel inlet shall overlap the fan base inlet for maximum performance and efficiency. The wheel shall be firmly attached to the motor shaft with two set screws.

F. Motor and motor Compartment: Motors shall be heavy duty ball bearing type, mounted out of the airstream and furnished at the specified voltage, phase and enclosure. Motor mounting plate shall be constructed of heavy gauge galvanized steel and isolated from the fan structure with vibration isolators. The motor compartment shall be cooled by outside air drawn through an extruded aluminum conduit tube. To seal the conduit tube passage and prevent noise silicone rubber grommets shall isolate the conduit tube from the fan housing. The motor compartment shall be of a two-piece construction with the top cap having quick release clips to provide quick and easy access to the motor compartment.

G. Shaft and Bearings: Shafts shall be precision ground and polished. Heavy duty, pre-lubricated bearings shall be selected for a minimum (L50) life in excess of 200,000 hours of operation at maximum cataloged operating speed. They shall be designed for and individually tested specifically for use in air handling applications.

H. Belts and Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be cast type, precision machined and keyed and secured attached to the fan and motor shafts. Drives shall be sized for a minimum of 150% of the installed motor horsepower. Fan operating speed shall be factory set using adjustable pitch motor pulleys.

I. Grease Spout: A grease spout made of aluminum tubing shall be welded to the fan housing. The weld shall be factory tested to ensure it will not leak.

J. Nylon Washers: To provide a tight seal all fasteners in the fan housing shall be backed with nylon washers.

K. Safety Disconnect Switch: A safety disconnect switch shall be standard on all NCA-FA units with open drip proof motors. Switches shall be installed in a NEMA3R enclosure and mounted to exterior of windband for easy access.

L. Provide exhaust fan model EADU85H by Econ-Air.

2.05 FACTORY FABRICATED PACKAGED HEATING MAKE-UP AIR UNITS

A. GENERAL ASSEMBLY
1. Unit(s) shall be factory assembled, tested and shipped as a complete packaged assembly, for indoor or outdoor mounting, consisting of the following specifications, deliver all capacities scheduled, and conform to design indicated herein. Alternate layouts or dimensional changes will not be accepted.

B. CABINET
1. Unit(s) shall be constructed of minimum 20-gauge G-90 galvanized steel riveted together via structural pop-rivets. All metal shall be CNC bent for precise assembly.
   a. Base Construction: The base shall be constructed of galvanized steel for improved rigidity. Base shall be structurally reinforced to accommodate the blower assembly and burner.
   b. Rigging Provisions: The unit shall have a structural base constructed of minimum 14-gauge G-90 galvanized steel, and include lifting points on all four sides.
   c. Roof Construction: Roof shall be pitched to allow for proper drainage.
   d. Exterior Wall Construction: All exterior walls shall consist of insulated galvanized steel construction.
   e. Service Access Doors: All door jambs shall be gasketed around their perimeter. Doors may be mounted via spring actuated, stainless steel hinges with stainless steel rivets, and self-compressing stainless steel pad lockable latches or through removable sliding panels.
   f. Each compartment shall have removable access panels to allow for ease of service and maintainability. Electrical cabinet doors shall be outfitted with manual pouches mounted on the door, along with wiring diagram attached to the indoor from the factory.
2. Entire interior and exterior casing shall be constructed of minimum 20-gauge G-90 galvanized steel with no painting, and shall have undergone a salt spray corrosion test as per ASTM B 117.
3. An observation port shall be located on the exterior of the unit for observation of the main flame and pilot flame. All controls, gas valves, modulating controls and electrical components shall be mounted within the burner vestibule. The burner vestibule shall be an integral part of the unit and not extend outside the exterior casing of the unit and not exposed to the main air stream.
4. When required, entire unit shall be Miami-Dade wind rated up to ±130psf per TAS 201, 202 & 203.

C. AIRFLOW CONFIGURATIONS
1. Unit shall be configurable for up (vertical) discharge through unit.
2. Unit shall be configurable for down (vertical) discharge through unit.
3. Unit shall be configurable for side (horizontal) discharge through the cabinet.
4. 100 percent outdoor air unit - The intake airflow configuration shall be through use of a fresh/outdoor Damper. 80/20 percent outdoor air unit - The intake airflow configuration shall be through use of a fresh/outdoor and return air damper.
   a. Damper: Manufacturer shall provide and install on unit, when possible, a two-position, motor-operated damper with internal end switch to energize the blower-starter circuit, when damper is 80% open. Blades shall be a maximum of 6" wide 16-gauge G-90 galvanized steel and shall be made to guarantee the absence of noticeable vibration

at design air velocities. Damper blades are to be mounted on friction-free synthetic bearings. Damper edges shall have PVC coated polyester fabric mechanically locked into blade edge. Jamb seals used are flexible metal, compression type. Dampers shall exceed AMCA Class 1A standard for low leakage.

b. Insulated Damper: Shall be thermally broken with an insulation R-value = 5.
c. Discharge Diffuser: Shall be constructed of G-90 galvanized steel with horizontal and vertical blades capable of four-way diffusion.
d. Actuator: A single direct drive damper actuator shall be used with spring return to ensure that the outdoor air section opens when not powered.

D. SUPPLY AIR BLOWER AND MOTOR
1. All supply fans shall be:
   a. Direct Drive: Blower assembly shall consist of a centrifugal backward inclined, non-overloading wheel secured directly to a heavy-duty, ball bearing type motor via two set screws. The motor and wheel assembly shall be mounted to a heavy gauge galvanized steel frame. The motor shall be controlled by a variable frequency drive, allowing for variable airflow without the need of belts and pulleys.
   b. Belt Drive: Blower(s) shall be forward-curved, centrifugal, Class I or II (depending on application requirements), double width, double inlet, constructed G-90 galvanized steel. Unit shall have a heavy-duty, solid-steel shaft. Belts shall be oil and heat resistant, non-static, grip-notch type. Drives shall be cast type, precision machined and keyed, and secured attached to the fan and motor shafts. Fan operating speed shall be factory set using adjustable pitch motor pulleys. All drives shall be a minimum of 2 grooves above 2 HP.
2. Blower Motor: Motor shall be a premium efficiency motor available as:
   a. Open Drip Proof (ODP) motor driven by a Variable Frequency Drive.
   b. Totally Enclosed Fan Cooled (TEFC) motor driven by a Variable Frequency Drive.
   c. Electronically Commutated Motor (ECM).
3. Fans to be selected at or near efficiency peak. Check fan curves provided with job.
4. Blower and motor assembly shall be dynamically balanced. The entire blower and motor assembly shall be mounted on rubber vibration isolators. Wheels balanced as per AMCA 204-96; Balance Quality and Vibration Levels for fans.

E. VARIABLE AIR VOLUME
1. VFD Manual - Blower will communicate with VFD. VFD will run at user defined static speed set through HMI.
2. VFD 0-10V - External 0-10V signal will be applied to MUA board for speed reference.
3. VFD Pressure - Differential pressure sensor located on MUA board. Blower will operate on differential set point option.
4. ECM Manual - PWM output signal for ECM. ECM speed set by user through HMI.
5. ECM 0-10V - External 0-10V signal will be applied to MUA board for speed reference.
6. ECM Pressure - Differential pressure sensor located on MUA board. Blower will operate on differential set point option.

F. SHAFTS AND BEARINGS
1. Shafts shall be precision ground and polished. Heavy duty, pre-lubricated bearings designed for, and individually tested, specifically for use in air handling applications.

G. HEATING SYSTEM
1. The gas burner shall be natural gas at an inlet-supply pressure to the unit of 7” w.c. minimum natural gas.
2. The gas burner shall be liquid-propane gas at an inlet-supply pressure to the unit of 11” w.c. minimum LP Gas.

3. Burner design shall be capable of using natural gas. Burner ignition shall be of the direct-spark design with remote flame sensing at the pilot assembly to detect the presence of flame in the burner.
4. Burner design shall be capable of using LP type gas. Burner ignition shall be of the direct-spark design with remote flame sensing at the pilot assembly to detect the presence of flame in the burner.
5. Direct-sparking sequence shall last through the complete duration of the trial for ignition period for guaranteed light-off. Each burner ignition module shall have LED indicators for troubleshooting and a set of exposed prongs for testing flame indication signal.
6. Unit should include self-adjusting burner profile plates, which ensure proper air velocity and pressure drop across the burner for clean combustion. Spring-loaded profile plates should react to the momentum of the fresh air stream. No motors or actuators are needed to drive them, nor should they need to be manually set to a specific position. Units should be capable of variable air volume applications.
7. Each furnace shall have:
    a. The burner shall have non-clogging, stainless steel combustion baffles attached to a ductile aluminum gas-supply section with no moving parts to wear out or fail. The burner shall be capable of 92% combustion efficiency with a maximum turndown ratio of up to 30 to 1.
    b. Stainless steel Quick Seal Connection for gas connection.
    c. Manifold and Input gas pressure gauges.
    d. Inlet pressure gauge installed on the gas manifold (0-15#).
    e. Inlet pressure gauge installed on the gas manifold (0-35” wc).
    f. Inlet pressure gauge installed on the gas manifold (0-5#).
    g. Inlet pressure gauge installed on the gas manifold (-5 to 15” wc).
    h. High gas-pressure switches to disable heating if gas pressure is too high.
    i. Low gas-pressure switch to disable heating if gas pressure is too low.
    j. Proof-of-closure switch to energize the main-burner circuit only if the motorized gas valve is in a closed position.

H. FILTERS
1. Provide filters as part of unit. All filters shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified under another section of this work.
2. The filters shall be 2" thick, aluminum mesh coated with super-filter adhesive, aluminum mesh with polyester foam or pleated throw away. Aluminum-mesh filters shall have aluminum frames with media to be layers of slit and expanded aluminum, varying in pattern to obtain maximum depth loading. Washable 2" filters shall be enclosed in two-piece, die-cut frame with diagonal supports. Frame shall be constructed of heavy-duty beverage board. Filter media is supported on the air leaving side by a metal grid.
3. All filters shall be installed on tracks for easy removal from the unit.
4. Shall be either insulated or non-insulated constructed of G-90 galvanized steel with filters supported by internal slides and with removable access panels.
5. Unit shall have an optional adjustable pressure differential sensor for the filter bank to alert in the event of a clogged filter.

I. ELECTRICAL
1. All controls shall be pre-wired and housed in an insulated electrical cabinet within the unit to protect against risk of condensation.
2. All direct fired and cooling only units shall be provided with single point electrical connection.
3. Unit shall be provided with a door safety switch that de-energizes the supply fan when the door is opened.

4. Units shall be provided with a factory mounted averaging intake air temperature sensor to allow for accurate intake temperature reading regardless of how the OA/RA dampers are positioned.
5. The electrical cabinet shall be outfitted with the following:
    a. LED electrical cabinet service light with automatic activation upon door switch.
    b. Color wiring schematics, laminated to the interior wall of the cabinet doors.
    c. Factory mounted disconnect with unit bottom knockouts.
    d. A LED backlit, LCD Human-Machine Interface (HMI) shall be mounted within the unit's control cabinet to allow for all set points configuration and refrigeration system monitoring at the unit.
    e. Up to 4 additional space mounted HMIs available. Additional HMIs shall allow for full programming capabilities and are outfitted with integral temperature and humidity sensors. Additional HMIs shall be capable of being individually averaged for space temperature/humidity readings. All HMIs shall be wired using standard CAT5/6 cables.

J. CONTROLS
1. Unit shall be outfitted with a control board to allow for full control of the entire unit.
2. Provide onboard air flow switch located on MUA control board to sense air flow.
3. All unit controls shall be compatible with BACnet and LonWorks based building management systems.
4. All units shall be outfitted with CASLink cloud based monitoring, which monitors every point of operation. Provides configurable automated fault alert e-mails, and remote control capabilities.
5. Integrated cellular module to provide remote connection to monitoring services to view both real time and historical unit operation. Data shall be stored a minimum of 3 years on the cloud. Data sample rate shall be a maximum of 60 seconds.
6. Temperature Control System:
    a. Discharge Temp Control (Heating) - Unit modulates the burner flame to accurately maintain the desired discharge temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls.
7. Activation Controls:
    a. Activate Based on Intake (Heating) - Unit will activate heating when the intake temperature drops below the desired set point.
    b. Activate Based on Intake (Cooling) - Unit will activate Cooling when the intake temperature rises above the desired set point.

K. ROOF CURBS
1. Unit shall be factory assembled, and constructed of 18GA galvanized steel.
2. Unit shall be factory assembled, and constructed of 16-gauge galvanized steel.
3. Curb shall be fully insulated with 1" acoustical and thermal insulation.
4. Curb shall be factory outfitted with duct support hangers.

L. VARIABLE FREQUENCY DRIVES
1. Provide Variable Frequency Drive for speed control on all non-ECM direct drive supply fans.
2. All VFDs shall provide the following inherent protections:
    a. Phase protection
    b. Brownout protection
    c. Overload/Overheat protection
    d. Soft starts to protect bearings/hardware
    e. Low & High voltage & over-torque protections

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install kitchen hood in locations shown on drawings.

B. Installation to be in accordance with manufacturer's published recommendations as well as applicable sections of SMACNA manual and as specified above.

C. Provide all steel structural support screws, bolts, nuts, inserts, and material required for installation of the Hood against the wall and for attaching exhaust and supply ducts to the Hood.

D. Install complete fire suppression system for each hood.

E. Provide all interlocks between suppression system, exhaust fans, and make-up air fans. Electrical contractor shall provide all relays between fire suppression system and fire alarm panel.

3.02 EXHAUST FANS

A. Ensure enough clearances are around unit as recommended by the manufacturer and NFPA standard.

B. Connect duct to fans to allow for straight and smooth airflow.

C. Provide hard connection to duct work. The fan shall be connected to the ductwork by flanges securely bolted. Do not use flexible connectors. Connections shall be made as per NFPA 96. Use 1500 deg F rated gaskets.

3.03 INLINE MAKE UP AIR UNIT

A. Ensure enough clearances are around unit as recommended by the manufacturer and NFPA standard.

B. Avoid transitions and turns near the outlet of the fan.

3.04 TESTING

A. Check work for satisfactory installation and performance.

B. Check duct connections for leakage or condensation. Correct any deficiencies.

C. Test the performance of kitchen exhaust system. Adjust dampers for proper direction of air flow. Conduct final test of hood and hood fire suppression system in the presence of the Engineer.

END OF SECTION 233813

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Dual-Channel, Self-Contained Gas Detection System.

B. Remote Horn Strobe Combo.

1.02 SUBMITTALS

A. Submit product data on control panel and sensors including power requirements, wiring diagrams, dimension drawings, installation and operation manuals.

PART 2 - PRODUCTS

2.01 DUAL-CHANNEL, SELF-CONTAINED GAS DETECTION SYSTEM

A. The dual-channel, self-contained gas detection system shall be suitable for the monitoring of Carbon Monoxide (gas engine exhaust) and Nitrogen Dioxide (diesel engine exhaust).

B. Detection system enclosure shall be wall mounted, self-contained, of water/dust tight ABS/PVC construction with hinged, secured door and splash guard.

C. The system shall have two integral electrochemical sensors, one Carbon Monoxide with measurement range of 0-200 ppm Carbon Monoxide in air and one Nitrogen Dioxide with measurement range of 0-10 ppm Nitrogen Dioxide in air. Area of monitoring coverage shall be up to 5,000 to 7,000 square feet per sensor.

D. System power shall be low voltage 24V (nominal) or line voltage 90-240 VAC nominal in the same enclosure. External transformer not required.

E. Any conduit entry into the system enclosure must utilize liquid tight conduit bus.

F. The monitor shall provide an LED indicating light for power, low alarm, high alarm, and fault condition plus channel indication LEDs, one audible alarm and two SPDT dry contact alarm relays, each rated 5A at 240VAC. Monitor enclosure shall have a splash guard attached to the front sensor vent to prevent damage to internal sensors in wash down applications. The system must be accurate enough to measure to government workplace hazardous gas exposure standards. The system shall also provide field adjustable time delays for “delays on make” and “delays on break” for each sensor to allow custom configuration of fan control by the system relays. The gas detector shall have CEF (Calibration Extending Firmware) that takes into account the aging of the CO and NO2 sensors so that less frequent calibrations are required in less-critical applications such as parking garages. Yearly sensor calibration maintenance can be achieved externally through the front door using magnetic access. The Monitor shall be UL tested for electrical safety.

G. The controller shall provide a circuit test button to allow the user to confirm system operation and exhaust fan control from the panel. The controller shall also provide a push-button to allow the user to override the system control and operate exhaust fans continuously for 15-minute segments to evacuate air from specific parts of the parking garage.

H. Provide Model SCC-E-TCO-NO2B-S series by Critical Environment Technologies or approved equal.

2.02 REMOTE HORN STROBE COMBO

A. Provide remote horn strobe combo constructed in a water dust tight high impact polycarbonate housing for every 7,000 square feet of monitored area in high noise environments. Model RSH-24W

B. Siren Output shall be over 100 dB.

C. The remote mount Horn Strobe Combo shall operate on power supplied by the control panel.

D. Provide Model RSH-24W Remote Horn Strobe Combo by Critical Environment Technologies or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the dual-channel gas detection system as indicated in the Drawings. Exact location shall be coordinated in the field. Installation height shall be 4 feet to 6 feet from the floor.

B. Install the Remote Horn Strobe Combo as indicated in the Drawings.

C. The contractor shall provide all wiring, conduit and interconnection required for installation. All wiring shall be done in EMT.

3.02 EXECUTION

A. The system relays shall be normally energized in non-gas-alarm state so they act in fail-safe operation.

B. The digital display shall indicate the real time gas value.

C. Upon detection of 25 ppm Carbon Monoxide in air or 0.7 ppm Nitrogen Dioxide in air, the system shall illuminate the Low alarm LED (amber) and the low gas alarm relay shall de-energize activating the single-speed exhaust fans or low speed of two-speed exhaust fans and open the motorized damper(s) serving the make-up air intake louver(s).

D. Upon detection of 100 ppm Carbon Monoxide in air, or 1.5 ppm Nitrogen Dioxide in air, the system shall illuminate the High alarm LED (red), the system audible alarm shall be activated and the high gas alarm relay shall de-energize activating high speed of two-speed exhaust fans or remote alarm devices. The audible alarm shall be able to be silenced from the front panel push button.

E. In the event of a fail condition, the system audible alarm shall be activated and the fail LED on the front panel shall illuminate red.

END OF SECTION 236002.22

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Outdoor, roof curb mounted, electronically controlled, heating and cooling unit utilizing hermetic scroll compressor(s) with crankcase heaters for cooling duty and gas combustion for heating duty. Units shall discharge supply air vertically or horizontally as shown on contract drawings.

1.02 RELATED SECTIONS

A. Section 233113 - Sheet Metal Work.

B. Division 26.

1.03 SUBMITTALS

A. Shop Drawings: Submit drawings for each size of factory fabricated roof curb.

B. Product Data: Manufacturer's catalog sheets, brochures, performance charts, standard schematic drawings, specifications and installation instructions for each size unit.

C. Contract Closeout Submittals - Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Director's Representative.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Unit shall be factory tested and the design, construction and installation shall be in accordance with the following: ARI Standard 210, NFPA, UL, ASHRAE 15, Safety Code for Mechanical Refrigeration, and all State and Local codes or regulations having jurisdiction.
   2. Unit shall be listed by ETL as a total package.
   3. Unit shall be rated in accordance with AHRI Standard 210/240 and 340/360.
   4. Electrical components shall be UL listed.
   5. Gas heat equipped units shall be designed to conform with ANSI Standard Z21.47, Gas-Fired Central Furnaces.
   6. Roof curb shall be designed to NRCA criteria per Bulletin B-1986.
   7. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.
   8. Unit shall meet ASHRAE 90.1 minimum efficiency requirements.
   9. 3 phase units shall be Energy Star certified.

1.05 PRODUCT DELIVERY

A. Deliver each unit as an integral factory packaged assembly.

B. Unit shall be stored and handled per manufacturer's recommendations.

C. Unit shall only be stored or positioned in the upright position.

1.06 MAINTENANCE

A. Maintenance Service: A fully equipped authorized service organization capable of guaranteeing response within 8 hours to service calls shall be available 24 hours a day, 7 days a week to service the completed Work.

B. Extra Materials: Provide with each unit, one spare set of air filters. Suitable box and label spare filters as to their usage.

PART 2 - PRODUCTS

2.01 GAS HEAT/ELECTRIC COOLING PACKAGED ROOFTOP UNITS

A. General
1. Units shall be manufactured by Carrier or approved equal in an ISO 9001 certified facility. Carrier units are convertible single packages with a common footprint cabinet and common roof curb for all 3 through 12-1/2 ton models. All 6-1/2 through 12-1/2 ton units have two compressors with independent R-410A refrigeration circuits to provide 2 stages of cooling. The units were designed for light commercial applications and can be easily installed on a roof curb, slab, or frame. All units are self-contained and assembled on rigid full perimeter base rails allowing for 3-way forklift access and overhead rigging. Every unit is completely charged with R-410A, wired, piped, and tested at the factory to provide a quick and easy field installation. All units are convertible between side and down airflow. Independent economizer designs are used on side and down discharge applications, as well as all tonnage sizes.

B. Description
1. Units shall be factory assembled, single package, (Gas/ Elect), designed for outdoor installation. They shall have built in field convertible duct connections for down discharge supply/return or horizontal discharge supply/return and be available with factory installed options or field installed accessories. The units shall be factory wired, piped and charged with R-410A refrigerant and factory tested prior to shipment. All unit wiring shall be both numbered and color coded. The cooling performance shall be rated in accordance with DOE and AHRI test procedures. Units shall be CSA certified to ANSI Z21.47 and UL 1995/CAN/CSA No. 236-M90 standards.

C. Unit Cabinet
1. Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 1000 hour salt spray test per ASTM-B117 standards. Indoor blower sections shall be insulated with up to 1” thick insulation coated on the airside. Either aluminum foil faced or elastomeric rubber insulation shall be used in the unit’s compartments and be fastened to prevent insulation from entering the air stream. Cabinet doors shall be hinged with toolless access for easy servicing and maintenance. Full perimeter base rails shall be provided to assure reliable transit of equipment, overhead rigging, fork truck access and proper sealing on roof curb applications. Disposable 2” filters shall be furnished as standard and be accessible through hinged access door. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating bypass of the coils. Condensate pan shall be slide out design, constructed of a non corrosive material, internally sloped and conforming to ASHRAE 62-B9 standards. Condensate connection shall be a minimum of ¾” I.D. female and be rigid mount connection.

D. Outdoor (Condenser) Fan Assembly
1. The outdoor fans shall be of the direct drive type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets and shall be dynamically balanced for smooth operation. The outdoor fan motors shall have permanently lubricated bearings internally protected against overload conditions and staged independently. A cleaning window shall be provided on two sides of the units for coil cleaning.

E. Refrigerant Components

1. Compressors:
   a. Shall be fully hermetic type, direct drive, internally protected with internal high-pressure relief and over temperature protection. The hermetic motor shall be suction gas cooled and have a voltage range of + or - 10% of the unit nameplate voltage.
   b. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.
2. Coils:
   a. Evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed. Special Phenolic coating shall be available as a factory option.
   b. Evaporator coils shall be of the direct expansion, draw-thru design.
   c. Condenser coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed or Micro-Channel aluminum tube, aluminum fins. Special Phenolic coating shall be available as a factory option.
   d. Condenser coils shall be of the draw-thru design.
3. Refrigerant Circuit and Refrigerant Safety Components shall include:
   a. Independent fixed-orifice or thermally operated expansion devices.
   b. Solid core filter drier/strainer to eliminate any moisture or foreign matter.
   c. Accessible service gage connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge.
   d. The 6-1/2 through 12-1/2 ton unit shall have two independent refrigerant circuits, equally split in 50% capacity increments.
4. Unit Controls:
   a. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
   b. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit should any of the following standard safety devices trip and shut off compressor:
      1) Loss-of-charge/Low-pressure switch.
      2) High-pressure switch.
      3) Freeze-protection thermostat, evaporator coil. If any of the above safety devices trip, an LED (light-emitting diode) indicator shall flash a diagnostic code that indicates which safety switch has tripped.
   c. Unit shall incorporate “AUTO RESET” compressor over temperature, over current protection.
   d. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.
   e. Unit control board shall have on-board diagnostics and fault code display.
   f. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to 0 ºF.
   g. Control board shall monitor each refrigerant safety switch independently.
   h. Control board shall retain last 5 fault codes in non-volatile memory, which will not be lost in the event of a power loss.

F. Gas Heating Section
   1. Heat exchanger and exhaust system shall be constructed of aluminized steel and shall be designed with induced draft combustion with post purge logic, energy saving direct spark ignition, and redundant main gas valve. The heat exchanger shall be of the tubular type, constructed of T1-40 aluminized steel for corrosion resistance and allowing minimum mixed air entering temperature of 40 ºF. Burners shall be of the in-shot type, constructed of aluminum-coated steel. All gas piping shall enter the unit cabinet at a single location, through either the side or bottom, without any field modifications. An integrated control

board shall provide timed control of evaporator fan functioning and burner ignition. Heating section shall be provided with the following minimum protection:
   a. Primary and auxiliary high-temperature limit switches.
   b. Induced draft pressure sensor.
   c. Flame proving controls.
   d. All two stage gas units shall have two independent stages of capacity (70% or 75% 1st stage, 100% 2nd stage) 3 through 5 ton and (60% 1st stage, 100% 2nd stage) 6-1/2 through 12-1/2 ton.

G. Unit Operating Characteristics
   1. 1. Unit shall be capable of starting and running at 125 ºF outdoor temperature, exceeding maximum load criteria of AHRI Standard 340/360. The compressor, with standard controls, shall be capable of operation down to 0 ºF outdoor temperature. Unit shall be provided with fan time delay to prevent cold air delivery before heat exchanger warms up. (Gas heat only)

H. Electrical Requirements
   1. All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry to minimize roof penetrations and avoid unit field modifications. Separate side and bottom openings shall be provided for the control wiring.

I. Standard Limited Warranties
   1. Compressor - 5 Years, Heat Exchanger - 10 Years, Stainless Steel Heat Exchanger - 15 Years, Elect. Heat Elem. - 5 Years, Parts - 1 Year.

J. Factory Installed Options:
   1. Hot Gas Reheat - When the RCB detects a need for dehumidification (24VAC) at "HUM" via the field supplied dehumidistat connected to RHTB-1 and RHTB-2, and there is not a call for cooling, it energizes the HGR, which energizes the SOL 3, SOL 2, and de-energizes SOL 1. The unit then operates with circuit #1 in reheat mode and circuit #2 in cooling mode. When the room thermostat calls for first stage cooling while there is still a call for dehumidification, no operational change is made. The call for cooling is ignored and the unit continues to operate with circuit #1 in reheat mode and circuit #2 in cooling mode. When the room thermostat calls for second stage cooling, the RCB senses a signal through "Y1" & "Y2" and de-energizes the HGR, which de-energizes SOL 3 and SOL 2, and energizes SOL 1. Both circuits operate in the cooling mode. Indoor blower operation is initiated upon a call for first stage cooling, second stage cooling or dehumidification.
   2. Electronic Enthalpy Automatic Economizer - Outdoor and return air dampers that are interlocked and positioned by a fully-modulating, spring-return damper actuator. The maximum leakage rate for the outdoor air intake dampers shall not exceed 2% when dampers are fully closed and operating against a pressure differential of 0.5 IWG. A unit-mounted potentiometer shall be provided to adjust the outdoor and return air damper assembly to take in outdoor air to meet the minimum ventilation requirement of the conditioned space during normal operation. During economizer operation, a mixed-air temperature control shall modulate the outdoor and return air damper assembly to prevent the supply air temperature from dropping below 55 ºF. Changeover from compressor to economizer operation shall be provided by an integral electronic enthalpy control that feeds input into the basic module. The outdoor intake opening shall be covered with a rain hood that matches the exterior of the unit. Water eliminator/filters shall be provided. Simultaneous economizer/compressor operation is also possible. Dampers shall fully close on power loss. Available with barometric relief or power exhaust.
   3. Powered Convenience Outlet - Unit is provided with an internally powered 120VAC GFCI outlet with cover on the corner of the unit housing the compressors.
   4. Coil Guard - Designed to prevent condenser coil damage
   5. Breaker - An HACR breaker can be factory installed on gas heat units or cooling units with electric heat

6. Stainless Steel Heat Exchanger - For applications in a corrosive environment, this option provides a full stainless steel heat exchanger assembly.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Roof Curbs:
   1. Install curbs in complete accordance with the manufacturer's printed instructions, and as indicated.
   2. Deliver roof curbs to construction contractor for installation.

B. Air Conditioners:
   1. Install equipment on roof curbs in complete accordance with the manufacturers' printed instructions, and as indicated.
   2. Provide all piping, electrical and ductwork connections to equipment through roof curb openings under units.

3.02 FIELD QUALITY CONTROL

A. Preliminary Requirements: Employ the services of a Company Field Advisor of the rooftop air conditioner manufacturer for the following:
   1. Inspect air conditioner installations prior to start-up.
   2. Supervise initial start-up of machine.
   3. Instruction of State Personnel.
   4. Service.

B. Pre-Start-Up, Start-Up and Instruction: Upon completion of the installation of the air conditioner, to the satisfaction of the Company Field Advisor, start-up and preliminary testing shall be accomplished under the Company Field Advisor's supervision. When all necessary adjustments have been made and air conditioner is properly operating, the Company Field Advisor shall instruct State Personnel in the operation and maintenance of the air conditioner and accessories.

END OF SECTION 238100

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PART 1 - GENERAL

1.01 SYSTEM DESCRIPTION

A. The Air Conditioner or heat pump system shall be a Mitsubishi Electric split system with Variable Speed Inverter Compressor technology. The system shall consist of a horizontal discharge, single phase outdoor unit, a matched capacity indoor section that shall be equipped with a wired wall mounted, and/or wireless wall mounted controller.

1.02 QUALITY ASSURANCE

A. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.

D. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001.

E. A dry air holding charge shall be provided in the indoor section.

F. A pressure charge of R410A refrigerant sufficient for up to twenty-five (25) feet of refrigerant tubing shall be provided in the outdoor condensing unit.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled according to the manufacturer's recommendations.

B. The wireless controller shall be shipped inside the carton with the indoor unit able to withstand 105 degree F storage temperatures and 95% relative humidity without adverse effect.

1.04 WARRANTY

A. The units shall have a manufacturer's parts and defects warranty for a period five (5) year from date of installation. The compressor shall have a warranty of seven (7) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.

B. Manufacturer shall have over 30 years of continuous experience in the U.S. market.

1.05 SUBMITTALS

A. Submit manufacturer's product data including capacity of unit, electrical requirements, airflow, sound pressure data, indoor and outdoor unit measurements, weight, control schematics, and wiring diagrams.

PART 2 - PRODUCTS

2.01 WALL MOUNTED INDOOR UNIT

A. General
   1. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit,

in conjunction with the wired wall-mounted, wireless wall-mounted or wireless handheld controller, shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry air before shipment from the factory.

B. Unit Cabinet
   1. The cabinet shall be formed from high strength molded plastic with smooth finish, flat front panel design with access for filter. Cabinet color shall be white. The unit shall be wall mounted by means of a factory supplied, pre-drilled, mounting plate.

C. Fan
   1. The indoor unit fan shall be high performance, double inlet, forward curve, direct drive type fan with a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of three (3) speeds. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set-point and space temperature.

D. Vane
   1. There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement.

E. Filter
   1. Return air shall be filtered by means of a removable washable filter.

F. Coil
   1. The evaporator coil shall be of nonferrous construction with pre-coated aluminum strake fins on copper tubing. All tube joints shall be brazed. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.
   2. A drain pan level switch, designed to connect to the control board, shall be provided and installed on the condensate pan to prevent condensate from overflowing.
   3. A condensate mini-pump shall be provided to provide a means of condensate disposal.

2.02 OUTDOOR UNIT

A. General
   1. The outdoor unit shall be compatible with the associated indoor unit. The connected indoor unit shall be of the same capacity as the outdoor unit.
   2. The outdoor unit shall be equipped with an electronic control board that interfaces with the indoor unit to perform all necessary operation functions.
   3. The outdoor unit shall be capable of cooling operation down to 0°F ambient temperature without additional low ambient controls. A wind baffle shall be provided with the unit.
   4. The outdoor unit shall be completely factory assembled, piped, wired, and tested.

B. Cabinet
   1. The casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection.
   2. Mounting feet shall be provided and shall be welded to the base of the cabinet and be of sufficient size to afford reliable equipment mount and stability.
   3. Easy access shall be afforded to all serviceable parts by means of removable panel sections.
   4. The fan grill shall be of ABS plastic.

C. Fan

1. Unit shall be furnished with a DC fan motor.
2. The fan motor bearings shall be permanently lubricated.
3. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent external contact with moving parts.

D. Coil
1. The condenser coil shall be of copper tubing with aluminum fins. The coil shall be protected with an integral metal guard.
2. Refrigerant flow from the condenser shall be controlled by means of an electronic linear expansion valve (LEV) metering device. The LEV shall be control by a microprocessor controlled step motor.
3. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1” thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E84 and CAN / ULC S-102.

E. Compressor
1. The compressor for wall mounted units shall be a Frame Compliant Scroll compressor with Variable Speed Inverter Drive Technology. The compressor recessed units shall be a DC twin-rotor rotary compressor with Variable Speed Inverter Drive Technology.
2. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which shall result in significant energy savings.
3. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.
4. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

PART 3 - EXECUTION

3.01 GENERAL

A. Install all equipment, piping, and controls in accordance with manufacturer’s installation instructions.

B. Install refrigerant piping as per manufacturer’s instructions and specification.

C. Mount the outdoor condensing unit on a concrete equipment pad.

D. Support the indoor unit as per the manufacturer’s instructions.

E. Mount the controller. Coordinate exact location with the owner.

F. Install the drain line. Pitch drain line in the direction of flow.

G. Install new filter on indoor unit.

H. Clean all equipment after installation.

END OF SECTION 238126

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. Electric Unit Heaters.

B. Electric Cabinet Unit Heaters.

C. Electric Ceiling Heaters.

D. Electric Wall Heaters.

1.02 REFERENCES

A. Electric unit heaters shall meet the requirements of the National Electric Code (NEC) and shall be UL listed.

1.03 SUBMITTALS

A. Submit under provisions of Section 013300 - SUBMITTALS.

B. Submit manufacturer's product data and installation instructions to Engineer.

C. Submittal data shall include capacity and size of each heater and wiring instructions.

PART 2 - PRODUCTS

2.01 ELECTRIC CEILING HEATERS

A. Ceiling mounted electric automatic fan forced heaters shall be Model CDF as manufactured by QMark or approved equal. The heaters shall be UL listed and be designed for ceiling surface, recess, or T-bar mounting. Refer to equipment schedule for mounting type.

B. Heating Assembly: The heating assembly shall consist of a fan panel upon which is mounted all of the operational parts of the heater.

C. Heating Element: The heating element shall be of the non-glowing design consisting of 80/20 NiCh resistance wire and closed in a steel sheath to which plate fins are copper brazed. It shall be warranted for 5 years.

D. Fan and Fan Motor: The fan shall be five bladed aluminum. The fan motor shall be totally enclosed.

E. Fan Delay Switch: Fan controls hall be of bi-metallic, snap action type and shall activate fan after heating element reaches operating temperature. The fan shall continue to operate after thermostat is satisfied and until the heating element is cool.

F. Thermal Cutout: A thermal cutout shall be built into the system to shut off the heater in the event of overheating.

G. Disconnect Switch: A 3-pole single throw disconnect switch shall be mounted on the back box for positive disconnect or power supply. It will be completely concealed behind the faceplate.

H. Back Box: The back box shall be designed for duty as a recessed rough-in box. The back box shall be 20-gauge galvanized steel and shall contain knockouts through which power leads are brought.

I. Faceplate: The louvered faceplate shall be of 14-gauge cold-rolled steel, phosphatized, then electrostatically painted by a baked enamel process. A 1/4 inch mesh screen shall be installed beneath the faceplate to deter the insertion of foreign objects. The faceplate shall be secured to the heating unit with tamper-resistant screws.

J. Provide other accessories as described on the contract drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install unit in accordance with manufacturer's published installation instructions.

B. Do not install horizontal unit heaters closer than 12 inches to combustible materials in any direction.

C. Do not install vertical unit heaters closer than 18 inches from ceiling and 24 inches horizontally from combustible materials in any direction. The bottom of the unit must be a minimum of 8 feet above the floor.

END OF SECTION 238239

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Unit Heaters.

1.02 RELATED SECTIONS

A. Section 232007 - Piping Specialties

B. Section 232001 - Pipes, Valves and Fittings

C. Section 230993 - Sequence of Operations

D. Section 230594 - Balancing of Systems

1.03 SUBMITTALS

A. Product Data

B. Submit manufacturer's catalog sheets, brochures, performance charts, specifications and installation instructions.

C. Maintenance Data

D. Submit maintenance instructions and spare parts lists. Include this data, product data, shop drawings and schedule in maintenance manuals in accordance with Division 1.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications

B. Firms regularly engaged in manufacture of unit heaters, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Unit heaters shall be shipped from the factory in suitable protective covering. Store unit heaters and components in clean dry place. Protect from weather, fumes, water, construction debris, and physical damage.

PART 2 - PRODUCTS

2.01 UNIT HEATER (HWUH-1)

A. Unit heater shall consist of an enclosed, extended-surface heating element with propeller-type fan, with capacity and electrical characteristics as shown on the drawings. The entire unit and controls shall be UL-labeled. Heater shall be mounted with threaded rod, unless directed otherwise by manufacturer, and be suitable for mounting with horizontal air discharge.

B. Hot Water Coil: Extended surface type, utilizing aluminum fins and DLP-type copper tubes with cast bronze supply and return connections. Coils shall be of serpentine design with horizontal tubes, vertical fins, and center supply and return connections. All tube bends shall be brazed. Tubes shall be mechanically bonded to the collars of the fins. Coils shall be capable of operating at hot water pressures and temperatures of 150 psig and 375 deg F.

C. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard/motor mounting bracket; horizontal models with permanently lubricated sleeve bearings. Aluminum construction secured to a steel hub.

D. Cabinet shall be minimum 20 gauge steel treated to prevent corrosion and painted with a corrosion resistant, high solids gray-green finish. Casing top shall be provided with threaded rod connections for hanger rods, except models to be directly mounted to the supply and return piping as suggested by the manufacturer. Provide horizontal and vertical louvers on the discharge for direction of the air.

2.02 CONTROLS

A. Controls shall consist of a wall-mounted, line voltage thermostat, with protective cover and lock. See section 230993 for sequence of operation.

2.03 ACCESSORIES REQUIRED (PROPELLER TYPE)

A. Accessories required are as follows:
   1. Thermostats as required. Some thermostats will control (multiple) unit heaters. Refer to the contract drawings for the required number of thermostats.
   2. Galvanized Support brackets.

2.04 ACCEPTABLE MANUFACTURERS

A. Unit heater shall be the make and model number shown on the drawings or equivalent products by:
   1. Modine model HSB/HC-63
   2. Approved Equal

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install unit heaters using threaded rod, sized according to unit tappings. Secure to structural support as required.

B. Install the unit heaters in the locations shown on the contract drawings.

C. Make electrical connections for power and controls as required by code. Refer to the Sequence of Operation in Section 230993.

D. Check the unit heater for proper operation, including safety controls.

END OF SECTION 238239.12

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation and backfill for electrical work.

B. Demolition of existing electrical systems.

C. Primary power wiring and distribution system.

D. Secondary power wiring and distribution system.

E. Lighting, including lamps.

F. Wiring devices.

G. Electrical control systems and interlock wiring.

H. Wiring for built-in equipment.

I. Motor Control Centers.

J. Distribution panels and switches.

K. Engine generator system and automatic transfer switch.

L. Sound acoustical generator enclosure.

M. Generator, automatic transfer switch, and generator enclosure substitution procedures.

N. Instrumentation and Controls.

O. Snow Melting System.

1.02 RELATED WORK

A. Foundations and pads required for equipment furnished under this division of specifications.

B. Field painting, except such painting as is required to maintain shop coat painting and factory finish painting.

C. Flashing and sealing of conduits through outside walls.

D. Cutting and patching for electrical work, except for errors and omissions under this Division.

1.03 QUALITY ASSURANCE

A. It is understood that the rights and benefits given the Owner by the guarantees found in the technical specifications are in addition to and not in derogation of any rights or benefits found in the special and general provisions of the contract.

B. Electrical equipment provided under this Division shall be turned over in operating condition. Instruction on further operation and maintenance shall be included in the operating and maintenance instructions.

1.04 REFERENCES

A. Perform work in accordance with standards listed below. Where these specifica-tions are more stringent, they take precedence. In case of conflict, obtain a decision from the Engineer.
   1. NFPA-70: National Electrical Code
   2. NFPA-101: Life Safety Code
   3. New York State Energy Code
   4. IBC New York State
   5. Applicable New York State Administrative Code
   6. Applicable Town Ordinances.
   7. Electric utility rules and regulations.
   8. Telephone utility rules and regulations.

1.05 PERMITS AND FEES

A. The Contractor shall obtain and pay for all permits, construction charges, fees, licenses, certificates, inspections and other use charges required in connection with the work.

B. Such permits include, but are not limited to:
   1. Transportation and disposal of debris.
   2. Temporary Electrical Services and Permanent Electrical Service.
   3. Telephone Service.
   4. Electrical Inspectors, Inc., or a pre-approved electrical inspection agency.
   5. Road opening permits.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. All materials and equipment used in carrying out these specifications shall have UL listing and label. Specifications and drawings indicate name, type, or catalog numbers of materials and equipment to be used as standards. Proposals shall be based on these standards. Contractor may use materials and equipment equivalent to those speci-fied, subject to Engineer's approval.

PART 3 - EXECUTION

3.01 COORDINATION

A. Carefully examine specifications, drawings and project site to be thoroughly familiar with items which require electrical connections and coordination. Electrical drawings are dia-grammatic and shall not be scaled for exact sizes.

B. Notify other Contractors of any deviations or special conditions necessary for the installation of work. Interferences between work of various contractors to be resolved prior to installation. Work installed not in compliance with specifications and drawings and without properly checking and coordinating as specified above shall, if necessary, be removed and properly reinstalled without additional cost to the Owner. Engineer to be mediating authority in all disputes arising on project.

C. Equipment shall be installed in accordance with manufacturer's recommendation. Where conflicts occur between contract documents and these recommendations, a clarification shall be requested of the Engineer for decision before preceding with such work.

D. Insofar as it is possible to determine in advance, advise masonry tradesmen to leave proper chases and openings. Place all outlets, anchors, sleeves, and supports prior to pouring

concrete or installation of masonry work. Should the Contractor neglect doing this, any cutting and/or patching required to be done is at this Contractor's expense.

E. FIRE ALARM – For any facilities that utilize an existing fire alarm system, the contractor shall coordinate with the owner and fire alarm monitoring company prior to removing or disabling any devices. It shall be the contractor's responsibility to provide fire watch as per the latest addition of the IFC of New York State. The contractor shall provide fire watch for all areas of a facility while occupied and unoccupied when any device or part of the fire alarm system is de-activated or put into "test mode".

3.02 CUTTING AND PATCHING

A. Repair or replace routine damage caused by cutting in performance of work under this Division.

B. Correct unnecessary damage caused due to installation of electrical work, brought about through carelessness or lack of coordination.

C. Holes cut through floor slabs to be core drilled with drill designed for this purpose. All openings, sleeves, and holes in slabs to be properly sealed, fire proofed and waterproofed.

D. Repairs to be performed with materials which match existing materials and to be installed in accordance with appropriate sections of these specifications.

3.03 TESTS

A. On completion of work, installation shall be completely operational and entirely free from ground, short circuits, and open circuits. Perform a thorough operational test in presence of the Engineer. Balance all circuits so that feeders to panels are not more than 10% out of balance between phases with all available load energized and operating. Furnish all labor, materials and instruments for above tests.

B. Furnish Engineer with a copy of such tests including identification of each circuit and readings recorded, also the main service ground resistance test as described in Section 260526 of these specifications. Test information to include ampere readings of all panels and major circuit breakers, isolation resistance reading of motors and transformers.

3.04 IDENTIFICATION OF EQUIPMENT

A. Properly identify the following:
   1. Distribution panels.
   2. Disconnect switches.
   3. Transfer switches.
   4. Individually mounted circuit breakers.
   5. Relays.
   6. Pilot lights and control switches.
   7. Service entrance equipment and main circuit breaker.
   8. Generator

B. Use permanently attached black phenolic plates with 1/4-inch white engraved lettering on the face of each, attached with two sheet metal screws.

C. Panelboard identification plates shall indicate panel by name.

3.05 INSTALLATION

A. The Contractor shall carefully move and replace existing equipment, appliances and all related items, as required to conduct proposed work.

B. Install and conduct all work per applicable NEC, State and local codes.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

1.02 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work.

1.03 REGULATORY REQUIREMENTS

A. Conform to applicable code for demolition work, safety of structure and dust con-trol.

B. Obtain required permits from authorities.

C. Notify affected utility companies before starting work and comply with their requirements.

D. Do not close or obstruct egress width to exits.

E. Do not turn off electric equipment without authorization from Owner.

F. Conform to procedures applicable when discovering hazardous or contaminated materials.

G. Obtain a utilities mark-out of all buried underground utilities for telephone, electric, gas, sewer and water, including all customer owned utilities.

1.04 SCHEDULING

A. Schedule Work to coincide with new construction.

PART 2 - PRODUCTS

2.01 NOT USED.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify field circuiting arrangements at Mutual Fire Station.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation. Report discrepancies to the Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing condition.

3.02 PREPARATION

A. Coordinate utility service outages with Utility Company.

B. Provide power, wiring and connections to maintain all existing power, control and telemetry systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction, as indicated on drawings.

B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

D. Repair adjacent construction and finishes damaged during demolition and extension work.

E. Provide caps and filler plates/plugs for all openings in equipment and enclosures after removal of conduits.

F. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.

G. Remove demolished materials from site as work progresses.

H. Completely remove and dispose of all electrical power, control, and telemetry feeds including conduits, conductors, boxes and supports not scheduled to remain after new construction is tested and operational.

I. Where existing devices and equipment are called to be removed, Contractor shall maintain circuit continuity to all existing devices and equipment remaining on that circuit. Contractor shall provide all required conduit, conductors and boxes as required.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Remove temporary work.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wires and cables.

B. In general, the wires and cables included under this Section shall include, but not be limited to, the following:
   1. 600V power and control cable
   2. Instrumentation wires
   3. Communication cables

C. All conductors to be continuous from origin to panel or equipment termination without splices.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electric Code.

B. NECA Standard of Installations.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

1.04 QUALITY ASSURANCE

A. Products used in the work of this Section shall be produced by manufacturers regularly engaged in the manufacturing, installing and servicing of similar items with a history of successful production acceptable to the Engineer as specified herein and in accordance with the General Conditions.

B. Contractor shall submit the following information pertaining to the manufacturer(s):
   1. Complete literature, performance, and technical data describing the proposed equipment and listing of items made by the manufacturer.
   2. Location of closest service office from which this equipment shall be serviced.
   3. Location of closest parts inventory for item installation.

1.05 COORDINATION

A. Coordination:
   1. Coordinate wire and cable required with the equipment being furnished by others for the satisfactory operation of the equipment or system.
   2. Review installation procedures under other sections and contracts and coordinate them with the work specified herein.
   3. Notify other prime contractors in advance of the installation of the work included to provide them with sufficient time for installation and coordination of interrelated items that are included in their contracts and that must be installed in conjunction with the work included in this Section.

1.06 PROJECT CONDITIONS

A. Verify that embedded conduit, in masonry and concrete, is installed as shown on the Drawings prior to the work being enclosed by others.

B. The Contractor shall be present at all concrete pours made by the General Contractor.

C. Conductor sizes are based on copper at 75°C.

D. Wire and cable routing shown on Drawings is approximate unless dimensioned or specifically called for such as where conduit is to be embedded in concrete or masonry. Route wire and cable as required to meet project conditions and shall be routed above ceilings, directly under joists, in pipe trenches, where available, and in masonry. Where exposed conduit is permitted, it shall be run to maximize wall space.

E. Field verify destination location to determine cable routing.

F. Where wire and cable routing is not shown for proposed destination, determine exact routing and lengths required. Routing shall be reviewed with the Engineer.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. Install products in accordance with manufacturer's recommendations.

B. Single copper conductors with 600-volt insulation.

C. Minimum size of feeder conductors and grounds shall be No. 12 AWG.

D. Insulation: No. 12 AWG and No. 10 AWG, provide ANSI/NFPA 70, Type THWN-2.

E. Use solid conductor for feeder and branch circuits, 10 AWG and smaller.

F. All conductors shall include complete set of manufacturer's markings for insulation and conductor size.

G. Manufacturers shall be ANACONDA, TRIANGLE, ROME, or approved equal.

H. Provide white colored neutral conductors; provide black, color coded phase conduc-tors; provide green colored ground conductors.

2.02 4-PAIR CATEGORY 6 UNSHIELDED TWISTED PAIR CABLE

A. Manufacturers: Subject to compliance with project requirements, manufacturers offering Products which may be incorporated in the Work include the following:
   1. Belden Corporation, Carmel, IN (800) 246-2673.
   2. Avaya, Basking Ridge, NJ (800) 344-02232.
   3. Berk-Tek, Incorporated, New Holland, PA (800) 237-5835.
   4. CommScope, Hickory, NC (800) 982-1708.
   5. Draka Comteq, Franklin, MA (888) 541-7100.
   6. General Cable, Highland Heights, KY (800) 424-5666.
   7. Mohawk/CDT Leominster, MA (978) 537 9961.
   8. NORDX/CDT, Worcester, MA (800) 331-0779.
   9. Superior Essex, Atlanta, GA. (800) 685-4887.
   10. Tyco Electronics, Harrisburg, PA (800) 522-6752.

B. Conductors: 4 twisted pair - 24 AWG, solid copper w/ RJ-45 connector ends
   1. Individually insulated plenum rated conductors under common plenum rated sheath unless entire cable is installed within conduit/EMT or if area where cable is installed is not considered a return air plenum according to any applicable codes.

2. Complies with individual characteristics established in ANSI/TIA/EIA-568-B, and all addendums for Category 6E cable performance specification.
3. Overall Nominal Diameter: .365 x .165 in.
4. Nominal Impedance: 100 ohms plus or minus 15 percent.
5. Certified capable of performing to minimum 350 MHz.

C. Mechanical Characteristics
1. Operating temperature: -20°C to +80°C
2. Bulk cable weight: 29 lbs./1000 ft.
3. Maximum recommended pulling tension: 45 lbs.
4. Minimum bend radius: 1 in.

D. Flame test: UL1666 Riser

E. Electrical Characteristics:
1. Nom. Mutual Capacitance @ 1 KHz 15.0 pF/ft
2. Maximum Capacitance Unbalance (pF/100 m) 49.2 pF/100 m
3. Nominal Velocity of Propagation 70 %
4. Maximum Delay (ns/100 m) 510 @ 100MHz ns/100 m
5. Maximum Delay Skew (ns/100m) 25 ns/100 m
6. Maximum Conductor DC Resistance @ 20 Deg. C 9 Ohms/100 m
7. Maximum DCR Unbalance @ 20 Deg. C 3 %
8. Max. Operating Voltage - UL 300 V RMS

2.03 MECHANICAL CONNECTORS

A. Conductor tapping connectors shall be BURNDY Servit split bolt, Series KS and KS3, or approved equal.

B. Split bolt connectors shall use BURNDY Type SC Servit cover on indoor applica-tions.

C. Terminal lugs shall be BURNDY Universal Terminal Series. Terminal lugs shall be sized for proper ampacity and proper number of conductor holes. Each conductor shall occupy only one hole on a terminal lug.

D. Conductor tapping connectors for multiple conductors shall be BURNDY Series V-Tap with V-Tap covers, and V-Blok mounting platforms.

2.04 BELOW GRADE EXTERIOR SPLICES

A. Manufacturer: 3M or approved equal

B. Model: 72-N series for inline splices

C. Model: 90-B1 for WYE splices

D. Splices shall be weatherproof, made with epoxy resin UL listed for dierect burial.

E. For use with all exterior pull boxes and hand holes where splices are made.

F. Provide all connectors and crimp couplings as required.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Make terminations in accordance with cable manufacturers instructions for the particular type of wire and cable.
   2. Splices are not allowed in the underground duct and manhole systems. If splices are required, the Contractor shall obtain approval in writing from the Engineer prior to splicing.
   3. All splices shall be in made in terminal boxes.

B. Wire and Cable Sizes: The sizes of wire and cable shall be as shown on the Contract Drawings, or if not shown, as approved by the Engineer. Minimum size wire shall be No. 12 AWG for all power, lighting and receptacle circuits. Wires for control circuits shall be No. 14 AWG minimum. Wire for instrumentation circuits shall not be smaller than No. 16 AWG. If due to field routing the voltage drop exceeds 2.5%, the size of conductors shall be increased such that 2.5% is the maximum voltage drop incurred.

C. Number of Wires: The number of wires indicated on the Contract Drawings for the various control, indications, and metering circuits were determined for general schemes of control and for particular indication and metering systems. Coordinate wiring schemes with equipment schematics.

D. Wiring Identification: All wiring shall have a unique wire number and be labeled at both ends. Wire numbers shall correspond with the equipment terminal wire numbers. Where no wire numbers are indicated, the Contractor shall assign wire numbers. Wire numbers shall not be duplicated.

E. Cable Identification Tags: The Contractor shall furnish all labor and materials and affix in a permanent way to each cable in manholes, cable compartments and vaults, junction boxes, pull boxes and points of termination, a laminated plastic tag, bearing clearly printed, the cable number indicated on the Contract Drawings or some other approved identification number or symbol. All cables shall be temporarily tagged with its full ID number immediately after it has been pulled.

F. Wiring Supplies: Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used. Friction tape shall be in accordance with ASTM D69.

G. Training of Cable: Furnish all labor and material required to train cables around cable vaults within buildings and in manholes in any outdoor underground duct system. Sufficient length of cable shall be provided in each manhole and vault so that the cable can be trained and racked in an approved manner. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation.

H. Connections at Control Panels, Limit Switches and Similar Devices:
   1. Where stranded wires are terminated at panels, and/or devices connections shall be made by solderless lug, crimp type ferrule or solder dipped.
   2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make 7-strand, No. 12 AWG, wire terminations impractical, the Contractor shall terminate external circuits in an adjacent junction box of proper size and shall install No. 14 AWG stranded wires to the junction box in a conduit.

I. Pulling Temperature: Cable shall not be flexed or pulled when the temperature of the insulation or of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature within a three day period prior to pulling of 40°F or lower, cable reels shall be stored during the three day period prior to pulling in a protected storage with an ambient temperature not lower than 55 degrees F and pulling shall be completed during the work day for which the cable is removed from the protected storage.

J. Color Coding:
1. Conductor jacket shall be color coded as follows:

AC POWER

208Y/120 Volt, 3f
Phase A - Blue
Phase B - Black
Phase C - Red
Neutral - White
Ground - Green

2. DC Power
   a. Positive Lead - RED
   b. Negative Lead - BLACK
3. Instrumentation Signal
   a. Pairs - Black and White
   b. Triads - Black, Red and White
4. Equipment Ground - GREEN

K. Instrumentation Cable Installation:
1. Where instrumentation cables are installed in panels, etc., arrange wiring to provide maximum clearance between cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.
2. Grounding of cable shield shall be accomplished at one point only, unless otherwise required by instrumentation systems manufacturer.
3. Special instrument cable shall be as specified or recommended by the vendor of the equipment or instruments requiring such wiring. Installation, storage, terminations, etc., shall be per manufacturer's recommendations.

3.02 IDENTIFICATION

A. Identify wire and cable under provisions of Section 260553.

B. Identify each conductor with its circuit number.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014523.

B. Inspect wire and cable for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Field Testing:

1. Wires and cables shall be tested before being connected to motors, devices or terminal blocks.
2. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.
3. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment.

E. Continuity Tests: All cables, wires and shields shall be tested for continuity. Testing for continuity shall be by test light or buzzer.

F. Insulation-Resistance Tests:
1. 600V power and control cables and wires shall be tested for their insulation-resistance values. Test shall utilize a megohmeter with applied voltage to be 1000VDC for one (1) minute. Insulation-resistance test shall be performed on each conductor with all other conductors grounded. The resistance value shall be 20 megohms or greater.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Grounding electrodes and conductors.

B. Equipment grounding conductors.

C. Bonding.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electric Code.

1.03 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Ground clamps: OZ ELECTRICAL MANUFACTURING COMPANY, Type "CG", or equal by STEEL CITY or APPLETON.

B. Raceways, conductors, outlet boxes, pull and junction boxes to be furnished in accordance with applicable sections of these specifications.

C. Rod Electrode: Copper, 3/4-inch diameter, 10 feet long.

D. Wire: Copper, sized to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:
   1. Clean all conductive surfaces on equipment to be grounded, to assure good electrical continuity.
   2. Effectively bond all grounding conductors to grounding rod electrodes, equipment enclosures and ground busses.
   3. Locate all grounding attachments away from areas subject to physical damage. Provide protective covering as required.
   4. Install service entrance building ground as per NEC and Con Edison requirements.
   5. Service entrance shall be bonded to street side of first flange or coupling of incoming main water line with heavy duty ground clamp. Bonding conductor to be sized in accordance with NFPA 70.
   6. Building steel shall be bonded to ground bus on main service with a conductor the same size as in B.1 below.
   7. Install new service grounds and grounding systems for new service as per Con Edison and NEC requirements.
   8. Generators shall have a dedicated grounding system for a separately derived system for switching neutrals.

B. Feeder/Branch Circuits:
   1. All circuits shall have a separate green grounding conductor in conduit sized in accordance with NFPA 70. Minimum size of conductor shall be No. 12 AWG.
   2. Flexible conduit will not be approved as achieving continuity of ground. All flexible conduit to have a jumper wire sized to ampacity of branch breaker and to be connected to conduit system on both ends; this applies to fixtures, motors, controls, etc.

3.02 TEST

A. Test ground on main service. Ground system resistance shall be no greater than 10 ohms using test equipment similar to a "Biddle" test. Test data to be submitted to the Engineer for approval and such approved test data to become a part of the Record Documents.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. System of supporting devices and hangers for support or bracing for conduit, electrical equipment, safety switches, fixtures, panelboards, outlet boxes, junction boxes and cabinets.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electric Code.

1.03 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.01 EQUIPMENT REQUIREMENTS

A. Provide appropriate corrosion-resistant supporting devices and hangers for electrical equipment, as manufactured by ERICO PRODUCTS, INC., CADDY FASTENERS, STEEL CITY, MINERALLAC or equivalent.
   1. "Z" purlin clips.
   2. Conduit clips.
   3. Beam clamps (universal and vertical flange).
   4. Beam clamps (set screw type).
   5. Combination push-in conduit clips.
   6. Combination conduit hanger clamps.
   7. Flexible conduit clips.
   8. Special combination conduit clips.
   9. One hole steel straps.
   10. Conduit hangers.

B. Provide materials, sizes and types of anchors, fasteners and supports to carry the loads of equipment, wire in conduit and conduit.

2.02 CHANNEL SUPPORT SYSTEM

A. Channel systems and supports shall be manufactured by KINDORF/THOMAS & BETTS, or approved equal.

B. Channels shall be 1-1/2" x 1-1/2".

C. Channels and all associated accessories and bolts shall be hot dipped galvanized.

D. Channels shall have 9/16" bolt holes on 1-1/2" centers.

E. Provide end caps for all channels.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Secure conduits to within 3 feet of each outlet box, junction box, cabinet, fitting, etc., and at intervals not to exceed 10 feet in accordance with currently effective edition of the National Electric Code.

B. In seismic zones, support conduits 1 inch and smaller at 6 foot intervals.

C. Install clamps secured to structure for feeder and other conduits routed against structure. Use drop rods and hangers to support conduits run apart from the structure.

D. Provide and install suitable angle iron, channel iron or steel metal framing with accessories to support or brace electrical equipment including safety switches, fixtures, panelboards, etc.

E. Paint all supporting metal not otherwise protected, with rust inhibiting primer and then with a finish coat if appropriate to match the surrounding metal surfaces. Prepainted or galvanized support material is not required to be painted or repainted.

F. Do not use chains, perforated iron, baling wire or tie wire for supporting conduit runs. Use of clips to support conduit to top of t-bar ceiling grid will not be permit-ted.

G. Obtain permission from Engineer before drilling or cutting structural members.

H. Install surface mounted cabinets and panelboards with a minimum of four anchors.

I. Do not fasten supports to pipes, ducts, mechanical equipment and conduit.

J. Install products in accordance with manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Conduit system with associated couplings, connectors and fittings. Conduits to be mechanically and electrically continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes.
   1. Conduit Use - Rigid Galvanized Conduit:
      a. All exterior above grade circuits.
   2. Conduit Use - PVC Sch. 80
      a. All exterior below grade circuits.
      b. Transition to RGC shall be made below grade for all conduit extending above grade.
   3. Conduit Use - Electrical Metallic Tubing (EMT) Conduit:
      a. All interior above grade circuits.
   4. Conduit Use - Metal Clad (MC) Cable:
      a. All 15 and 20 amp branch circuits concealed in walls or ceilings.
   5. Conduit Use - Flexible Liquid-tight Metal Conduit:
      a. Connecting motors, generators and other equipment subject to vibration, maximum length - 3 feet.
      b. Passing through building expansion joints.
   6. Surface mounted raceway (Wiremold)
      a. For use in finished areas on block walls and plaster walls, only.
      b. Wiremold shall not be permitted in any area on the first floor of the building.
      c. Wiremold shall be permitted in the following spaces, only: KITCHEN R204, MEETING HALL R205 (as required), MEMBER'S ROOM R206 (as required)
   7. J-Hooks
      a. For use above finished ceilings for telephone, PA, CAT 6 data and fire alarm cable only.

B. Device Boxes: Provide each fixture switch, receptacle and other wiring device with a box of appropriate size and depth for its particular location use unless indicated otherwise.

C. Pull boxes, junction boxes and wire troughs

1.02 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

B. ANSI/NFPA 70 - National Electric Code.

C. NECA Standard of Installation.

D. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

E. NEMA TC 3 - PVC Fittings for use with Rigid PVC conduit and tubing.

F. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

G. ANSI/NEMA OS1 - Sheet-steel outlet boxes, device boxes, covers and box supports.

H. NEMA 250 - Enclosures for electrical equipment (1000 volts maximum).

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc.

B. Conform to requirements of ANSI/NFPA 70.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 017839.

B. Accurately record actual routing of all conduits.

1.06 FIELD SAMPLES

A. Provide under provisions of Section 014523.

B. Provide field sample of conduit two each at 2 feet in length.

C. Provide field sample of expansion/deflection fitting, two each.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products in accordance with manufacturers' recommendations.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing abovegrade. Provide appropriate covering.

1.08 PROJECT CONDITIONS

A. Verify all conduit routings by field measurements.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system. Provide all required sweeps, boxes and fittings.

PART 2 - PRODUCTS

2.01 RIGID GALVANIZED CONDUIT

A. Rigid conduit shall be hot dipped, galvanized, or electro-galvanized steel by Wheatland, Triangle, Republic or approved equal.

B. Associated couplings, connectors and fittings shall be as manufactured by THOMAS & BETTS CORP., O.Z. GEDNEY CO., EFCOR or approved equal. Catalog numbers used below are those of THOMAS & BETTS CORP. based on 3/4-inch size and are consid-ered standards by which equivalents are to be judged.

C. ERICKSON couplings, Series 676 or approved equal, shall be used where neither length of conduit can be rotated.

D. Conduit connectors shall be threaded type. Set screw and compression type connections ARE NOT acceptable.

E. Sealing fitting locknuts shall be Series 142SL.

F. Steel or malleable iron insulated bullet hub, Series 370-379, complete with sealing "O" ring. DO NOT use "die cast" material.

G. Entrance ells shall be Series 1491 or approved equal.

H. Combination coupling shall be Series 531 for connecting rigid galvanized conduit to electrical metallic tubing.

2.02 PVC CONDUIT

A. PVC conduit shall be manufactured by WHEATLAND, TRIANGLE REPUBLIC or approved equal.

B. Description: NEMA TC 2; Schedule 80 PVC.

C. Fittings and Conduit Bodies: NEMA TC3.

2.03 ELECTRICAL METALLIC TUBING (EMT)

A. Electrical metallic tubing shall be WHEATLAND, TRIANGLE, REPUBLIC, or approved equal.

B. Associated couplings, connectors and fittings shall be as manufactured by THOMAS & BETTS CORP., O.Z. GEDNEY CO., EFCOR, or approved equal. Catalog numbers used below are those of THOMAS & BETTS CORP. based on 3/4-inch size and are considered standards by which equivalents are to be judged.

C. EMT connectors shall be TC-2125C compression type with threaded locknut. Set screw connectors will not be acceptable.

D. EMT couplings shall be TK-2125C compression type. Set screw connectors will not be acceptable.

2.04 METAL CLAD CABLE (MC)

A. Metal clad cable shall be manufactured by BICCGENERAL or approved equal.

B. Associated couplings, connectors and fittings shall be as manufactured by THOMAS & BETTS CORP., O.Z. GEDNEY CO., EFCOR or approved equal.

C. Conductors shall be types THHN and THWN. Ground wire shall be sized as per NEC with green THHN/THWN insulation. All conductors shall be cabled and wrapped in polyester tape. All conductors shall be rated for 600 VAC.

D. Armor material shall be Aluminum Interlocked Armor.

2.05 SURFACE MOUNTED RACEWAY (WIREMOLD)

A. Manufacturer: Wire Mold shall be manufactured by LEGRAND or approved equal.

B. Model: 700 Series - One-Piece Steel Surface Raceway.

C. Paint wire mold to match existing wall color.

D. UL5 and ADA compliant.

E. UL and cUL Listed.

2.06 DUCT SEAL

A. RectorSeal or approved equal.

B. Model #: 81881

2.07 J-HOOKS

A. For use above finished ceilings for telephone, PA, CAT 6 data and fire alarm cable only. All exposed telephone, PA, CAT 6 data and fire alarm cable shall be in conduit.

B. Erico Caddy HP J. Hook Series or approved equal.

C. Provide wire retainers for all.

D. Provide mounting hardware and accessories as required.

E. Spacing of J-Hooks and supports shall not exceed 5’-0” on center.

2.08 FLEXIBLE LIQUID-TIGHT METAL CONDUITS AND FITTINGS

A. Liquid-tight flexible metal conduit shall be ANACONDA or approved equal.

B. Description: Interlocked steel construction with PVC jacket.

C. Provide flexible liquid-tight conduits and fittings as manufactured by THOMAS & BETTS CORP., O.Z. GEDNEY CO. or approved equal. Catalog numbers used below are those of the THOMAS & BETTS CORP., based on 3/4" size and are to be considered as standards by which equivalents are to be judged. All conduit shall be liquid-tight flexible type, UL type UA, or suitable for exposure to continuous or intermittent moisture.

D. Flexible liquid-tight connectors shall be Series 5333 or approved equal.

2.09 OUTLET AND DEVICE BOXES

A. Acceptable Manufacturers: Raco, General Electric or approved equal.

B. Sheet Metal Outlet Boxes - All concealed boxes shall be NEMA OSI, galvanized steel:
   1. Luminare and Equipment Supporting Boxes: Rated for weight of equipment supported. Provide 1/2" male fixture stubs where required.

C. Concrete Ceiling Boxes: Concrete type.

D. Cast Boxes: All exposed surface mounted boxes shall be NEMA FB1, Type FD, cast feralloy. Provide gasketed cover by box manufacturer.

2.10 PULL BOXES

A. Hand Hole
   1. Manufacturer shall be Quazite or approved equal.
   2. Provide Tier 22 traffic loaded pull boxes and Tier 22 loaded covers. Covers shall have logo "LIGHTING".
   3. Hand Hole Model Number: PG1118BG18.

a. Hand Hole shall have two (2) mouseholes and shall have an open botton.
b. Hand Hole shall be gasketed.

4. Cover Model Number: PG1118HH0029
   a. Cover shall be gasketed.
   b. Cover shall be bolted.
5. Minimum dimensions shall be 11"W x 18"L x 18"D.
6. Grout around all conduits entering/exiting the hand hole.
7. Hand Holes shall not be installed in roadways where they may be subject to vehicular traffic.
8. Site plan shows minimum required Hand Holes. Provide and install additional Hand Holes as required by NEC and utility requirements.

B. Pull Boxes
1. All pull boxes used for this project shall be minimum B-36 style or specifically approved equal for all customer installed power and control circuits, unless specifically noted as "hand hole". Manufacturer shall be Coastal Pipeline or approved equal. All pull boxes shall be approved by Con Edison.
2. Provide AASHTO HS20-44 Highway Loading rated pull box and cover. Cover shall have logo "ELECTRIC". Manufacturer shall be B+R Cast Iron Products, Inc. or approved equal. Model #: Q-8-7 or approved equal.
3. Minimum dimensions shall be 42"W x 33"L x 36"D.
4. Grout around all conduits entering/exiting the pull box.
5. Site plan shows minimum required Pull Boxes. Provide and install additional Pull Boxes as required by NEC and utility requirements.

2.11 JUNCTION BOXES

A. Acceptable Manufacturers: RACO, GENERAL ELECTRIC or approved equal.

B. Sheet metal boxes: NEMA OS1, galvanized steel.

C. Covers: Galvanized steel.

2.12 WIRE TROUGH

A. Wireways shall be manufactured by Square D, Class 5100, General purpose or approved equal.

B. Wireway shall be completely enclosed with removable covers.

C. Construction: 16 Gauge Galvanized Steel. 8-inch and 12-inch wire trough shall be 14-gauge galvanized steel.

D. Finish: ANSI-49 epoxy paint applied by cathodic electro-deposition paint process over a corrosion resistant phosphate preparation.

E. UL listed.

2.13 EXTERIOR WIRE TROUGH

A. Wireways shall be manufactured by SQUARE D, Class 526, rain tight.

B. Wireway shall be completely enclosed with removable covers.

C. Construction: Wireway shall be constructed of Type 304 stainless and shall have stainless steel screw clamps, and oil resistant gaskets.

D. All hardware, bolts, brackets, and supports shall be constructed of Type 304 stainless steel.

2.14 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT THREAD COMPOUND

A. KOPR-SHIELD or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUITS

A. Minimum size of conduits shall be 3/4-inch.

B. Minimum conduit depth shall be 24" below grade, measured to the top of the conduit on exterior underground installations.

C. Conduit joints shall be cut square, threaded, reamed smooth, and drawn up tight so con-duit ends will butt in couplings, connectors and fittings.

D. All threaded conduits and fittings shall have KOPR-SHIELD compound applied to all threads prior to assembly.

E. Make bends or offsets with standard ells or field bends with an approved bender.

F. Run concealed conduits in direct line with long sweep bends or offsets. Run exposed conduits parallel to and at right angles to building lines. Group multiple conduit runs in banks.

G. Secure conduits to all boxes and cabinets with double locknuts and bushings so system will be electrically continuous from service to all outlets.

H. Install conduit in accordance with NECA Standard of Installation.

I. Cap ends of conduits to prevent entrance of water and other foreign material during construction.

J. Complete all conduit systems before pulling conductors.

K. Support conduits under provisions of Section 260529.

L. Provide approved expansion joints or fittings and bonding jumpers where conduits in concrete pass through building expansion joints.

M. Provide cable supports in conduits rising vertically in accordance with the National Electric Code, Article 300-19.

N. Provide No. 12 AWG copper pull wires or nylon cord in all empty conduits. Steel wire not acceptable as pull wire.

O. Install conduit to preserve fire resistance rating of partitions and other elements.

P. Ground and bond conduit under provisions of Section 260526.

Q. Where neither length of conduit can be rotated, ERICKSON couplings Series 676 shall be used.

R. In areas where enclosed and gasketed fixtures and weatherproof devices are specified, where rigid conduit enters a sheet metal enclosure, junction box and outlet box, and not terminated in

a threaded hub, a steel, or malleable iron nylon insulated bullet hub, com-plete with recessed sealing "O" ring, shall be used, Series 370-379 . DO NOT use die cast material.

S. In concrete slabs block up conduit from forms and securely fasten in place. All conduits in slabs shall be installed below concrete slab.

T. Where conduits running overhead pass through building expansion joints, install flexible liquid tight conduit of same size with sufficient slack to allow conduits on either side of expansion joint to move a minimum of 3-inches in any direction. Pro-vide supports as required on each side of expansion joint, all in accordance with seismic requirements of specific area.

U. Failure to route conduit through building without interfering with other equipment and construction shall not constitute a reason for an extra charge. Equipment, conduit and fixtures shall fit into available spaces in building and shall not be introduced into building at such times and manner as to cause damage to structure. Equipment requiring servicing shall be readily accessible.

V. Arrange supports to prevent misalignment during wiring installation.

W. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

X. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

Y. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

Z. Do not attach conduit to ceiling support wires.

AA. Arrange conduit to maintain headroom and present neat appearance.

AB. Route exposed conduit parallel and perpendicular to walls.

AC. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

AD. Route conduit in and under slab from point-to-point.

AE. Do not cross conduits in slab.

AF. Maintain adequate clearance between conduit and piping.

AG. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104°F (40°C).

AH. Bring conduit to shoulder of fittings; fasten securely.

AI. Use conduit hubs with sealing locknuts to fasten conduit in damp and wet locations.

AJ. Install no more than equivalent of three 90-degree bends on interior locations between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2-inch size.

AK. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

AL. Do not use dissimilar strap or clamp supports. Provide dielectric tape, fittings, straps, and bushings where dissimilar metals are used.

AM. Where fittings for liquid-tight flexible conduit are brought into an enclosure with a knockout, a gasket assembly, consisting of one piece "O" ring, with a Buna-R seal-ing material, Series 5200, shall be installed on outside of box. Fittings shall be made of either steel or malleable iron only, and shall have insulated throats or insulated bushings.

AN. A copper ground wire sized in accordance with NEC shall be installed on the inside of the conduit as a jumper around flexible conduit to assure a continuity of ground.

AO. Install a copper jumper across all flexible conduit including lighting fixtures, controls and other utilization equipment.

AP. Install liquid-tight flexible conduit in such a manner as to prevent liquids from running on surface toward fittings.

AQ. Allow sufficient slack conduit to reduce the effect of vibration.

AR. Complete all conduit systems before pulling the conductors.

AS. Support in accordance with requirements of National Electric Code.

3.02 INSTALLATION OF BOXES

A. Install boxes concealed in finished walls.

B. Locate boxes to prevent moisture from entering or accumulating within them.

C. Support boxes independently of conduit, as required by the National Electric Code.

D. Provide 4" x 1-1/2" octagonal, 4" x 1-1/2" square or 4" x 2-1/8" square ceiling outlet boxes.

E. Where required to hang a specific fixture, provide a fixture stud of the no-bolt, self-locking type on ceiling outlets.

F. Provide 2-1/2" x 3-3/4" one gang masonry boxes for switches and receptacles installed concealed in concrete block walls. For increased cubic capacity, provide 3-1/2" x 3-3/4" one gang masonry boxes. Where more than two conduits enter the box from one direction, provide 4" square boxes with square cut device covers not less than 1" deep specifically designed for this purpose. Use round edge plaster rings only if the block walls are to be plastered. Use sectional or gang-type outlet boxes only in drywall construction.

G. Provide 4-11/16" square outlet boxes with square cut device corners for block walls or round edge plaster rings for plastered walls for telephone outlets. Single gang device boxes are not acceptable.

H. Provide fittings with threaded hubs for screw connections and with the proper type covers for switches and receptacles served by exposed conduit. Use pressed steel outlet only for ceiling fixture outlets.

I. Provide condulets with threaded hubs and covers and with proper configurations for all changes of direction of exposed conduits. Standard conduit ells may be used if they do not interfere or damage or mar the appearance of the installation.

J. Use boxes of sufficient cubic capacity to accommodate the number of conductors to be installed, in accordance with the National Electric Code.

K. Effectively close unused openings in boxes with metal plugs or plates.

L. Set boxes so that front edges are flush with finished surfaces.

M. Support boxes from structural members with approved braces.

N. Install blank device plates on outlet boxes left for future use.

O. Provide bushings in holes through which cords or conductors pass.

P. Install boxes so that the covers will be accessible at all times.

Q. Electrical boxes may be installed in vertical fire resistive assemblies classified as fire/smoke and smoke partitions without affecting the fire classification, provided such openings occur on one side only in each framing space and that openings do not exceed 16 square inches. All clearance between such boxes and the gypsum board shall be completely filled with joint compound or approved fire-resistive compound. The wall shall be built around outlet boxes larger than 16 square inches so as not to interfere with the wall rating.

3.03 INSTALLATION OF PULL BOXES, JUNCTION BOXES AND WIRE TROUGHS

A. Provide junction boxes as shown on Drawings and otherwise where required, sized according to number of conductors in box or type of service to be provided. Minimum junction box size 4-inch square and 2-1/8 inches deep. Provide screw covers for junction boxes.

B. Install boxes in conduit runs wherever necessary to avoid long runs or too many bends. Do not exceed 100-foot runs without pull boxes. Install pull boxes at all 90-degree bends.

C. Rigidly secure boxes to walls or ceilings. Conduit runs will not be considered adequate support.

D. Install boxes with covers in accessible locations. Size boxes in accordance with the National Electric Code.

E. Do not install pull boxes or junction boxes for joint use of line voltage and signal or low voltage controls unless all conductors are insulated for the highest voltage being used in the same box.

F. Coordinate installation of exterior pull boxes with General contractor to establish elevations of finished grades and pavements. All castings shall have chimney adjustment of + 6”.

3.04 CONDUIT LOCATIONS

A. Route all conduit concealed in walls or above finished ceilings. Provide boxes and conduits concealed in walls for all power and controls.

B. Surface mounted conduits will only be allowed on existing block walls on first floor where conduit runs cannot be concealed. Surface mounted conduits shall only be permitted for vertical runs. All horizontal runs shall be installed above finished ceilings where finished ceilings exist.

C. Surface mounted raceway (wiremold) conduit will only be allowed on finished block walls or on plaster walls, as detailed in Section 1.01 of this Specification. All horizontal runs shall be installed above finished ceilings, where drop ceilings are located.

D. All conduit and wiremold shall be primed and painted to match existing adjacent wall color.

E. J-Hooks are only permitted to be used above finished ceilings for telephone, PA, CAT 6 data and fire alarm cable.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Nameplates and labels.

B. Wire and cable markers.

C. Conduit markers.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

1.03 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Product Data: Provide catalog data for nameplates, labels and markers.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Underwriters Laboratories, Inc. Include instructions for storage, han-dling, protection, examination, preparation and installation of product.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.01 NAMEPLATES AND LABELS

A. Nameplates: Engraved three-layer laminated plastic, white letters on black background.

B. Locations:
1. Distribution panelboards.
2. Transfer Switches.
3. Generator Enclosure.

C. Letter Size:
1. Use 1/4 inch (6 mm) letters for identifying all control pilot lights.

D. Labels: Embossed adhesive tape, with 3/16” (5mm) white letters on black background. Use for identifying existing equipment, distribution panels, switchboards, disconnect switches, and individual electrical devices.

2.02 WIRE MARKERS

A. Manufacturers:
1. 3M ELECTRICAL SPECIALTY DIV., Product Scotch Code.
2. THOMAS & BETTS CORP., Product E-Z Code.
3. Substitutions shall be permitted only after receiving written approval from the Engineer.

B. Description: Epoxy film tape type wire markers.

C. Locations: Each conductor at panelboards, auxiliary gutters, pull boxes, outlet and junction boxes, circuit breakers and each load connection.

D. Legend:
   1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
   2. Control Circuits: Control wire number indicated on interconnection diagrams on drawings.

2.03 CONDUIT MARKERS

A. Manufacturers:
   1. THOMAS & BETTS CORP.
   2. Substitutions shall be permitted only after receiving written approval from the Engineer.

B. Description: Self-sticking vinyl; black letters on orange background.

C. Location: Furnish markers for each conduit longer than 6 feet (1.8 m).

D. Spacing: 20 feet (6 m) on center.

2.04 UNDERGROUND WARNING TAPE

A. Manufacturers:
   1. THOMAS & BETTS CORP., Model NAF-0700.
   2. Substitutions shall be permitted only after receiving written approval from the Engineer.

B. Description: 6 inch (150 mm) wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

PART 3 - EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.02 APPLICATION

A. Install nameplate and label parallel to equipment lines.

B. Secure nameplate to equipment front using screws, rivets or adhesive.

C. Secure nameplate to inside surface of door on panelboard that is recessed in fin-ished locations.

D. Apply conduit markers at 20 foot (6 m) intervals.

E. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches (75 mm) below finished grade.

3.03 ELECTRICAL EQUIPMENT IDENTIFICATION

A. The Contractor shall identify all existing circuits in existing distribution panels, switchboards and disconnect switches to remain.

B. Label all circuits identifying the load served including all individual circuit breakers.

C. Label all new circuit breakers and switches used for new feeder and branch circuits.

D. Contractor shall furnish a minimum of 5 custom engrave three-layer laminated plastic labels with up to 20 words per label as directed by the engineer/owner in addition to the required labels for all pilot devices, switches, controls and timers.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surge protection device.

1.02 RELATED SECTIONS

1.03 STANDARDS

A. The specified suppressor shall be designed, manufactured, tested and installed in compliance with:
   1. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.11, C62.41 and C62.45).
   2. Federal Information Processing Standards Publication 94 (FIP PUB 94).
   3. National Electrical Manufacturer Association (NEMA LS-1).
   4. National Fire Protection Association (NFPA 20, 70, 75 and 78).
   5. Underwriters Laboratories (UL 1449).
   6. CAN/C22.2 No. 8-M1986; CSA Electrical Certification Notice No. 516.
   7. The system individual units shall be UL listed under UL 1449 Standard for Transient Voltage Surge Suppressions (TVSS) and the surge ratings shall be permanently affixed to the TVSS.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. MCG ELECTRONICS, INC., Deer Park, New York.

B. Approved equal.

2.02 MANUFACTURED UNITS

A. Surge suppression shall be series Surge Free Model No. 160M-120Y.

2.03 SYSTEM REQUIREMENTS

A. The specified surge protective device shall provide effective high energy surge diversion for application ANSI/IEEE C62.41-1991 Location Category C3 environments. Testing per ANSI/IEEE C62.45-1992 using ANSI/IEEE C62.41 Category C3 waveforms and amplitudes. UL 1449 listing. The specified surge protective device shall provide:
   1. 160,000 transient amps, per phase of surge protection.
   2. Peak surge current ratings must be independently tested and verified.
   3. All mode protection, L-N, L-G, L-L, N-G.
   4. Integral disconnect with safety dead front.
   5. Each MOV protected from over-current, thermal overload and monitored individually.
   6. Self diagnostics with comprehensive LED bar graph on front panel showing the exact % level of protection available.
   7. Audible fault alarm with silence switch.
   8. Event counter, indication of time and date of last event (battery backup for time and date).
   9. Remote alarm relay contacts (surge protected), Form C.
   10. Micro-Z low impedance installation cable.
   11. Twenty year warranty on entire system.
   12. LIFETIME “NO NONSENSE” WARRANTY ON FIELD REPLACEABLE POWER MODULES AND FUSES.

B. Environmental Requirements:
   1. Magnetic Fields: Connection shall be made using low impedance Micro-Z cabling provided with the suppressor for maximum magnetic field cancellation. Unit shall be shunt-installed with no series connected elements.
   2. Operating Temperature: Operating temperature range shall be -40° to +71° C (-40° to +160° F).
   3. Storage Temperature: Storage temperature range shall be -40° to +185° F.
   4. Relative Humidity: Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.
   5. Operating Altitude: The system shall be capable of operation up to an altitude of 13,000 feet above sea level.
   6. Operating Voltage: Maximum continuous operating voltage shall be no less than 115% and no greater than 140% of the nominal rated line voltage.
   7. Power Frequency: The power frequency range shall be 47 to 63 Hertz.

C. Electrical Requirements:
   1. Unit Operating Voltage Requirements:

Voltage:	Description:	Joules (8/20us):	Vpeak L-N (20kV, 10kA):	Vpeak L-N (8/20us):
120/208 VAC	3phase, 4W + gnd, wye	10,300	800V	704V

   2. Unit shall be installed in parallel with the protected equipment. No series connected protective elements shall be used.
   3. The maximum surge current capacity per phase of the specified system, based on the standard IEEE 8/20 microsecond waveform, shall be at least: 1 Event at 160 kA. The surge life (8/20us) shall be at least 10,000 @ 6 kA occurrences. The transient suppression capability shall be bi-directional and suppress both positive and negative impulses.
   4. The suppressor shall be capable of interrupting a 100 kA, short circuit current delivered from the AC power line. The interrupt capability must be confirmed and documented by a recognized independent testing laboratory.
   5. The suppressor shall be designed so as to minimize the internal surge path impedance. Direct point-to-point internal wiring is inherently inductive and not acceptable. Connection to the power service shall be constructed for best performance.
   6. Equipment shall be as manufactured by MCG Electronics, Inc.: Model: 160M-Family or engineering department approved equal with supporting test data.

D. Protection System Components:
   1. Replaceable modules: The suppressor shall be constructed using field replaceable protection modules. The suppressor shall have individually fused and monitored 40mm Metal Oxide Varistors (MOV's), including neutral to ground protection mode. Each module will provide five times (5X) redundant protection, with three modules per each phase and five fuses per module. The status of each module shall be locally monitored with a green LED that becomes red in a fault condition. The transient peak rating of the fuse shall be coordinated with the Ipeak handling capability of the MOV so that the surge path capability is not limited by the series fusing. In addition, each MOV shall incorporate a thermal disconnect means to remove a shorted MOV safely from the protection system.
   2. Self-Diagnostics: Red, green and yellow solid state LED indicators shall be provided on the hinged front cover to indicate protection status. An illuminated green LED indicates power is present at the protector on all phases, and an illuminated red LED shall indicate that one or more of the modules have reduced protection. An illuminated yellow LED shall

indicate a suppression event. Both front panel and internal LEDs are required to provide power and fault indications in the event of even the loss of a single fuse or MOV. Relay operation shall be in a fail-safe operating mode (i.e., continuously energized so that power failure, reduced protection, or a break in the remote monitoring line will cause a fault indication at the remote monitor).

3. Remote Alarm Capability: Relay alarm contacts shall be provided for remote alarm monitoring capability of unit status. Form C normally open and normally closed contacts shall be provided with voltage and current limiting protection.
4. Audible Alarm: The specified system shall be equipped with an audible alarm which shall be activated when any one or more of the modules has a reduced protection condition. A mute option shall be provided for the audible alarm.
5. Advanced Diagnostic LED Display: A front panel, microprocessor controlled LED display, in the form of a bar graph, will indicate the protection status of each MOV on each phase including neutral to ground. A event counter will display number of suppressed transient events with a time and date stamp.
6. Integral Disconnect: Unit shall be provided with dead front disconnect to remove power from protector for maintenance access. The disconnect should not be accessed from the front panel unless the unit meets the minimum clamp voltage requirements.
7. NEMA 12 Enclosure: 14 gauge steel, with stainless steel hardware.

PART 3 - EXECUTION

3.01 INSTALLATION AND MAINTENANCE

A. The unit shall be factory installed in the motor control center by the Motor Control Center manufacturer, in accordance with the manufacturer’s printed instruction to maintain warranty. All local and national codes must be observed.

B. Units shall be installed as close as possible to the load side lugs of the transfer switch to which it is connected using low impedance Micro-Z cabling.

C. A 3-pole disconnect shall be provided to insure safety of maintenance personnel.

3.02 TWENTY YEAR WARRANTY

A. Manufacturer to provide twenty (20) year warranty to cover repair or replacement with a new device. Manufacturer to provide no cost replacement of fused protection modules for the life of the suppressor.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Distribution panel boards.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electric Code.

B. NECA Standard of Installation.

C. NEMA AB1 - Molded Case Circuit Breakers.

D. NEMA PB1 - Panel Boards.

E. NEMA PB1.1 - Instructions for Safe Installation, Operation and Maintenance of Panel Boards Rated 600 Volts or Less.

F. NEMA ICS2 - Industrial Control Devices, Controllers and Assemblies.

G. NEMA KS1 - Enclosed Switches.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

B. Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, and circuit breaker arrangement and sizes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. New Panelboards
   1. Panel Boards shall be manufactured by Siemens.
   2. Approved equal.

2.02 PANELBOARD REQUIREMENTS

A. Provide panel boards of circuit breaker, dead-front safety type, UL labeled, and meeting all applicable requirements of the National Electrical Manufacturers Association.

B. Provide panel boards with lugs (both main lugs and branch circuit lugs) suitable and UL approved for both aluminum and copper conductors.

C. Provide electrically isolated neutral bars.

D. Provide separate ground bars complete with lugs or connectors on bar.

E. Provide key operated door and door lock. Door shall prevent access to operate circuit breakers.

F. Provide panel boards with sequence phased bus bars or distributed phase bussing for voltage and phase as indicated on drawings.

G. Refer to drawings for numbers of branch circuits, their ratings, number of poles, arrangements, etc.

H. Provide typed circuit directory cards.

I. Provide front filler plates for unused breaker knockouts.

J. Refer to drawings for Ratings and Features.

K. All bus bars, including ground bars shall be tin-plated copper.

L. All circuit breakers shall be bolt-on type.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Ground separate ground bars to panel boxes and to the main service entrance ground bus with a code-sized grounding conductor installed in the same conduit as the phase and neutral conductors under provisions of Section 260526.

B. Install all circuits using a common neutral bus bay in accordance with the National Electric Code. Balance all circuits to achieve not greater than 7% unbalanced neutral current in panel feeders.

C. Provide six circuit breaker handle lock-on devices for each lighting and miscellaneous power panel board for installation by the contractor on circuits as directed by the Engineer to prevent unauthorized personnel from turning off circuits to controls, unit heaters, autodial alarm system, etc. Provide spare lock-on devices over to the Engineer.

D. Install panel boards in accordance with NEMA PB 1.1.

E. Install panel boards plumb.

F. Height: 6 feet (2 m) to top of panel board.

G. Provide typed circuit directory for each branch circuit panel board. Handwritten circuit directory cards will not be accepted. Revise directory to reflect circuiting changes required to balance phase loads.

H. Provide a typed circuit directory in accordance with NEC sections 110.22 and 408.4. Circuits shall be labeled with detailed information describing the switches function and equipment location.

I. For all existing circuits terminated to a new panelboard, contractor shall trace out and update the circuit directory in accordance with NEC sections 110.22 and 408.4. Include all costs for this work in base bid.

J. Revise directory to reflect circuiting changes required to balance phase loads.

K. Provide engraved plastic nameplates under the provisions of Section 260553.

L. Panel Boards shall be factory installed in the motor control center by the manufacturer of Motor Control Center where indicated on drawings.

3.02 FIELD QUALITY CONTROL

A. Maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Switches,timers, receptacles, device plates and other wiring devices as indicated on Drawings.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electric Code.

B. NEMA WD1 - General Purpose Wiring Devices.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

B. Provide manufacturer's catalog information showing dimensions, colors and configu-ration.

1.04 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.01 SWITCHES

A. Manufacturers: HUBBELL, BRYANT, GENERAL ELECTRIC.

B. Single pole, 20 amp, 120/277 VAC, NEMA WD-1, heavy duty, UL20.

C. Device Plate: Stainless steel.

2.02 RECEPTACLES

A. Manufacturers: HUBBELL, BRYANT, GENERAL ELECTRIC.

B. 20 amp, 125 VAC, NEMA WD-1, heavy duty.

C. 20 amp, 125 VAC, NEMA WD-1, heavy duty, ground fault circuit interrupter.

D. Duplex type.

E. Device Plate: Stainless steel.

2.03 TIMER SWITCH

A. Acceptable Manufacturers: Intermatic Model No.: FF2H or approved equal.

B. Operator: twist knob

C. Dedicated back box - single gang

D. Nameplate: 2.5-inch rectangle white nameplate with black engraved logo “Exhaust Fan”, unless noted otherwise on drawings.

E. 20 Amp Rated, 1 HP

2.04 MANUAL MOTOR RATED THERMAL SWITCH

A. Acceptable Manufacturers: SQUARE D, Class 2510, Type KG1A, Type KG2C (3-pole, 600V) or approved equal.

B. Contractor shall coordinate voltage, phase and current rating with equipment.

2.05 CONTACTORS

A. Manufacturers: Square D, Model No. LO1000V02.

B. 4 pole, 30 amp, open type contactor.

C. Electrically held coil, 120VAC.

D. Quantity required: as per drawings

2.06 ELECTRIC CORD REEL

A. Manufacturers: HUBBELL, Model No. HBL45123CO20 or approved equal.

B. Ratings: 120V, 20A, 3 conductors.

C. Cord length: 45' SJ cord.

D. Coordinate female plug end with Fire District prior to ordering.

2.07 DATA OUTLETS

A. Provide combination telephone/data jacks compatible with RJ-45 cable connections.

B. Provide “decora” type with matching vinyl cover plate.

C. Colors shall be selected by the District.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mounting:
   1. Mount all switches 46-inches above finished floor to center line of switch unless noted otherwise.
   2. Mount all receptacles 18-inches above finished floor to center line of receptacle unless noted otherwise.
   3. Install switches with OFF position down.

B. Polarity: Properly wire all receptacles so that the hot wire, the neutral wire and the ground wire connect to the proper terminal on all receptacles.

C. Grounding: Install all devices in boxes specified under Section 260533 and install a No. 12 green ground wire from device grounding terminal to the outlet box in accordance with the National Electric Code.

D. Install device plates on switch, receptacle and blank outlets in full contact with wall surface.

3.02 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Disconnect switches.

B. Fuses.

C. Enclosed Circuit Breakers.

1.02 REFERENCES

A. NEMA KS-1 - Enclosed Switches.

B. ANSI/UL 198C - High Intensity Capacity Fuses, Current Limiting Types.

C. ANSI/UL 198E - Class R Fuses.

D. FS W-S 865 - Switch, Box (Enclosed), Surface Mounted.

E. NEMA AB1 - Molded Case Circuit Breakers.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

B. Include outlet drawings with dimensions and equipment ratings for voltage, capacity, horsepower and short circuit current ratings.

1.04 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 DISCONNECT SWITCHES

A. Disconnect switches shall be GENERAL ELECTRIC, heavy-duty Type TH or approved equal.

B. 75ºC conductor ratings.

C. Ratings: 600VAC

D. Quick-break, quick-make, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

E. Suitable for use as service entrance equipment.

F. UL listed for Class R 200,000 RMS amps, symmetrical IC.

G. Class R fusing kit.

H. Enclosures: Refer to drawings.

2.02 FUSES

A. Fuses shall be Littlefuse KLNR Class RK1 or approved equal.

B. Fuses shall be rated for 600 volts AC.

C. Interrupting Rating: 200,000 RMS amps.

2.03 MOLDED CASE CIRCUIT BREAKERS

A. Install molded case circuit breakers for Main Circuit Breaker, Generator Circuit Breaker and Panel Circuit Breakers.

B. Molded Case Circuit Breaker:
   1. Manufacturer: SIEMENS
      a. 125 Amp, 3 Pole Type ED6.
      b. 250 Amp, 3 Pole Type HFD6.
      c. 400Amp, 3 Pole Type HJD6.
      d. 600Amp, 3 Pole Type HLD6.
   2. AIC Rating: 65,000
   3. Thermal magnetic with interchangeable trip

C. Enclosure
   1. Manufacturer: SIEMENS
   2. Rating: NEMA 1 (for interior use) or NEMA 4X Stainless Steel (for exterior use).
   3. External Throw.
   4. Suitable for Service Entrance Equipment (where applicable).

2.04 ELEVATOR MOTOR DISCONNECT SWITCH ("DS1")

A. COOPER BUSSMAN POWER MODULE SWITCH OR APPROVED EQUAL
   1. Provide Power Module Switch in a single NEMA enclosure with all necessary relay(s), control transformer and other options (as listed below), and as shown on drawings.
   2. The Power Module Switch shall have an ampere rating as shown on the Contract Drawings, and shall include a horsepower rated fusible switch with shunt trip capabilities. The amp rating of the switch shall be based upon elevator manufacturer requirements and utilize Class J Fuses (provide separately). It shall include as an accessory, a 100VA control power transformer with primary and secondary fuses.
   3. The coil of the isolation relay shall be 120Vac. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid.
   4. The module shall contain the following options:
      a. Key to test switch.
      b. “ON” Pilot Light (green, Red or White).
      c. Isolated Full Capacity Neutral Lug.
      d. 1P NC Mechanically Interlocked Auxiliary Contact (for open/closed switch status).
      e. Fire Alarm Voltage Monitoring Relay (Needed to comply with NFPA 72).
      f. NEMA 3R Enclosure.
      g. Provide all control wiring as required between disconnect switches and elevator controls as required by the elevator installer.

2.05 EXTRA MATERIALS

A. Provide one complete set based on number of poles of spare fuses for each fused disconnect switch. Provide to Owner.

PART 3 - EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Removed temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Provide switches/enclosed circuit breakers at locations as indicated on drawings.

D. Refer to disconnect switch schedule on drawings for ampacity ratings, fuse sizes, number of poles and enclosure ratings.

E. Install fuses in fusible devices.

F. Install engraved nameplates on each switch and enclosed circuit breaker identifying the following:
   1. Switch designated.
   2. Load served.
   3. Power origination.
   4. Fuse size as indicated on drawings.

3.02 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit breaker trip ranges.

END OF SECTION

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PART 1 - GENERAL

1.01 - SECTION INCLUDES

A. Magnetic motor starters.

1.02 - REFERENCES

A. NFPA 70 - National Electrical Code.

B. NECA "Standard of Installation," published by National Electrical Contractors Association.

C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.

D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

E. NEMA KS 1 - Enclosed Switches.

1.03 - SUBMITTALS

A. Refer to drawing for starter sizes on schedules.

B. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.

C. Test Reports: Indicate field test and inspection procedures and test results.

1.04 - QUALITY ASSURANCE

A. Perform Work in accordance with NECA Standard of Installation.

1.05 - QUALITY ASSURANCE

A. Perform work in accordance with NEMA ICS 2.3.

1.06 - REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

PART 2 - PRODUCTS

2.01 - MANUFACTURERS

A. Franklin Control Systems.

B. Substitutions: Under provisions of Section 016100.

2.02 - AUTOMATIC CONTROLLERS

A. Manufacturer: Franklin Control Systems, Model BAS-1P

B. Motor starters shall be NEMA rated.

C. Coil operating voltage: Coordinate voltage required with equipment to be installed and associated contactor(s).

D. Overload Relay: NEMA ICS; melting alloy overload.

E. Enclosure: As shown in contract drawings.

2.03 - PRODUCT OPTIONS AND FEATURES

A. Auxiliary Contacts:
   1. Fault Output
   2. Status Output

B. Motor running and overload indication lights.

C. Selector Switches: Hand-off-automatic selector switch.

D. Manual reset push button for overload.

PART 3 - EXECUTION

3.01 - INSTALLATION

A. Install enclosed controllers size as indicated, on starter schedule, in accordance with manufacturer's instructions.

B. Install enclosed controllers plumb in locations indicated on drawings. Provide supports in accordance with Section 260526.

C. Select and install overload heater elements in motor controllers to match installed motor characteristics.

D. Provide engraved plastic nameplates for each starter.

E. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor and voltage/phase rating.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Automatic transfer switch.

1.02 REFERENCES

A. NFPA 70 - National Electrical Code.

B. NEMA ICS 1 - General Standards for Industrial Control and Systems.

C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.

D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

B. Submit product data for transfer switches showing overall dimensions, electrical connections, electrical ratings, environmental restrictions, voltage, short circuit ratings, enclosure details and all accessories.

C. Submit manufacturer's installation instructions. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product.

D. Submit manufacturer's operation and maintenance manual as part of shop drawing submittal.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Section 017823.

B. Include instructions for operating equipment.

C. Include instructions for operating equipment under emergency conditions.

D. Identify operating limits which may result in hazardous or unsafe conditions, whether switch is being operated automatically or manually.

E. Document ratings of equipment and each major component.

F. Include manufacturer's recommended routine preventative maintenance schedule.

G. List any special tools, maintenance materials and recommended spare parts.

1.05 EXTRA SERVICES

A. The supplier shall include as a part of the package a 5-year warranty and 5-year planned maintenance agreement at no additional cost to the Owner. The agreement shall include, as a minimum, one service call per year. The services must be performed by the authorized distributor of the equipment furnished and may not be subcontracted. The following services shall be performed once a year.
   1. Check switches for loose, bare or broken wiring (replace as needed).
   2. Test transfer switch operation, time delays and manual operators.
   3. Test transfer switch operations and plant exerciser.

B. Manufacturer's Instructions: The manufacturer's instructions shall indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product.

1.06 REGULATORY REQUIREMENTS

A. Conform to all applicable national, state, city or local codes for standby electrical systems.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Transfer switch shall be ONAN Model OTPC.

B. Transfer switch shall be supplied and warranted for 5 years, including a five-year planned maintenance agreement by the single system source supplier. No exceptions.

C. Proposal for any substitute equipment shall provide complete submittal data, as specified to the Engineer for approval or disapproval. Physical dimensions of transfer switches are based on ONAN Model OTPC. Substitute equipment shall be field verified for adequate equipment spacing relative to other equipment to be installed in the same locations.

D. It is intended that all products specified herein be of standard ratings, therefore, the ampere ratings, withstand and closing ratings, etc., shall be the manufacturer's next available larger size of rating until the specifications are exactly met.

2.02 AUTOMATIC TRANSFER

A. Description: NEMA ICS 2; automatic transfer switches.

B. The switches shall be mechanically held, electrically operated and shall be interlocked mechanically and electrically to insure that normal power and emergency power mixing is impossible. The automatic transfer switches shall be suitable for use with emergency sources.

2.03 AUTOMATIC TRANSFER SWITCH

A. Sequence of Operation: Automatic switching shall occur from normal power to emergency power when there is a phase reversal or when any phase of the normal power drops between an adjustable voltage range of 75 to 98% voltage and to automatically restore the load to normal when all phases are between an adjustable voltage range of 75 to 98% normal voltage or phase rotation is corrected.

B. Main switch contacts shall be high-pressure silver alloy in order to improve interrupting and withstand capabilities. Main contacts shall be rated for 600 volts AC minimum. Contact assemblies shall have arc chutes for positive arc extinguishment. Arc chutes shall have insulating covers to prevent interphase flashover.

C. Transfer switches shall be equipped with transparent protective covers over all live parts of the switch. These covers are to serve as protection to operators or service personnel from contact with live parts, and from contact with arcing by-products if the switches operate with the door open. Barriers shall be transparent to allow for visual inspection for contact position and for damage.

D. Automatic transfer switches utilizing components of molded case circuit breakers are not acceptable.

E. All transfer switches and accessories shall be UL listed and labeled, tested per UL Standard 1008 and CSA approved.

F. Solid state undervoltage sensors shall simultaneously monitor all phases of both sources. Pick-up and drop-out setting shall be adjustable between 75 and 98% of system voltage. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage. Switches that do not monitor all three phases of both normal and emergency sources will not be acceptable.

G. Provide frequency sensing relay which will not permit transfer to emergency power until the generator set is operating at 60 Hz.

H. Control wiring shall be terminated interlocking, plug-type connectors. Operating current for the transfer shall be obtained from the source to which the load is to be transferred.

I. The controls shall include latching diagnostic indicators to pinpoint the last successful step in the sequence of control functions, and to indicate the present status of the control functions in real time, as follows:
   1. Source 1 OK.
   2. Start Generator Set.
   3. Source 2 OK.
   4. Transfer Timing.
   5. Transfer Complete.
   6. Retransfer Timing.
   7. Retransfer Complete.
   8. Timing for Stop.

2.04 RATINGS

A. Ratings shall be as follows:
   1. Voltage: 120/208, 3-Phase, 4-Wire.
   2. Switched Poles: 4, (overlapping neutral not acceptable).
   3. Load Inrush Rating: Combination Load.

B. All automatic transfer switches shall meet the following withstand ratings as a minimum. In order to protect the system under current or possible future conditions, whether protected by circuit breakers or current limiting fuses, the transfer switches must meet both of the following molded case circuit breaker and current limiting fuse withstand and closing ratings as a minimum. Ratings are stated in symmetrical RMS amperes for three phase faults.
   1. Transfer Amperage: 600
   2. WCR @ 208 Volts W/Molded Case C/B'S: 60,000
   3. WCR @ 208 Volts W/Current Limit Fuses: 200,000

C. Transfer switches shall be continuously rated in ambient temperatures of -40 to +122 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet.

2.05 AUTOMATIC SEQUENCE OF OPERATION

A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

B. Time Delay to Start Alternate Source Engine Generator: 0 to 15 seconds, adjustable.

C. Engine Start: Automatic controls shall signal the engine-generator set to start upon a signal from normal source sensors, after time delay to start has terminated.

D. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

E. Time Delay Before Transfer to Alternate Power Source: 2 to 120 seconds, adjustable.

F. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

G. Time Delay Before Retransfer to Normal Power: 0 to 30 minutes, adjustable; bypass time delay in the event of the alternate source failing.

H. Time Delay Before Engine Shut Down: 0 to 10 minutes, adjustable, of unloaded operation; factory set at 5 minutes.

I. Engine Exerciser: An Exerciser shall, once a week, start the generator set, transfer building load to the generator sets and after a set period of time, transfer the building load back to normal power. It shall be readily accessible and easy to start. Exercisers shall be furnished with load/no load selector switches. Provide bypass exerciser controls if the normal source fails during the exercise period.

2.06 ENCLOSURE

A. Enclosures: Transfer switch enclosure shall be NEMA 1. All controls which will be located on cabinets shall be key operated. Manual operating handles and all control switches, (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet doors. Transfer switches with manual operating handles and/or non key-operated control switches located on the outside of the cabinet do not meet this specification and are not acceptable.

2.07 ACCESSORIES

A. Indicating Lights: Mounted in cover of enclosure to indicate the following. Source light for AC power loss shall be 30.5 mm heavy duty oiltight press-to-test by SIEMENS.
   1. NORMAL SOURCE AVAILABLE.
   2. EMERGENCY SOURCE AVAILABLE.
   3. NORMAL SWITCH POSITION.
   4. EMERGENCY SWITCH POSITION..

B. Test Switches: Mounted in enclosure of MCC by MCC manufacture to simulate failure of normal source. Switches to be keyed operated. Provide TEST/NORMAL/RETRANSFER positions. Retransfer position to provide immediate Retransfer to normal, bypassing time delay.

C. Emergency Kill Switch Pushbutton (Maintained): When depressed shall shut down generator. This switch shall be in series with new exterior emergency kill switch. One kill switch shall be installed at generator. One kill switch shall be installed at ATS.

D. Transfer Switch Main Shaft Auxiliary Contacts: Two normally open; two normally closed. Wired to terminal block for easy access for indication of switch position. Rated at 10 Amps continuous and 250 VAC maximum.

E. Transfer switches are to be equipped with permanently attached operating handles and quick-break, quick-make mechanisms suitable for normal operation under load. Loose manual operating handles that need to be field attached for operation will not be acceptable.

F. All transfer switches shall be provided with a field adjustable time delay during the switching in both directions, during which time the load is isolated from both power sources, to allow load residual voltage to decay before closure to opposite source. The delay feature shall have an adjustable range of 0 to 7.5 seconds. Phase angle monitor/inphase type monitors are not acceptable.

G. Provide generator 20 light remote annunciator located inside the Chief's office. Interface generator set controls with battery charger and all status conditions. Provide all power, control wiring including conduits. Coordinate exact mounting location with district prior to installation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of transfer switches shall be in accordance with manufacture requirements. Provide applicable U.L. labeling for installed system.

3.02 POWER OUTAGE

A. After the transfer switch is installed, the Contractor shall be responsible to inspect the installation and field verify that the switch has been installed per manufacturer’s recommendations. Owner’s operating personnel shall be instructed on the use and service requirements of the transfer switch by the manufacturer. A minimum of two (2) hours manufacturers training is required.

3.03 DEMONSTRATION

A. Demonstrate operation of transfer switch under provisions.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Packaged engine generator set.

B. Exhaust piping, fittings, silencer and insulation.

C. Control panels.

D. Battery and charger.

E. Vibration isolation.

1.02 SUBSTITUTIONS OF ENGINE GENERATOR, AUTOMATIC TRANSFER SWITCH AND GENERATOR ENCLOSURE

A. Bidders considering substitute engine generator systems, transfer switches and generator enclosure manufacturers not listed in the specifications shall provide complete submittal data for review and acceptance, as indicated in the specifications, no later than 10 days after the bid date. No substitute equipment manufacturers will be considered accepted or reviewed after this date.

B. If substitute equipment is submitted within 10 days after the bid date and additional product data is required to determine if the proposed equipment is equal, said additional product data shall be submitted no later than 10 days. No further product data will be accepted after this date.

C. All proposed substitutions shall be submitted by the bidder. Any proposed substitutions submitted directly by supplier and/or manufacturers will not be reviewed or returned.

D. Failure to comply with the required submittal and substitution requirements as described in Specification Section 016000 will result in rejection of the substitution, without further review.

E. Acceptance of Substitute Equipment: If accepted, the contractor shall be responsible for all additional costs for generator concrete foundation, any necessary revisions to the plans and specifications, drawings and project documentation; and changes related to equipment spacing, pad sizes, mounts, electrical wiring, ventilation equipment, fuel, exhaust components, etc., as well as any engineering costs, resulting from said substitution. If a brand name other than that specified is proposed for use, the supplier must provide a locally available system for the Owner and Engineer to review and inspect, as well as witness testing to show compliance with the specifications. Also, the supplier must furnish a list of completed installations, including name, address and telephone number of at least five comparable installations which can prove the proposed products have operated satisfactorily for three years.

1.03 REFERENCES

A. NEMA AB1 - Molded Case Circuit Breakers.

B. NEMA MG1 - Motors and Generators.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. ANSI/NFPA 70 - National Electric Code.

E. NFPA 110 - Emergency Standby Systems.

F. NFPA 30 - Flammable and Combustible Liquids Code.

G. NFPA 37 - Installation of Stationary Engines.

H. NFPA 101 - Life Safety Code.

1.04 SUBMITTALS

A. Submit product data under provisions of Section 013300.

B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

C. Product Data: Provide data showing dimensions, weights, ratings, interconnection points and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, radiator and derating schedules, operating performance, exhaust flow data, and cooling system data. Submit generator alternator output curves, deration curves and temperature data on the complete genset individual components.

D. Test Reports: Indicate results of performance testing including 0.8 power factor test at 100 percent load.

E. Prototype Test Reports: Submittals will not be received without submission of prototype test reports. No exceptions.

F. Manufacturer's Installation Instructions: Indicate applica-tion conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of product. Provide typical system interconnection wiring diagrams.

G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

H. Manufacturer's Field Reports: Submit under provisions of Section 017900. Indicate procedures and findings.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 017700.

B. Operation Data: Include instructions for normal operation.

C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 110.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years experience, and with an authorized distributor offering 24-hour parts and service availability within 50 miles of the project. The manufacturer shall fabricate the engines, generators and control panel. Automatic transfer switches and generator enclosures shall be supplied, warranted and serviced by a single system source supplier.

B. Supplier: Authorized distributor of specified manufacturer with minimum six years documented experience with specified products and factory-trained service technicians. The supplier must be factory authorized to perform warranty service on the entire system, including but not limited to, the engines, generators, control panels and automatic transfer switches. The supplier must show proof of factory trained service technicians on all components.

C. The complete engine generator system shall be standard of a single manufacturer. It shall be factory built, tested and shipped by this single manufacturer.

1.08 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70 and NFPA 110.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and indicated.

1.09 EXTRA SERVICES

A. The single source supplier shall provide as part of the package a 5-year warranty and 5-year planned maintenance agreement at no additional cost to the Owner. This warranty shall cover the generator system, transfer switches and generator enclosures. Agreement shall include, as a minimum, one service call per year. The services must be performed by the authorized distributor of the equipment furnished, and may not be subcontracted. The following services shall be performed once a year.
   1. Replace engine-lubricating oil and remove used oil from premises.
   2. Replace oil and fuel filters.
   3. Check coolant system for proper levels and condition. Replace coolant filters and add corrosion inhibitor as needed.
   4. Check air filter.
   5. Check and clean crankcase breathers.
   6. Check turbocharger free-spin and end play.
   7. Check and adjust belts as required.
   8. Check engine for loose, bare or broken wiring. Replace as needed.
   9. Check entire equipment for fuel or water leaks.
   10. Check condition of batteries and report any action necessary for recharging or replacing.
   11. Start and run all engines, check temperatures and pressures.
   12. Test engine safety shutdown systems.
   13. Test all transfer switches operation and time delays.
   14. Submit a report of this inspection to the Owner and advise of any further work required.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. ONAN CORPORATION, Minneapolis, Minnesota, or specifically approved equal.

B. Proposal for any substitute equipment shall provide complete submittal data, as specified in Section 016000 - Product Requirements and specified herein, to the Engineer for approval or disapproval. The supplier must submit detailed sizing calculations for each generator to verify models are capable of picking up the entire loads with voltage dips as herein specified.

C. Approval of Substitute Equipment: Design has been based on ONAN Model Generators. If substitute equipment is approved, the contractor shall be responsible for the charges of any necessary revisions to the plans and specifications, drawings, and project documentation; and charges related to equipment spacing, enclosure sizes, foundation sizes, mounts, electrical

wiring, ventilation equipment, fuel, exhaust components, etc., as well as any engineering costs. If a brand name other than that specified is proposed for use, the supplier must provide a locally available generator system for the Owner and engineer to review and inspect, as well as witness testing to show compliance with the specifications. Also, the supplier must furnish a list of completed installations, including name, address and telephone number of at least five comparable installations which can prove the proposed products have operated satisfactorily for three years.

D. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer's next size or rating to exactly meet the specifications. No exceptions.

2.02 SYSTEM REQUIREMENTS

A. The engine generator shall start and provide continuous power to the loads with 100 percent block loading at the time of transfer.

2.03 NATURAL GAS ENGINE GENERATOR SET

A. Rating: The AC engine generator set, ONAN Model C125 N6 and shall be rated by the manufacturer for standby operation at 125 KW/156 KVA at 0.8 PF, 60 Hz, 1800 RPM for use at 120/208 volts, 3 phase, 4 wire. Ratings shall be at an elevation of 2,900 feet above sea level, and at 104 degrees F.
   1. Voltage regulation shall be +/- 1.0 percent of rated voltage for any constant load between no load and rated load.
   2. Frequency regulation shall be isochronous under varying from no load to 100% rated load.
   3. Random Voltage Variation: The cyclic variations in RMS voltage shall not exceed +/- 1.0% of rated speed for constant loads from no load to rated load, with constant ambient and operating temperature.
   4. Random Frequency Variation: Speed variations for constant loads from no load to rated load shall not exceed +/- 0.25% of rated speed, with constant ambient and operating temperature.
   5. Telephone Harmonic Distortion: The sum of AC voltage waveform harmonics, from no load to full linear load, shall not exceed 5% of rated voltage (L-N, L-L, L-L-L) and no single harmonic shall exceed 3% of rated voltage.
   6. Telephone Influence Factor: TIF shall be less than 50 per NEMA MG1-22.43.
   7. The natural engine generator set shall be capable of picking up 100% of nameplate KW and power factor in one step with the engine generator set at operating temperature, in accordance with NFPA Standard 110, Paragraph 5-13.2.6.
   8. The engine generator shall start and provide power to the loads in the following step starting sequence with a maximum instantaneous voltage dip of 11% and a maximum frequency dip of 8%.
   9. The generator shall at a minimum provide the performance based upon the load characteristics and steps stated in the "Load Summary Report" below:

Step No.	Description	Load (kW)	Volt/Phase	Motor HP	Load Type	Starting Method
1	Interior Lighting	4.75	120/1	-	Lighting	-
1	Comm. Systems	3.42	120/1	-	Misc.	-
1	Charge Reel #1	1.92	120/1	-	Batt. Charge	-
1	Charge Reel #2	1.92	120/1	-	Batt. Charge	-

Step No.	Description	Load (kW)	Volt/Phase	Motor HP	Load Type	Starting Method
1	Charge Reel #3	1.92	120/1	-	Batt. Charge	-
1	Charge Reel #4	1.92	120/1	-	Batt. Charge	-
1	Charge Reel #5	1.92	120/1	-	Batt. Charge	-
1	General Receptacles	16.2	120/1	-	Recept.	-
1	Restaurant Range Fan	.29	120/1	.25	Motor	Capacitor
1	Water Heater "WH1"	.49	120/1	.33	Motor	Capacitor
1	Toaster	2	120/1	-	Recept.	-
1	Water Cooler	.5	120/1	-	A/C	-
1	Fire Alarm Control Panel	.54	120/1	-	Recept.	-
1	Vehicle Exhuast Fan "VEF-1"	2.73	208/3	3	Motor	Across the line
1	Circ. Pump "CP1"	.07	120/1	.04	Motor	Capacitor
1	Circ. Pump "CP2"	.07	120/1	.04	Motor	Capacitor
1	Gas Detection "GD-1" & "GD-2"	.5	120/1	-	Recept.	-
1	Existing Air Filter 1	1.2	208/1	1	Motor	Capacitor
1	Existing Air Filter 2	1.2	208/1	1	Motor	Capacitor
	Exhaust Fan "EF-4"	.53	120/1	.03	Motor	Capacitor
1	Exhaust Fan "EF-3"	.61	120/1	.23	Motor	Capacitor
1	Exhaust Fan "EF-2"	.47	120/1	.23	Motor	Capacitor
1	Exhaust Fan "EF-1"	.36	120/1	.11	Motor	Capacitor
1	Exhaust Fan "EF-EL-1"	.17	120/1	.03	Motor	Capacitor
1	Circ. Pump "CP-5"	.86	120/1	.68	Motor	Capacitor
1	Exhaust Fan "EF-DC"	.14	120/1	.05	Motor	Capacitor
1	Generator Block Heater	1.5	120/1	-	Misc.	-
2	Air Scrubber "AS-1"	.57	120/1	.5	Motor	Capacitor
2	Existing Air Filter 3	1.2	208/1	1	Motor	Capacitor
2	Existing Air Filter 4	1.2	208/1	1	Motor	Capacitor
2	Refrigerator 1	.2	120/1	-	A/C	-
2	Refrigerator 2	.5	120/1	-	A/C	-
2	Freezer	.85	120/1	-	A/C	-
2	Refrigerator 3	.52	120/1	-	A/C	-
2	Bar Fridge	.5	120/1	-	A/C	-
2	Relocated Ice Maker	.5	120/1	-	A/C	-
3	RTU-1 Compressors	6.72	208/3	-	A/C	-
3	RTU-1 Combustion Fan	.14	208/3	.19	Motor	Across the line
3	RTU-1 Indoor Fan	1.67	208/3	2.27	Motor	Across the line
3	RTU-1 Outdoor Fan	.97	208/3	1.41	Motor	Across the line

Step No.	Description	Load (kW)	Volt/Phase	Motor HP	Load Type	Starting Method
3	RTU-2 Compressor	3.09	208/3	-	A/C	-
3	RTU-2 Indoor Fan	1.48	208/3	2.02	Motor	Across the line
3	RTU-2 Combustion Fan	.14	208/3	.19	Motor	Across the line
3	RTU-2 Outdoor Fan	.29	208/3	.39	Motor	Across the line
3	Sump Pump	.75	120/1	.5	Motor	Capacitor
3	Blender	1	120/1	-	Recept.	-
3	Hand Dryer 1	.79	120/1	1.11	Motor	Capacitor
4	DSCU-1 Compressor	3.3	208/1	-	A/C	-
4	DSCU-1 Fan Motor	0.07	208/1	.11	Motor	Capacitor
4	DSCU-2 Compressor	1.28	208/1	-	A/C	-
4	DSCU-2 Fan Motor	.07	208/1	.11	Motor	Capacitor
4	DSEU-1 Fan Motor	.05	208/1	.07	Motor	Capacitor
4	DSEU-2 Fan Motor	.04	208/1	.05	Motor	Capacitor
4	DSCU-3 Compressor	1	208/1	-	A/C	-
4	DSCU-3 Fan Motor	.09	208/1	.05	Motor	Capacitor
4	DSEU-3 Fan Motor	.17	208/1	.1	Motor	Capacitor
4	Dishwasher w/ Booster Heater	15.52	208/3		Recept.	-
4	DSCU-4 Compressor	1.5	208/1		A/C	-
5	DSCU-4 Fan Motor	.07	208/1	.11	Motor	Capacitor
5	DSEU-4 Fan Motor	.05	208/1	.07	Motor	Capacitor
5	Garage Door Motor #1	1.24	120/1	.75	Motor	Capacitor
5	Garage Door Motor #2	1.24	120/1	.75	Motor	Capacitor
5	Hand Dryer 2	.79	120/1	1.11	Motor	Capacitor
6	Hand Dryer 3	.79	120/1	1.11	Motor	Capacitor
6	Decon Washing Machine	.99	208/1	.8	Motor	Capacitor
6	RTU-3 Compressor	3	208/3	-	A/C	-
6	RTU-3 Indoor Fan	2.09	208/3	2.77	Motor	Across the line
6	RTU-3 Combustion Fan	.12	208/3	.19	Motor	Across the line
6	RTU-3 Outdoor Fan	1.01	208/3	1.37	Motor	Across the line
6	Kitchen Exhaust Fan "EXH-1"	2.73	208/3	3	Motor	Across the line
6	Make-up Air "SUP-2"	1.02	208/3	1	Motor	Across the line
6	Hand Dryer 4	.79	120/1	1.1	Motor	Capacitor
6	RTU-4 Compressor	3	208/3	-	A/C	-
6	RTU-4 Combustion Fan	.14	208/3	.19	Motor	Across the line

6	RTU-4 Indoor Fan	1.67	208/3	2.27	Motor	Across the line
6	RTU-4 Outdoor Fan	.24	208/3	.39	Motor	Across the line
7	Elevator (Solid State Starting)	16.95	208/3	20	Motor	Solid State

B. The generator as a packaged unit (engine, alternator and controls) provide a minimum of 920 SKVA sustaining a minimum of 90% of rated no load voltage with the specified 920 SKVA load at near zero power factor applied to the generator.

C. The alternator performance shall be designed to provide a minimum of 620 locked rotor KVA at a maximum voltage dip of 30%.

D. The following performance verifications shall be provided for substitute generators.
   1. Submit five copies of generator sizing program based upon the specified step/starting sequence and associated voltage/frequency dips and required starting KVA.
   2. As part of the substitution requirements the contractor shall enter all design step/starting sequence loads into the manufacturer's generator sizing program in the presence of the engineer to verify model proposed by substitute manufacturer meets the specified requirements for ambient temperature, site altitude, voltage dip, frequency dip, and starting KVA.

2.04 AC GENERATOR, REGULATOR AND EXCITER UNIT

A. The AC generator, exciter and voltage regulator shall be designed and manufactured by the engine generator set manufacturer as a complete generator system.

B. The AC generator shall be synchronous, four pole, revolving field, dripproof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan and directly connected to the engine with flexible drive discs. The armature shall have skewed laminations of insulated electrical grade steel, two-thirds pitch windings in order to minimize field heating and voltage harmonics. The rotors shall have amortissuer (damper windings) layer wound mechanically wedged winding construction. The rotors shall be dynamically balanced. The exciters shall be brush-less, three phase, with full wave silicon diodes mounted on the rotating shaft and a surge suppressor connected in parallel with the field winding. Field discharge resistors shall not be acceptable. Systems using three wire solid state devices (such as SCRs or transistors) mounted on the rotor shaft shall not be acceptable.

C. All insulation system components shall meet NEMA MG1 standard temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C to provide additional allowance for internal hot spots. The main generator and exciter insulation systems must be suitably impregnated for operation in severe environments for resis-tance to sand, salt and sea spray.

D. Generator shall be a Permanent Magnet Generator (PMG). Permanent magnet generators shall provide excitation power to the auto-matic voltage regulator for immunity from voltage distortion caused by nonlinear SCR controlled loads on the generator. The PMG's shall sustain main field excita-tion power for optimum motor starting and to sustain short circuit current for selective operation and coordination of system overcurrent devices.

2.05 ENGINE GENERATOR SET CONTROLS

A. The generator sets shall be provided with microprocessor-based control systems which are designed to provide automatic staring, monitoring, and control functions for the generator set.

The control systems shall also be designed to allow local monitoring and control of the generator sets, and remote monitoring and control as described in this specification. The controls shall be mounted on the generator sets, and shall be vibration isolated and prototype tested to verify the durability of all components in the system under vibration conditions encountered. The controls shall be UL-508 labeled, CSA282-M1989 certified, and meet IEC-8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure doors shall be gasketed. There shall be no exposed points in the controls (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std. 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions. The entire controls shall be tested and meet the requirements of IEEE587 for voltage surge resistance. The generator set mounted controls shall include the following features and functions:

1. The generator control panel shall provide a network interface for future use. This network interface shall communicate all the generator status, control, display messages, troubleshooting and safety features as described below. Software shall be available for interfacing PLC Software with generator control panel communications. This interface and software development will be performed by another contract.
2. Three position control switch labeled RUN/OFF/AUTO. In the RUN position the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
3. Red “mushroom-head” push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
4. Push-button RESET Switch: The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
5. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:
    a. 2.5-inch, 90 degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
    b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
6. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:
    a. Low Oil Pressure (alarm)
    b. Low Oil Pressure (shutdown)
    c. Oil Pressure Sender Failure (alarm)
    d. Low Coolant Temperature (alarm)
    e. High Coolant Temperature (alarm)
    f. High Coolant Temperature (shutdown)
    g. Engine Temperature Sender Failure (alarm)
    h. Fail to Crank (shutdown)
    i. Overcrank (shutdown)
    j. Overspeed (shutdown)
    k. Low DC Voltage (alarm)

l. Low Coolant Level (alarm or shutdown-selectable)
m. High DC Voltage (alarm)
n. Weak Battery (alarm)
o. Low Fuel-Daytank (alarm)
p. High AC Voltage (shutdown)
q. Low AC Voltage (shutdown)
r. Under Frequency (shutdown)
s. Over Current (warning)
t. Over Current (shutdown)
u. Short Circuit (shutdown)
v. Ground Fault (alarm)
w. Over Load (alarm)
x. Emergency Stop (shutdown)
y. In addition, provisions shall be made for indication of two customer-specified or future alarm or shutdown conditions. These two alarm conditions shall be interfaced with leak detection/overfill alarm panel for overfill and leak detection. Labeling of the customer specified or future alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate the generator set is not able to automatically respond to a command to start from a remote location.

7. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
   a. Engine Oil Pressure (psi of kPA)
   b. Engine Coolant Temperature for left and right block temperatures (degrees F or C; both)
   c. Engine Oil Temperature (degrees F or C)
   d. Engine Speed (rpm)
   e. Number of Hours of Operation (hours)
   f. Number of Start Attempts
   g. Battery Voltage (DC volts)
8. Control Functions: The control system shall provide for the following functions:
   a. The control system provided shall include a cycle cranking system, which allows for user selected crank time, reset time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
   b. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
   c. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
   d. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
   e. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure condition.
9. Alternator Control Functions: The generator set control shall include the following alternator control functions:
   a. The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system

shall be equipped with three-phase RMS sensing and shall control build up of AC generator voltage to provide a linear rise and limit overshoot. The systems shall include a torque-matched characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level.

b. The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.
c. Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
d. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
e. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
f. An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
g. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 10 VDC or more than 14VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 10 volts for more than two seconds a “weak battery” alarm shall be initiated.
h. The control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps, and include adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay which will function correctly in system as installed.

10. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:
    a. Form “C” dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
    b. One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
    c. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
    d. A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
    e. The control shall be provided with provisions for connection of remote monitoring equipment as described herein or shown on the drawings.

2.06 ENGINES

A. The natural gas / propane (dual fuel) engine shall be manufactured by Cummins Engine Company and designed specifically for generator set duty. The dual fuel engine shall be 4 cycle, natural gas or propane fueled, direct injection, 1800 RPM, with forged steel crankshaft and connecting rods. Minimum engines shall be 543 cubic inches. Engines shall have a minimum of 6 cylinders. The cylinder blocks shall be cast iron with replaceable wet liners and have four valves per cylinder. The engines shall be turbocharged and aftercooled.
   1. Engine shall be capable of running on either natural gas or propane. Transfer between fuel sources shall be automatic and shall not require operator intervention. All required accessories/modifications shall be made by the factory. Both natural gas and propane connections shall be made to the new genset.

B. Fuel Cnsumption at full load shall be as follows:
   1. Natural Gas: 1,915 scfh
   2. Propane: 783 scfh

C. Two cycle engines will not be acceptable.

D. Electronic governor systems shall provide automatic isochronous frequency regulation. The engine governing systems shall not utilize any exposed operating linkage.

E. The engines shall be cooled by a unit-mounted closed loop radiator system including belt-driven pusher fan, coolant pump and thermostat temperature control. The cooling systems shall be rated for full rated load operation in 113 degrees F (45 degrees C) ambient condition. The cooling capability of the generator sets shall be demonstrated by prototype tests on a representative generator set model conducted by the generator set manufacturer; calculated data from the radiator manufacturer only is not sufficient. Radiators shall be provided with a duct adapter flange permitting the attachment of an air discharge duct to direct the radiator air outside according to the manufacturer's instructions.

F. Rotating parts shall be guarded against accidental contact per OSHA requirements.

G. The maximum radiator cooling air shall not exceed 8,800 scfm. The alternator shall be cooled by direct drive blower. The maximum allowable static restriction shall not exceed 0.5 inches of water. The entire cooling air system is based on the above data. All costs incurred if an alternate manufacturer is purchased shall be the responsibility of the electrical contractor. These costs shall include costs to all other trades as well as any associated engineering fees.

2.07 ENGINE ACCESSORY EQUIPMENT

A. The engine generator sets shall include the following accessories:
   1. Electric starters capable of three complete cranking attempts without overheating, before overcrank shutdown (75 seconds).
   2. Positive displacement, mechanical, full pressure, lubrication oil pumps. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicators. Provide bypass oil filters.
   3. Replaceable heavy duty dry element air cleaners with restriction indicators and safety element.
   4. Engine mounted battery charging alternators, 100 ampere and solid-state voltage regulators.
   5. Anti-condensation heater for alternator.

2.08 BASES

A. The engine-generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components. The engine-generator set shall incorporate battery trays with battery holddown clamps on the base rails. Provisions for stub up of electrical connections shall be within the footprint of the generator set base rails and within the basetanks as specified in the housing section of the specification. Vibration isolators, spring type, shall be provided to be mounted under the generator set base.

2.09 GENERATOR SETS CIRCUIT BREAKERS

A. Generator main circuit breaker shall be solid state UL listed, molded case type, rated as listed below. Circuit breakers shall be mounted in a separate NEMA 1 enclosure and be shipped completely wired to the gensets. No exceptions. Enclosures shall include neutral blocks for field connection.

B. Solid State circuit breakers shall be 100% rated: Refer to drawings for sizes.

C. Circuit breaker (CB) shall be long time current and instantaneous pickup with solid state trip unit. CB shall have visible mechanical fault indicator and push button trip.

D. Circuit breakers shall be rated at 65,000 AIC.

E. Provide auxiliary contacts on breaker position.

2.10 EXHAUST SYSTEMS

A. One exhaust silencer shall be provided for the generator set. The silencer shall be super critical grade.

2.11 ACCESSORIES

A. Vibration isolators: Spring type.

B. Starting and control Batteries: One (1) 12 volt starting batteries each genset, lead acid type sized to accommodate 45 seconds of cranking at an ambient of 0 degrees F without being recharged.

C. Battery Chargers: One 10 amp voltage regulated battery charger shall be provided for each engine-generator set and shall be installed in the genset. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30 VDC for remote indication of :
   1. Loss of AC Power - red light.
   2. Low Battery Voltage - red light.
   3. High Battery Voltage - red light.
   4. Power ON - green light (no relay contact).

D. Block Heaters: Thermostatically controlled jacket water heater shall be supplied for each genset with a minimum size shall be 1,500 watts. Input voltage of heaters shall be 120 VAC 1 phase.

E. Provide generator 20 light remote annunciator located inside the Chief's Office. Interface generator set controls with battery charger and fuel tank alarms for all status conditions. Provide all power, control wiring including conduits.

2.12 ENCLOSURE

A. The generator set shall be provided with a factory-installed Level II sound attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rate load to a maximum of 71.3 dBA at any location 7 meters from the generator set in a free field environment. Housing materials used shall be aluminum. Fiberglass and plastic are not acceptable. Acoustical materials used shall be oil and water resistant. No foam materials shall be used.

B. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment and a hinged rear see-through control door. Key-locking and padlockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

C. The enclosure shall be provided with an exhaust silencer which is mounted inside of the enclosure, and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.

D. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electrocoating paint process, or equal meeting the performance requirements specified below. Metal part surfaces shall be prepared, primed and painted. The painting process shall result in a coating which meets the following requirements:
   1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
   2. Gloss, per ASTM D523, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
   3. Crosshatch adhesion, per ASTM D3359, 4B-5B.
   4. Impact resistance, per ASTM D2794, 120-160 inch pounds.
   5. Salt spray, per ASTM B117, 1000+ hours.
   6. Humidity, per ASTM D2247, 1000+ hours.
   7. Water Soak, per ASTM D2247, 1000+ hours.

E. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts will not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work. The enclosure shall be built and tested by the engine generator manufacturer.

2.13 SOURCE QUALITY CONTROL

A. To provide proven reliability of the system, three series of tests shall be performed: prototype model tests, production model tests and field tests. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and factory tested at 0.8 PF will not be acceptable.

B. Generator Set Factory Production Tests and Evaluation: These tests and evaluations must have been performed on a prototype generator set representative of the Model specified. A summary of the generator set testing results shall be submitted for review. The manufacturer's standard series of components development tests on the generator system, engine and other major components shall also be performed and available for review, but shall not be acceptable as a substitute for prototype testing on the complete representative generator set prototype.

C. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torisional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating

speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.

D. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.

E. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.

F. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer's standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.

G. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two minutes.

H. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer's acceptance criteria.

I. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122°F) of the system rating. Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge, shall be verified by this test.

J. Maximum Motor Starting KVA: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent of no load voltage with the specified load KVA at near zero power factor applied to the generator set.

K. Transient Response, Steady State Speed Control and Voltage Regulation: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency backwidth with steady state load, maximum voltage and frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.

L. Generator Set Factory Production Tests: On the equipment to be shipped, an 8-hour test shall be performed at rated load and 0.8 PF. These tests shall include certified data to document the following: run at full load, maximum power, voltage regulation, transient and steady state governing, single step load pickup and safety shutdowns. Provide a factory certified test record of the production testing. Certified test record shall be sealed by a licensed professional engineer.

2.14 WARRANTY

A. Provide a 5-year manufacturer's limited warranty, including 100% parts and labor, ONAN Option L031. The complete electrical power system, including but not limited to, generator set, controls, associated switches, enclosures, and accessories, as provided by the single source manufacturer, shall be warranted by the manufacturer against defects in materials and workmanship for a period of five (5) years from the date of system startup. Coverage shall include parts, labor, travel expenses, and labor to remove/reinstall the equipment, per ONAN's standard published limited warranty. Supplier must be factory authorized to perform warranty service on the entire system, including, but not limited to, the engine, the generator, the control panels, and the automatic transfer switches.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install engine generator and all appurtenances in accordance with manufacturer's recommendations.

B. Enclosure manufacturer shall install all exhaust components as shown on the drawings and as required to comply with NFPA 37 and local codes and regulations. Components shall be sized to assure full load operation without excessive backpressure sized as per manufacturer's recommendations with actual site dimensions when installed as shown on the drawing. Make provisions as required for pipe expansion and contraction.

C. Coordinate installation of anchor bolts with generator enclosure manufacturer.

D. Installation shall comply with applicable State and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

3.02 FIELD QUALITY CONTROL

A. Initial startup and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment.

B. Test data shall be collected and recorded on the following: time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabiliza-tion time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.

C. Procedure: Generator manufacturer shall conduct a six (6) hour load bank test at 1.0 power factor for each generator set. Contractor shall provide load bank for testing generator set at 100% load. Contractor is not permitted to use load bank specified as part of the testing requirements. Load bank test shall test generator at full nameplate KW rating. Generator manufacturer's representative shall record test data, as described in (B) above. Test data shall be tabulated and typed for submission and approval by the engineer for final acceptance. No handwritten field notes will be allowed.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Interior and exterior luminaries and accessories.

B. Emergency lighting and units.

1.02 REFERENCES

A. NEMA WD 6 - Wiring Devices - Dimensional Requirements.

B. NFPA 70 - National Electric Code.

C. NFPA 101 - Life Safety Code.

D. LM-79-08, IESNA Approved Method for the Electrical and Photometric Measurements of Solid-Sate Lighting Products

E. LM-80-08, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, performance data and installation instructions.

D. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

E. **All foot candle calculations and photometrics must be provided with substitute products. Photometrics shall include a room by room analysis showing walls, room names and room numbers. Calculation points shall be 2 feet on center, measured at 30" above the floor. Maintained foot candle levels shall meet or exceed those listed in Section 2.03A of specification 265000. On each drawing, provide a table showing the Room Name, Room Number, Maximum Light Level, Minimum Light Level, Average Light Level, Min:Max Ratio, and IES File Light Fixtrure Model Number.**

F. All substitute LED light fixtures and LED retrofit lighting kits must be Design Lights Consortium (DLC) qualified.

G. All substitute LED replacement lamps must be listed by Energy Star as Certified Light Bulbs.

1.04 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc.

1.05 1.06 - EXTRA PRODUCTS

A. Section 017800 - Closeout Submittals.

B. LED Fixtures: At completion of installation, deliver to Owner.

C. Refer to light fixture schedule drawings for quantities.

PART 2 - PRODUCTS

2.01 LIGHTING UNITS

A. Refer to LIGHTING FIXTURE SCHEDULE on drawings for fixture manufacturer, catalog number, and fixture description.

B. Provide electronic energy saving ballasts. Where dimming is shown on drawings, provide dimmable type ballasts.

C. Incandescent and high intensity discharge recessed lighting fixtures are to be furnished with thermal cut outs as required by NEC.

D. All fixtures equipped with emergency battery packs shall have test light and switch accessible and visible from the room floor.

2.02 LIGHTING FIXTURE NOTES

A. MOUNTING: Electrical Contractor is responsible for reviewing all mounting arrangements prior to ordering any products. Electrical Contractor is responsible for ordering all of the proper fixtures, mounting hardware and miscellaneous fasteners to complete project. Fixtures to be secured to the structure from a minimum of two points, at opposing ends of the fixture when ceiling recessed or surface mounted. Four points shall be secured where necessary for the fixture to be parallel and tight to underside of ceiling. All recessed fixtures to fit tight to ceiling to eliminate all light leaks. Trim kits, when not secured internally to fixture, shall be secured to structure at a minimum of two points.

B. MOUNTING: Prior to submitting and ordering any light fixture, Contractor is responsible for verifying adequate mounting clearances for all light fixtures that are to be recessed into a grid type ceiling. Where new ceilings are to be installed, contractor shall coordinate with ceiling installers for exact mounting heights and required mounting spaces.

C. FINISHES: All exposed portions (permanent or adjustable) of fixtures to be finished by the manufacturer in a finish as specified.

D. Fixtures shall come pre-assembled and complete with all sockets (incandescent to be spring supported), lamp ends, ballasts, transformers, fixture ends, trim rings, plates, and low density mounting kits (as required) for a complete installation.

E. LENSES:
   1. Minimum 0.125” thick and to be virgin acrylic.
   2. Low voltage - Tempered glass, to enclose lamp.

F. LAMPS: SYLVANIA, PHILLIPS or GENERAL ELECTRIC, as selected by the Electrical Contractor. Note, all lamps for one project to be furnished by the same manufacturer unless otherwise specified. At the end of the project, the Electrical Contractor shall turn over to the Owner one lamp envelope from each type installed. The Contractor shall be responsible for

replacing all lamps which burn out during construction and up to ninety (90) days after Owner occupancy of the building.

G. VOLTAGE: As noted on the LIGHTING FIXTURE SCHEDULE. Contractor is responsible for field verifying available voltage(s) and ordering fixtures, ballasts, and transformers accordingly.

H. ORDERING: It is solely the responsibility of the Contractor to order fixtures, lamps, mounting brackets and accessories so that the fixtures will be installed and operating upon Owner Occupancy opening. Contractor is responsible for all delays because of his/her lack of effort to order the products in a timely manner.

I. SHIPPING: The light fixture manufacturer shall mark the fixture type as indicated on the contract drawings and/or shop drawings on the respective carton when shipping luminaries. The Contractor shall be responsible for checking each carton immediately upon receipt for verification that fixtures are undamaged and no contents are missing. All discrepancies must be reported to shipper and manufacturer immediately; otherwise the Contractor shall be responsible for items which are lacking or damaged.

2.03 REQUIRED LIGHT LEVELS

A. Requirements for maintained horizontal foot-candles for each location within each building are listed below. Confirm designated use of each “Location” with owner and engineer prior to beginning calibration work:

Location	**Required Maintained Horizontal Foot-Candles**
Offices [on desks]	35
Meeting Rooms	35
Apparatus Bays	40
Locker rooms and toilets	20

2.04 WARRANTY

A. All light fixtures shall have a 5-year manufacturer’s warranty. Warranty shall begin on date of substantial completion.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install fixtures in accordance with manufacturer's instructions.

B. Mount fixtures in locations as shown on drawings and as called for in schedule on electrical drawings. Determine type of ceiling to be installed in each space from drawings and schedules and furnish fixtures suitable for the exact type.

C. Joints in fixture wiring shall be made using wire nuts, pre-insulated Scotch locks, or other approved mechanical means of connection.

D. Adjustable type fixtures shall be adjusted by the Contractor to illuminate intended area to satisfaction of the Engineer.

E. Surface fixtures in or on plastered or drywall ceilings shall be supported from pieces of support channel spanning across main support channels and shall not depend on ceilings for support.

F. Coordinate fixture locations to clear diffusers, ductwork, piping, etc.

G. Maintain integrity of enclosures on all enclosed and gasketed fixtures. Minimize number of enclosure penetrations and make such penetrations water and dust tight with appropriate gasketing and fittings.

H. Fixtures are to fit tight against construction to eliminate light leaks.

I. Recessed downlights are to be provided with adjustable mounting bars/frames for drywall or lay-in ceilings as required. Fixtures shall be securely fastened to the ceiling framing member by mechanical means such as bolts, screws, rivets, or listed clips identified for use with the type of ceiling framing members and fixtures.

J. Support recessed fixtures 2 foot x 2 foot and larger using a minimum of four independent wire hangers, one on each corner, of same gauge as ceiling suspension system supported from building structure independent of ceiling framing. Install earthquake clips to secure recessed grid-suspended luminaries in place.

K. Wall-mounted fixtures shall be mounted plumb with building lines and installed with proper box and cover hardware.

L. Surface-mounted fixtures are to cover mounting hardware. Use a canopy that is no longer than the length and width of the fixture and at a height that is no higher than required to mount the fixture absolutely vertical. Fixtures shall be plumb and shall align with building lines and with each other. Support surface mounted luminaries on grid ceiling directly from building structure. Secure to prevent movement.

M. Stem-mounted fixtures are to be mounted to be absolutely vertical or horizontal. Install suspended luminaries using pendants supported from swivel hangers or in accordance with details shown in drawings. Provide pendant length required to suspend luminaire at indicated height. Support stem-mounted fixtures directly from the building structure.

N. Install recessed luminaries using accessories and firestopping materials to meet regulatory requirements for fire rating. In fire rated ceilings, recessed luminaries must carry one-hour UL fire rating classification.

O. Install all accessories specified with each fixture. Install recessed luminaries to permit removal from below.

P. Bond products and metal accessories to branch circuit equipment grounding conductor.

Q. At completion of installation and before turning over to owner, clean and remove all dirt and smudges from all lighting fixtures including lenses, louvers and reflectors.

R. Relamp luminaries that have failed at completion of project.

END OF SECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Main Circuit Breaker/Current Transformer/Meter Cabinet and Meter Pan.

B. Secondary conduits, conductors, excavation, concrete and backfill.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electric Code.

1.03 SUBMITTALS

A. Submit product data under provisions of Section 013300.

PART 2 - PRODUCTS

2.01 METERING EQUIPMENT

A. Meter pans, meter, current transformers and ground fault circuit protection shall be on Con Edison's approved lists of manufacturers and models.

B. CT Cabinets, Current Transformers and Ground Fault Protection shall be factory installed into motor control center manufacturer’s structures as per Con Edison specifications.

2.02 PULL BOXES

A. Provide pull boxes including property line pull boxes as per Con Edison requirements for both primary and secondary services.

B. Provide Con Edison approved property line pull box for all secondary services above 400 amperes.

2.03 CABLE

A. Install new secondary service conductors in conduit.

B. Primary service conductors shall be 15 KV, copper size 1/0, type TR-XLPE with 220 mils insulation thickness as per ConEd requirements.

C. Secondary service conductors shall be installed per Con Edison requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate secondary service installation with Con Edison prior to beginning work.

B. Contractor shall file application for new electrical service and pay related fees. Contractor shall coordinate with owner for all information related to the service application.

END OF SECTION

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PART 1 - GENERAL

1.01 1.01 - SECTION INCLUDES

A. Temporary electric service for construction.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electric Code.

1.03 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Shop Drawings: Indicate locations where temporary electric service will be located and routed.

1.04 REGULATORY REQUIREMENTS

A. Obtain required permits from authorities.

B. Notify affected utility companies before starting work and comply with their require-ments.

C. Do not close or obstruct egress width to exits.

D. Do not turn off electric equipment without authorization from Owner and Engineer. Provide 72 hours advance notification.

PART 2 - PRODUCTS

2.01 TEMPORARY ELECTRIC SERVICE

A. Temporary service shall be available during the entire contract period and during all phases of work, day and night for the fire station.

B. Temporary service shall be installed and maintained per NEC, OSHA, IBC New York State and Con Edison requirements.

C. The temporary electrical service shall be sized correctly for all of the new and existing loads.

D. All existing equipment shall be protected against damage caused by the installation, operation and removal of the temporary service. Any equipment or items damaged shall be replace at no cost to the Owner.

E. Provide temporary lighting for fire station. Minimum foot candle for temporary lighting: 30fc, measured at floor surface. The Contractor shall set up light to minimize glare.

F. Provide wiring, utility poles, metering equipment, distribution panel and other equipment for temporary light and power to fire station. Contractor shall pay all fees required for temporary service and complete all required applications. Contractor shall pay all application and construction fees required for temporary service and complete all required applications. Contractor shall pay for all electrical consumption for temporary service.

G. Provide Owner with three (3) keys to all distribution panels for temporary power for distribution to General Contractor and Village Personnel.

H. Wiring for temporary light, controls and power shall include a distribution panel for 3 phase, 4 wire, 120/208 volt, 200 AMP service. Feeders in building shall have branch circuits of #12 conductors minimum. Contractor shall pay all application and construction fees required for temporary service and complete all required applications

I. Provide 20 amp branch circuits with fused ground type receptacle outlet for single phase power.

J. Where distribution panels are provided for temporary power provide four (4) 20 amp circuits with #12 AWG SO cord pigtails with 20 amp plugs with strain relief. Provide one (1) 30 amp circuit with #10 AWG SO cord pigtail with 30 amp plug with strain relief.

K. Provide lamps and fuses, including replacements required.

L. Provide new materials for temporary light and power.

M. Provide ground fault protection (such as portable plug-in type ground fault circuit interrupters) on single phase 20 amp receptacle outlets.

N. Provide receptacle outlets, portable cord connectors and attachment plugs with standard NEMA configurations.

O. Install all temporary light and power materials in accordance with National Electrical Code and OSHA requirements.

P. Upon completion of the project, remove all temporary electric light and power work and restore all affected finishes, connections and sitework.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing system voltage characteristics and match to existing system voltage characteristics.

B. Verify that the temporary service is sized to accommodate all loads.

C. Determine locations and routings for temporary electric wires, cables and conduits with Engineer and Owner.

3.02 TEMPORARY POWER

A. Temporary wiring and power shall be installed so as not to be a hazard and shall be protected from damage. Separate circuits shall be provided for light and power. Over-current protective devices and switches shall be provided. All equipment, tools, metal cabinets and boxes shall be grounded.

B. Disable existing power only to make final connections or when new service is to be installed.

C. Remove and dispose of all temporary power and control feeds after receiving written approval from Engineer. Restore all finishes to original specified conditions.

END OF SECTION

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Fire Alarm Control Panels (FACP).

B. Remote Annunciator.

C. Addressable Manual Fire Alarm Stations.

D. Addressable Area Smoke Detectors.

E. Addressable Duct Mounted Smoke Detectors.

F. Remote for Smoke Alarms.

G. Heat Sensors.

H. Audio/Visuals.

I. Visual Devices.

J. Pull Stations.

K. Door Hold/Release

L. Addressable Carbon Monoxide Detectors

M. IP / Cellular Digital Communicator

1.02 RELATED SECTIONS

A. Section 260533 - Raceways and Boxes for Electrical Systems.

1.03 REFERENCES

A. NFPA 70 - National Electrical Code.

B. NFPA 72 - National Fire Alarm Code.

C. NFPA 101 - Life safety code.

1.04 WORK INCLUDED

A. Furnish and install as described in these specifications and as indicated on the drawings, fire alarm and smoke detection equipment with battery backup.
   1. All equipment shall be UL listed under category UOJZ as an integrated control system; equipment listed under category UOXX as a control unit accessory shall not be acceptable. The installation shall meet the applicable requirements of NFPA 72 and New York State Code, as well as those standards set by the authorities having jurisdiction.
   2. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component. The catalog numbers specified under this section constitute the type, product quality, material and desired operating features.
   3. Provide all labor, materials and services to perform all operations required for the complete installation and related work shown on the drawings and as specified herein.

4. All electrical work and equipment shall meet the requirements of NFPA 70 and 72.
5. Existing fire alarm system to be disconnected and removed in its entirety once new system is installed, operational and tested. Contractor to patch and paint all openings as a result of removed equipment. Contractor to provide and install new ceiling tiles to match existing where damaged or holes are left from removed equipment.

1.05 SUBMITTALS

A. Submit product data as required by Section 013300.
   1. Two copies of all submittals shall be submitted to the Architect/Engineer for review.
   2. All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality.
   3. Equivalent equipment (compatible UL-Listed) from other manufacturers may be substituted for the specified equipment as long as the minimum standards are met, and upon approval of the Architect/Engineer.

B. Shop drawings:
   1. Provide a list (bill of materials) of all types of equipment and components provided.
   2. Provide annunciator layout and system wiring diagram showing each device and wiring connection required, including existing equipment. Provide a description of operation of the system. Provide system ampere load and time calculations to substantiate compliance with battery back-up (24 hours in non-alarm condition followed by 5 minutes in alarm, after normal power loss)
   3. Sufficient information, clearly presented shall be included to determine compliance with drawings and specifications.
   4. Include manufacturer's printed product data with name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.

C. Manuals:
   1. Submit simultaneously with the shop drawings, complete operating and maintenance manual listing the manufacturers name(s) including technical data sheets.
   2. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
   3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.
   4. Indicate application conditions and limitations of use stipulated by product testing agency.
   5. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of products

D. Test Reports and Certifications:
   1. Indicate satisfactory completion of required tests and inspections.
   2. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.
   3. Contractor shall provide Engineer with a complete set of drawings (including all floors, crawl spaces, closets, open spaces) showing a complete survey of all new fire equipment devices and appliances prior to submission to Fire Marshal. Contractor shall provide Engineer with a complete list of all HVAC equipment to remain, including their associated CFM ratings and all associated duct smoke detectors. Upon approval from Engineer, Contractor shall submit complete package, with New York professional engineer's stamp, to Fire Marshal as per local requirements. The Contractor shall have a licensed New York State Professional Engineer stamp all drawings and applications, including submittals for approval from H2M. Pay for all fees to obtain permits and approval.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 017839.

B. Record actual locations of initiating devices, signaling appliances, and end-of-line devices as they are installed.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 017839.

B. Minimum maintenance, inspection and testing must be in accordance with provisions in NFPA 72: National Fire Alarm and Signaling Code Fire Code. A preventive maintenance schedule shall be provided by the Contractor that shall describe the protocol for preventative maintenance. The schedule shall include:
   1. Systematic examination, adjustments and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays and all accessories of the fire alarm system.
   2. Each circuit in the fire alarm system shall be tested semiannually.
   3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten (10) years documented experience, and with service facilities within fifty (50) miles of project location.

B. Installer: Company specializing in installing the products specified in this section with minimum three (3) years documented experience, and certified by the State of New York as fire alarm installer.

1.09 PERMITTING

A. The Contractor shall submit to the local Fire Marshal all necessary drawings, equipment specifications, and applications required for a complete Fire Marshal approved system.

B. The Contractor shall have a licensed New York State Professional Engineer stamp all drawings, complete all applications, and pay for all fees to obtain permits and approvals.

PART 2 - PRODUCTS

2.01 2.01 - MANUFACTURERS

A. SILENT KNIGHT (OR APPROVED EQUAL)

2.02 GENERAL

A. All equipment and components shall be new, and the manufacturer’s current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of a protected premises protective signaling (fire alarm) system.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning equipment installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

D. All equipment locations shall comply with ADA requirements for mounting heights and accessibility.

2.03 CONDUIT AND WIRE

A. Conduit:
   1. Conduit shall be in accordance with the National Electric Code (NEC), local and state requirements.
   2. All wiring shall be installed using plenum rated cable. Refer to the conduit specification for additional conduit requirements.
   3. Cable must be separated from any open conductors, as per NEC Article 760-29.
   4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals
   5. Conduit shall enter the Fire Alarm Control Panel, Remote Annunciator Panel and/or backboxes where conduit entry is designated and permitted by the FACP manufacturer.
   6. Conduit shall be ¾ inch (19.1 mm) minimum.
   7. In finished areas where conduit cannot be concealed, surface mounted raceway is to be used and shall be painted to match wall color.

B. Wire:
   1. All fire alarm system wiring shall be new.
   2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760), and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and not less than 14 AWG (1.63mm) for Notification Appliance Circuits. All wiring shall be of the type recommended by the manufacturer.
   3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
   4. All wire and cable shall have a fire resistance rating suitable for the installation as indicated in NFPA 70, and shall test free from grounds or crosses between conductors.
   5. Wiring used for the multiplex communication loop shall be twisted and shielded and installed in conduit unless specifically excepted by the fire alarm equipment manufacturer. The system shall permit use of IDC and NAC wiring in the same conduit with the communication loop
   6. All field wiring shall be completely supervised.

C. Terminal Boxes, Junction Boxes and Cabinets:
   1. All boxes and cabinets shall be UL listed for their use and purpose.

D. Circuits shall be arranged to serve like categories (manual, smoke, horn, strobe). Mixed category circuitry shall not be permitted except on signaling line circuits connected to addressable reporting devices.

2.04 SEQUENCE OF OPERATIONS

A. Basic Addressing and Circuiting Guidelines
   1. The addressable fire alarm system shall provide an individual multiplex data address for each addressable manual fire alarm station, addressable area smoke detector, addressable duct smoke detector, addressable heat detector, Monitor Zone Addressable Module (MZAM), Control Zone Addressable Module (CZAM) or Signal Zone Addressable Module (SZAM).
   2. The FACP shall provide NFPA Standard 72A, Style 4 (Class B, two wire) addressable data communications circuits to provide connection of and communication with the addressable devices, as required by these Specifications and/or as shown on the Drawings. Each addressable data communications circuit shall provide the capability of communicating with up to ninety nine (99) addressable devices.

B. Fire Alarm System Sequence of Operation
   1. The FACP central processing unit (CPU) shall provide for the monitoring of addressable, smoke sensors. Each smoke sensor shall be individually monitored for its normal output voltage level, which is a function of accumulating environmental factors such as dirt and dust. The normal output voltage level shall be digitized and transmitted to the FACP CPU every four (4) seconds. The FACP CPU shall maintain a moving average of these normal voltage outputs in an individual sensor average file. When smoke enters the sensor, the output voltage rises in direct proportion to the density of the smoke and the alarm condition of each smoke sensor is determined at the FACP CPU by comparing the current actual value with the sensor's normal average value combined with the alarm threshold programmed for that sensor. The alarm threshold may be individually programmed for each smoke sensor as a sensitivity percentage (0.5%, 1.0%, 1.5%, 2.0%, 2.5%, 3.0% and 3.7%) above its normal average value. The sensitivity percentage for each sensor may also be programmed to change as a function of the time of day and day of week. When an individual sensor's normal average value rises to a fixed, preset level due to excess accumulation of dirt and dust, a system trouble condition shall be generated and a "sensor dirty" message shall be displayed, for that sensor, on the FACP LCD display and entered into the system historical trouble log. If the sensor is not cleaned and further accumulation occurs that would degrade proper sensor operation, a second system trouble condition shall be generated and a "sensor excessively dirty" message shall be displayed and entered into the system historical trouble log.
   2. Operation of any manual fire alarm station or activation of any smoke sensor, area smoke detector, duct smoke detector, or heat detector throughout the building shall automatically:
      a. Sound all horns (except the exterior sprinkler horn/strobe) throughout the building with an individual Temporal ‘3’ Code. The alarm signals may be silenced during the alarm condition by operation of the FACP alarm silence switch. Subsequent alarm conditions shall re-sound the alarm horns.
      b. Flash all alarm strobe lights (except the exterior sprinkler horn/strobe) throughout the building. The alarm strobe lights shall be turned off when the system is reset.
      c. Display a general alarm indication and system status summary (numbers of alarm, supervisory and/or trouble conditions) on the FACP liquid crystal display (LCD). Pressing the alarm acknowledge key shall display, for thirty (30) seconds, the individual device or circuit display, to include the "alarm" status and custom label (up to forty characters and spaces) for the addressable device or circuit of alarm initiation on the liquid crystal display (LCD). At the end of the thirty (30) second period, the general alarm indication and system status summary shall again be displayed. The individual device/circuit display may be recalled at any time by repressing the alarm acknowledge key or until the alarm condition is reset to normal.
      d. Enter the alarm condition custom label with time and date of occurrence into the FACP historical alarm log for future recall.
      e. Shutdown all fans over 1000 CFM.

f. Release Magnetic Door Hold Opens.
g. Activate circuit for to initiate alarm to central station. The Central station monitoring shall be furnished by owner.

3. Operation of any carbon monoxide detector the building shall automatically:
   a. Sound the integral sounder base on the carbon monoxide detector in alarm only, with an individual Temporal ‘4’ Code. The alarm signals shall only be silenced when carbon monoxide detector is no longer in alarm.
   b. Display/sound an alarm indication and system status summary (numbers of alarm, supervisory and/or trouble conditions) on the FACP liquid crystal display (LCD) stating “Carbon Monoxide Alarm”. Pressing the alarm acknowledge key shall display, for thirty (30) seconds, the individual device or circuit display, to include the "alarm" status and custom label (up to forty characters and spaces) for the addressable device or circuit of alarm initiation on the liquid crystal display (LCD). At the end of the thirty (30) second period, the general alarm indication and system status summary shall again be displayed. The individual device/circuit display may be recalled at any time by repressing the alarm acknowledge key or until the alarm condition is reset to normal.
   c. Enter the alarm condition custom label with time and date of occurrence into the FACP historical alarm log for future recall.
   d. Shutdown all fans over 1000 CFM.
   e. Release Magnetic Door Hold Opens.
   f. Activate circuit for to initiate alarm to central station stating “Carbon Monoxide Alarm”. The Central station monitoring shall be furnished by owner.

2.05 MAIN FIRE ALARM CONTROL PANEL

A. The fire alarm control panel (FACP) shall be the Silent Knight 6820 analog/ addressable control panel.

B. The following FACP hardware shall be provided:
   1. The FACP must have a 6 amp power supply and be capable of expansion to a maximum of 54 total amps via bus connected expander modules that supervise low battery, loss off AC and loss of communication.
   2. The FACP must have Drift Compensation sensitivity capabilities on detectors and be capable of supporting 99 detectors and 99 analog addressable modules and expandable to a maximum of 396 detectors and 396 modules. This shall be accomplished via four signaling line circuits (SLC) capable of supporting a minimum of 99 detectors and 99 addressable module devices each. The communication protocol on the SLC loop must be digital.
   3. The FACP must support a minimum of six programmable “Flexputs”. The panel must have a built in 80 character LCD annunciator with the capability of having an additional eight supervised remote annunciators connected in the field.
   4. The FACP must have a built in UL approved digital communicator. The communicator must allow local and remote up/downloading of system operating options, event history, and detector sensitivity data.
   5. The FACP must automatically test the smoke detectors in compliance with NFPA standards to ensure that they are within listed sensitivity parameters and be listed with Underwriters Laboratories for this purpose.
   6. The FACP must compensate for the accumulation of contaminants that affect detector sensitivity. The FACP must have maintenance alert feature (differentiated from trouble condition), detector sensitivity selection, auto-programming mode (Jumpstart) and the ability to upgrade the core operating software on site or over the telephone.
   7. The FACP shall have a Jumpstart feature that can automatically enroll all properly connected accessories into a functional system within 60 seconds of powering up the panel. Panels that do not have these capabilities will not be accepted.

8. The main communication bus (S-Bus RS485) shall be capable of class A or class B configuration with a total Bus length of 6,000 feet.
9. Cabinet: Lockable steel enclosure. Arrange unit so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to from a complete control unit, provide exactly matching modular unit enclosures. The system cabinet shall be red and can be either surface or flush mounted. The cabinet door shall be easily removable to facilitate installation and service
10. The main control must have a built in annunciator with an 80-character LCD display and feature LED's for General alarm, Supervisory, System trouble, System Silence and Power. When in the normal condition the LCD shall display time and date based on a 200 year clock which is capable of automatic daylight savings time adjustments. All controls and programming keys are silicone mechanical type with tactile and audible feedback. Keys have a travel of .040 inches. No membrane style buttons will be permissible. The annunciator must be able to silence and reset alarms through the use of a keypad entered code, or by using a firefighter's key. The annunciators must have twenty levels of user codes that will allow the limitation of operating system programming to authorized individuals.
11. The fire system shall be able to support up to eight I/O modules (SK5880) that shall be used to drive remote LED graphic style displays and accommodate up to eight dry contact type switch inputs. The I/O modules shall each drive up to 40 LEDs without requiring external power connections. The I/O module inputs shall be supervised and be suitable for alarm and trouble circuits as well as reset and silence switches. The system shall also support up to 40 LED drivers that reside on the two-wire SLC loop. These driver boards shall contain 80 LED outputs that are powered by an external power source.
12. An audible system trouble sounder shall be an integral part of the control unit. Provisions shall also be provided for an optional supervised remote trouble signal.
13. The entire system shall operate on 24 VDC, filtered switch mode power supply with the rated current available of 6 Amps. The FACP must have a battery charging circuit capable of complying with the following requirements:
    a. Twenty Four (24) hours of battery standby with five (5) minutes of alarm signaling at the end of this twenty four (24) hour period (as required per NFPA 72 remote station signaling requirements) using rechargeable batteries with automatic charger to maintain standby gel-cell batteries in a fully charged condition. Battery shall be sized for all devices shown on the drawings plus 20% additional expansion.
    b. The power supply shall comply with U.L. Standard 864 for power limiting.
    c. The FACP will indicate a trouble condition if there is a loss of AC power or if the batteries are missing or of insufficient capacity to support proper system operation in the event of AC failure. A "Battery Test" will be performed automatically every minute to check the integrity of the batteries. The test must disconnect the batteries from the charging circuit and place a load on the battery to verify the battery condition.
    d. In the event that it is necessary to provide additional power one or more of the model 5895XL or 5496 Distributed Power Modules shall be used to accomplish this purpose.
    e. The FACP shall be capable to be networked to the existing data network via a Silent Knight Gateway. See Section 2.31 for additional information.

2.06 PERIPHERAL DEVICES

A. Manual Fire Alarm Stations (Model #: SK-Pull-SA) shall be addressable, single action type, with a key operated test-reset lock in order that they may be tested, and so designed that after actual emergency operation, they cannot be restored to normal except by use of a key. The reset key shall be so designed that it will reset manual station and open FACP without use of another key.

B. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of fifty feet, front or side.

C. Manual stations shall be constructed of red LEXAN or die cast metal with clearly visible operating instructions on the front of the stations in raised letters.

D. Stations shall be suitable for surface mounting on matching backbox, or semi-flush mounting on a standard single-gang box, and shall be installed within the limits defined by the Americans with Disabilities Act (ADA) dependent on manual station accessibility or per local requirements

E. Protective Shield shall be STI Model 1100 with tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

2.07 SMOKE SENSORS

A. Smoke detectors shall be Silent Knight (Model SK-PHOTO) ceiling mounted, addressable photoelectric smoke detectors.

B. The combination detector head and twist lock base shall be U.L. listed compatible with the Silent Knight 6820 fire alarm control panel.

C. The base shall permit direct interchange with Silent Knight's SK-Ion ionization smoke detector, SK-Acclimate multi-criteria smoke detector or the SK-Heat detector. The base shall be the appropriate twist lock base B210LP.

D. The smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel's reset switch.

E. The sensitivity of the detector shall be capable of being selected and measured by the control panel without the need for external test equipment.

F. It shall be possible to perform a sensitivity test of the detector without the need of generating smoke. The test method shall simulate the effects of products of combustion in the chamber to ensure testing of the detector circuits. Detectors shall have completely closed back to restrict entry of dust and air turbulence and have a 30 mesh insect screen.

G. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I.

2.08 MULTI-CRITERIA DETECTOR WITH CARBON MONOXIDE SENSING AND INTEGRAL SOUNDER BASE.

A. Carbon Monoxide Detector (with integral fire detection) shall be Silent Knight (Model SK-FIRE-CO), addressable carbon monoxide detector.

B. Each carbon monoxide shall be provided with a sounder base (Model B200S, sold separately).

C. When a carbon monoxide sensor is in alarm, that carbon monoxide sounder base only shall sound a 'Temporal 4' code pattern.

2.09 DUCT SMOKE SENSORS

A. Interior Duct Smoke Detectors (sensors) shall be Silent Knight (Model SK-Duct) with the Model SK-Photo Smoke detectors. Exterior Duct Smoke Detectors shall have a weatherproof enclosure (Model DH400OE-1) and shall be compatible with SK-Photo Smoke detectors.

B. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied.

C. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

D. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

E. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch.

F. All duct smoke detectors installed above a finished ceiling shall have a remote LED installed flush with the ceiling below the unit.

2.10 HEAT SENSORS

A. Heat Sensors shall be Silent Knight (model SK-Heat) ceiling mounted, addressable fixed temperature at 135 degrees Celsius.

B. The combination heat detector and twist lock base shall be U.L. listed compatible with the Silent Knight 6820 fire alarm control panel.

C. The base shall permit direct interchange with the Silent Knight SK-Ion smoke detector, SK-Acclimate smoke detector and the SK-Photo photoelectric smoke detector. The base shall be appropriate twist lock base B210LP.

D. The heat detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel’s reset switch.

E. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I.

F. Weather Proof Heat Detectors (Honeywell Model 302-EPM-194 or approved equal) - Shall be installed with a remotely located addressable module. Module shall be located as stated on drawings.

2.11 ANNUNCIATION (NOTIFICATION) DEVICES

A. The visual and audio/visual signaling devices shall be compatible with the 6820 as stated in the installation manuals and be Listed with Underwriters Laboratories Inc. per UL 1971 and/or 1638.

B. The visual and audio/visual signaling devices shall be wall mounted to meet ADA requirements.

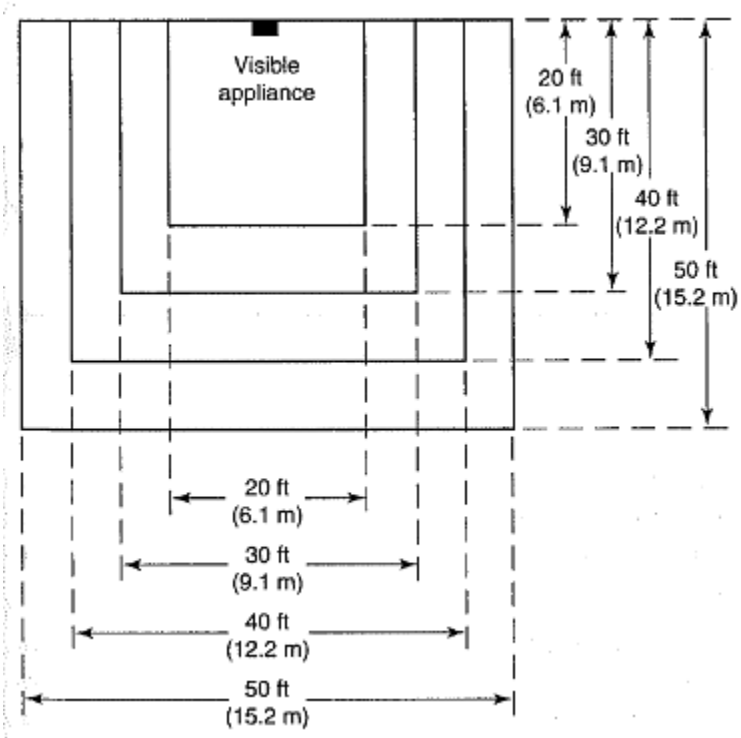
C. Each indicating appliance circuit shall be electrically supervised for opens, grounds and short circuit faults, on the circuit wiring, and shall be so arranged that a fault condition on any indicating appliance circuit or group of circuits will not cause an alarm to sound. The occurrence of any fault will light the trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.

D. The notification appliance (combination audio/visual units only) shall produce a peak sound output of 90dba or greater as measured in an anechoic chamber.

E. The notification appliance (combination audio/visual units and visual only units) shall provide field selectable flash intensities of 15cd, 30cd, 75cd, 110cd. The appliance shall be capable of meeting the candela requirements of ADA. Provide, adjust and install audio/visual units and

visual units to meet the requirements of NFPA 72, defined in Room Spacing for Wall-Mounted Visible Appliances Table and Figure below:

Maximum Room Size		*Minimum Required Light Output [Effective Intensity (cd)]*		
ft	*m*	*One Light per Room*	*Two Lights per Room (Located on Opposite Walls)*	*Four Lights per Room (One Light per Wall)*
20 × 20	6.10 × 6.10	15	NA	NA
28 × 28	8.53 × 8.53	30	Unknown	NA
30 × 30	9.14 × 9.14	34	15	NA
40 × 40	12.2 × 12.2	60	30	15
45 × 45	13.7 × 13.7	75	Unknown	19
50 × 50	15.2 × 15.2	94	60	30
54 × 54	16.5 × 16.5	110	Unknown	30
55 × 55	16.8 × 16.8	115	Unknown	28
60 × 60	18.3 × 18.3	135	95	30
63 × 63	19.2 × 19.2	150	Unknown	37
68 × 68	20.7 × 20.7	177	Unknown	43
70 × 70	21.3 × 21.3	184	95	60
80 × 80	24.4 × 24.4	240	135	60
90 × 90	27.4 × 27.4	304	185	95
100 × 100	30.5 × 30.5	375	240	95
110 × 110	33.5 × 33.5	455	240	135
120 × 120	36.6 × 36.6	540	305	135
130 × 130	39.6 × 39.6	635	375	185



F. The appliance shall be polarized to allow for electrical supervision of the system wiring. The unit shall be provided with terminals with barriers for input/output wiring and be able to mount a single gang or double gang box or double workbox with the use of an adapter plate.

G. Power supplies and batteries shall be sized to accommodate 110 cd at each strobe.

H. Sprinkler horn/strobe shall be Wheelock #MTWPB-24MCCH-NW or approved equal that is compatible with the 6820. Sprinkler horn/strobe shall have a blue lens.

2.12 MAGNETIC DOOR HOLDERS

A. The magnetic door holders shall be compatible with the 6820 as stated in the installation manuals and be listed with Underwriters Laboratories Inc. per UL 228.

B. The magnetic door holders shall be equipped for surface mounting as indicated and are complete with matching doorplate. Unit shall operate from a 120VAC, 24VAC. 24VDC source and develops a minimum of 25 lbs. holding force.

2.13 REMOTE LCD ANNUNCIATOR

A. The fire system shall be capable of supporting up to eight remote annunciators. Remote Annuciators shall be Silent Knight (Model 5860).

B. LCD Remote annunciators shall have the same control and display layout so that they match identically to the built in annunciator.

C. Remote annunciators shall be capable of operating at a distance of 6000 feet from the main control panel on unshielded non-twisted cable.

D. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

E. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

F. The LCD shall display the following information relative to the abnormal condition of a point in the system:
   1. 40 character custom location label.
   2. Type of device (e.g smoke, pull station, heat)
   3. Point status (e.g. alarm, trouble)
   4. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge. Silence and Reset operation shall be the same as the FACP.

2.14 GRAPHIC MAP

A. Contractor shall provide and install a weather proof map of the facility. Map shall be on 24” by 36” laminated paper, minimum. Contractor shall program descriptions for detection devices to include room number, name and device address. Contractor shall coordinate with Village for exact descriptions prior to programming. Map shall be provided with and installed in a weatherproof lockable enclosure, with a clear display window (41” x 42-1/4” x 2”, minimum) (Displays 260 Model ODNBCB12BK or approved equal) located adjacent to each remote annunciator and fire alarm control panel. Village will provide contractor with a drawing of the facility in AutoCAD 2000 format.

2.15 DISTRIBUTED POWER MODULE

A. The contractor shall supply (where required) a power module (model 5895XL) compatible with the 6820 fire alarm control panel.

B. The power module must have 6 amps of output power, six notification circuits rated at 3 amps each, and two form C relay circuits rated at 2.5 amps at 24 volts DC. The six notification circuits shall have the same functionality as the notification circuits on the main panel.

C. The 5895XL shall be capable of being connected via a RS-485 system bus (SBUS) at a maximum distance of 6000 feet from the main control panel. The power module shall contain an additional RS-485 bus that is completely compatible with all 6820 add on modules including 5860 Remote Annunciators, 5824 serial/parallel modules and addressable devices. The power module will also act as a bus repeater so that additional RS-485 (modules) devices can be connected at a maximum distance of 6000ft. from the power module.

D. The 6820 shall be capable of supporting up to eight (8) of the Distributed Power Modules in any combination.

E. The power module's RS-485 bus shall be electrically isolated providing ground loop isolation and transient protection.

2.16 DIGITAL COMMUNICATOR

A. IP / Cellular Digital Communicator shall be Honeywell (Model: IPGSM-4G).

B. Digital communicator shall communicate with central station via both IP networked and cellular connections (IP primary, cellular backup).

C. Fire alarm control panel shall be provided with Digital Alarm Communicator Transmitter (DACT) compatible with the IP / Cellular Digital Communicator.

D. The digital communicator must be capable of reporting all zones or points of alarm, supervisory, and trouble as well as all system information such as loss of AC, low battery, ground fault, loss of supervision to any remote devices with individual and distinct messages to a central station or remote station.

E. The communicator must also be capable of up/downloading all system programming options, event history, and sensitivity compiance information to a PC on site or at a remote location.

F. The communicatior must be capable of reporting via SIA and Contact ID formats. The communicator shall have a delayed AC loss report function which will provide a programmable report delay plus 10-25 min random component to help ease traffic to the central station during a power outage.

G. Controls that use external modems for remote programming and diagnostics shall not be accepted.

H. Digital communicators that communicate via POTS telephone lines or mesh radio networks shall not be accepted.

I. Controls that use External modems for remote programming and diagnostics shall not be accepted.

2.17 DRY CONTACTS

A. The FACP will have three form “C” dry contacts, one will be dedicated to trouble conditions, the other two will be programmable for alarm, trouble, notification, pre-alarm, manual pull, aux. 1 or aux. 2. The trouble contact shall be normal in an electrically energized state so that any total power loss (AC and Backup) will cause a trouble condition. In the event that the Microprocessor on the FACP fails the trouble contacts shall also indicate a trouble condition.

2.18 GROUND FAULT DETECTION

A. A ground fault detection circuit, to detect positive and negative grounds on all field wiring. The ground fault detector shall operate the general trouble devices as specified but shall not cause an alarm to be sounded. Ground fault will not interfere with the normal operation, such as alarm, or other trouble conditions.

2.19 OVER CURRENT PROTECTION

A. All low voltage circuits will be protected by microprocessor controlled power limiting or have self restoring polyswitches for the following: smoke detector power, main power supply, indicating appliance circuits, battery standby power and auxiliary output.

2.20 TEST FUNCTIONS

A. A “Lamp Test” mode shall be a standard feature of the fire alarm control panel and shall test all LED’s and the LCD display on the main panel and remote annunciators.

B. A “Walk Test” mode shall be a standard feature of the fire alarm control panel. The walk test feature shall function so that each alarm input tested will operate the associated notification appliance for two seconds. The FACP will then automatically perform a reset and confirm normal device operation. The event memory shall contain the information on the point tested. the zone tripped, the zone restore and the individual points return to normal.

C. A “Fire Drill” mode shall allow the manual testing of the fire alarm system notification circuits. The “Fire Drill” shall be capable of being controlled at the main annunciator, remote annunciators and via a remote contact input.

D. A “Bypass Mode” shall allow for any point or nac circuit to be bypassed without effecting the operation of the total fire system.

2.21 REMOTE INPUT CAPABILITIES

A. The control panel shall have provisions for supervised switch inputs for the purpose of Alarm reset and Alarm and trouble restore.

2.22 NOTIFICATION APPLIANCE MAPPING STRUCTURE

A. All notification circuits and modules shall be programmable via a mapping structure that allows for a maximum of 250 output groups. Each of these groups shall have the ability to be triggered by any of the panels 125 Zones. A zone may trigger from groups individually, or may contain a global trigger for manual pull stations, fire drills and two different system alarms. Additionally each Zone will individually control the cadence pattern of each of the Groups that it is “Mapped” to so that sounders can indicate a variety of conditions. The Zone shall be capable of issuing a different cadence pattern for each of the Groups under it’s control. The mapping structure must also allow a group to be designated to “ignore cadence” for use with strobes and other continuous input devices. Zones shall have eight different output categories; Detector alarm,

Trouble, Pre-alarm, Manual pull, Zone auxiliary one and Zone Auxiliary two. Each of the categories shall have the ability to control from 1 to 8 output groups with a cadence pattern. The patterns are; March code, ANSI 3.41, Single Stroke Bell Temporal, California code, Zone 1 coded, Zone 2 coded, Zone 3 coded, Zone 4 coded, Zone 5 coded, Zone 6 coded, Zone 7 coded, Zone 8 coded, Custom output pattern 1, Custom output pattern 2, Custom output pattern 3, Custom output pattern 4, and Constant. This mapping/cadence pattern shall be supported by all system power supplies and Notification Expander Modules.

2.23 ON BOARD PROGRAMMER

A. The FACP shall have an on board programmer which will allow for all system functions and options to be programmed via the on board annunciator keypad. Any panel that does not have this capability will not be accepted.

2.24 DOWNLOADING SOFTWARE

A. The fire alarm control panel must support up/downloading of system programming from a PC under Windows7, Windows 8, Windows 98, Windows XP, Windows N/T, or Windows Vista. The FACP must also be able to download the detector sensitivity test results and a 1000 event system event buffer to the PC.

B. Communication shall take place over a direct connection to the PC and/or via the same telephone lines as the built in digital communicator and shall not require an external modem to be connected to the panel. The downloading software shall contain a code that will block unauthorized persons from accessing the panel via direct connection or over the phone lines.

2.25 FACILITY MANAGEMENT SOFTWARE

A. The FACP must support a facility management software capable of providing off site access to FACP data that is necessary to manage fire system operation. A software package capable of uploading the detector sensitivity test results and the 1000 event system event buffer to the PC shall be required as part of the bid package.

B. Communication shall take place over a direct connection to the PC and/or via the same telephone lines as the built in digital communicator. The facility management package must be separate from the downloader package and must not be capable of affecting programmed system options.

2.26 SERVICE REMINDER

A. The FACP shall be capable of automatically generating textual service reminder and the main and remote annunciator LCD’s to inform the user of required testing or service. The service reminder shall not interfere with the normal operation of the FACP.

2.27 ENGLISH LANGUAGE DESCRIPTIONS

A. The FACP shall provide the ability to have a text description of each system device, input zone and output group on the system. The use of individual lights to provide descriptions will not be acceptable.

2.28 ADDRESSABLE NOTIFICATION MODULE (INDIVIDUAL ADDRESSABLE MODULE)

A. The contractor shall furnish and install where indicated on the plans, addressable notification modules, Silent Knight model SK-Control. The modules shall be U.L. listed compatible with Silent Knight’s 6820 fire alarm control panel. The notification module must provide one class A (Style Z) or class B (Style Y) notification output with one auxiliary power input. The notification

module must be suitable for mounting in a standard 4 square electrical box and must include a plastic cover plate. The notification module must provide an LED that is visible from the outside of the cover plate. The notification module must be fully programmable for such applications as required by the installation. The SK-Control shall reside on the SLC loop and can be placed up to 10,000ft.from the control or 5815XL SLC loop module.

2.29 REMOTE POWER SUPPLIES

A. The Remote Power Supplies for Notification appliances shall be the Silent Knight Models 5496 and/or 5895XL. The 5496 and 5895XL Intelligent Power Supplies shall hang on the main S-Bus and be programmed through the 6820 control. The 5496 will support 6 amps of 24 volt DC power with 4 notification circuits rated at 3 amps each. The 5895XL will support 6amps of 24 volt DC power, with 6 Flexput circuits, rated at 3amps each. Two additional 5815 SLC loop expanders shall be capable of being installed in the cabinet, to allow an additional 396 points. The power supply will also regenerate the S-Bus for an additional 6000'.

B. The remote power supply model 5495 or 5499 may also be used on the system. These power supplies support 6amps or 9amps of 24VDC power with 4 notification circuits rated at 3amps each. These power boosters may also be activated from another notification circuit from either the fire alarm control or the Distributed Power Modules.

C. Provide all 120Volt wiring in conduit and as required.

2.30 REMOTE CRTS AND PRINTERS (SERIAL/PARALLEL INTERFACE)

A. The fire system shall be capable of supporting up to two serial / parallel interfaces (SK5824) that are capable of driving standard computer style printers. The interface shall be programmable as to what information is sent to it and shall include the ability to print out Detector Status by point, Event History by point and System Programming.

2.31 SILENT KNIGHT GATEWAY

A. The FACP shall include provision for networked system via the existing data network. Gateway module (Silent Knight IFPN-GW-KIT), shall include a NEMA 1 lockable enclosure and shall be mounted adjacent to the FACP.

B. IFP-Net-3 software shall be provided on a CD and left in the Gateway module enclosure for future use.

C. The Gateway Module shall provide future provisions for:
1. Autonavigation shall automatically locate and zoom to the device related to an alarm or event based on the priority of the event.
2. System Administrator-definable security profiles allow for extremely flexible definitions for operator accounts.
3. Standard mouse control which uses "point and click" operations.
4. Dynamically generated sizable key map.
5. New and Acknowledged Event boxes display all off-normal events, simultaneously with graphic screens.
6. Operator log with response tracking.
7. History Manager records operator, event, and response (with time and date stamp) to disk.
8. Powerful search filters for custom reporting of all events.
9. Screen database with screens for all sites.
10. Administrator-definable macros for device communication.
11. Definable function keys, functional buttons, and navigational buttons.
12. Floor plans can be zoomed in and out to any level.
13. Devices can be placed at any zoom level.

14. Import vector .wmf, .bmp, .jpg or .gif
15. Full linked multimedia (text, audio, video, and bitmaps) to any device, all-definable by the administrator.
16. Device pull-downs and proximity displays for device-specific information and functions.

PART 3 - EXECUTION

3.01 INSTALLATION

A. No installation shall begin without approved plans from the engineer. All submittals shall be stamped by a N.Y. State Professional Engineer.

B. The entire system shall be installed in a workmanlike manner, in accordance with approved manufacturer's wiring diagrams. The Contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation.

C. All penetrations of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.

D. End of Line Devices (Resistors/Diodes/Capacitors): Shall be furnished as required for mounting as directed by the manufacturer.

E. All wiring shall be color coded throughout, to National Electrical Code standards and a minimum of No. 18 AWG., unless otherwise noted. All wiring shall be of the type recommended by the manufacturer.

F. All wires shall test free from grounds or crosses between conductors.

G. Fire alarm system terminal and junction locations shall be identified in accordance with NFPA Standard 70, Section 760-3. Terminal and junction boxes shall be painted red and stenciled in white letters "FIRE ALARM", preventing unintentional interference with the fire alarm system wiring during testing, servicing and additional modifications to the system.

H. The system shall be arranged to receive power from two/three-wire, 30 Ampere, 120 volt, 60 cycle alternating current supply through fused cut-out. All low voltage operation shall be provided from the FACP(s).

I. All final connections between system equipment and the wiring shall be made under the supervision of a trained manufacturer's technical representative.

J. The contractor shall submit to the Authority Having Jurisdiction (AHJ), all necessary drawings and equipment specifications required for a complete AHJ approved system. Drawings shall be prepared by the Contractor.

K. The Contractor shall have a licensed New York State Professional Engineer Stamp all submittals, drawings and applications. Pay for all fees to obtain all necessary permits.

L. All junction boxes housing relays must be labeled with P-Touch type labeler with relay point number and device it serves, i.e. (0001-Smoke 1).

M. Contractor to review points list prior to programming with Owner. Contractor only to program approved points list. Any changes to program not previously approved by Owner will be done at Contractor’s expense.

3.02 CLEAN UP

A. Upon completion of the installation, all debris created by the installation shall be removed from the premises or disposed of as directed by the Owner.

B. 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 engineer, owner or AHJ, the installing contractor shall be responsible for the clearing of all devices prior to final acceptance.

3.03 TESTS

A. Prior to the final acceptance test, the Contractor and a trained manufacturer's technical representative shall test the completed system for proper operation. The system shall be demonstrated to perform all of the functions as below listed in 3.04. Any system, equipment or wiring failures discovered during said test shall be repaired or replaced before requesting scheduling of the final acceptance test.

B. The system shall be tested for final acceptance in the presence of the Owner's representative, Architect's representative, Engineer's representative, the local Code enforcement official, Contractor's representative and the Manufacturer's representative.

C. At least 50% of the test shall be performed while on battery back-up only.

D. During the final acceptance test:
   1. Every manual fire alarm station shall be tested.
   2. Every smoke detector shall be tested using Silent Knight tester or equivalent device.
   3. Every audible alarm signaling device shall be sounded.
   4. Every visual alarm signaling device shall be lit or flashed.
   5. Every system control function shall be tested for its proper operation.
   6. All supervised circuits shall be opened at two (2) locations to test for proper supervision.

E. Upon successful completion of all final acceptance tests, the Contractor's and Manufacturer's representatives shall each author and sign a letter confirming the successful completion of testing. Two (2) copies of each letter shall be forwarded to the Owner's representative, the Architect's representative, the Engineer's representative and the local Code enforcement official.

F. All final acceptance testing shall be done at a time convenient to the local Code enforcement official and the Owner's representatives and all testing costs shall be born by the Contractor as part of this Contract.

3.04 DOCUMENTATION AND TRAINING

A. The Contractor shall provide the services of a trained manufacturer's employee for 2 training periods of four (4) hours each, during normal business hours, to instruct the Owner's designated personnel on the operation and maintenance of the entire system.

3.05 MAINTENANCE AND TESTING AGREEMENT

A. The equipment manufacturer shall provide to the Owner a price quotation for a one (1) year and five (5) fire alarm system maintenance and testing agreement to begin after one (1) year warranty expires. System Supplier shall have a local service organization with a minimum of 20 factory trained technicians. Technicians shall be NICET Level 2 certified.

B. The equipment manufacturer shall make available a fully equipped service organization, capable of guaranteeing an on-site service response time within eight (8) hours to a service request call. Said service shall be available twenty-four (24) hours per day and seven (7) days per week.

3.06 SERVICE AND MAINTENANCE

A. The equipment manufacturer shall make available a fully equipped service organization, capable of guaranteeing an on-site service response time within eight (8) hours to a service request call. Said service shall be available twenty-four (24) hours per day and seven (7) days per week.

B. The equipment manufacturer shall make available, to the Owner, a price quotation for a one (1) year maintenance and testing agreement, to take effect on the date of final acceptance.

3.07 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 016500.

B. Provide instruction as required for operating the system. “Hands-on” demonstration of the operation of all system components and the entire system including program changes and functions shall be provided

C. Demonstrate normal and abnormal modes of operation and required responses to each.

D. The Contractor and/or the Systems Manufacturer’s representative shall provide a typewritten “Sequence of Operation” to the Owner at the time of demonstration.

E. Contractor to provide O&M manuals for the fire alarm equipment on disk format.

3.08 FAN SHUT DOWN

A. The contractor shall provide fan shutdown for all equipment shown on the drawings. All ducted equipment, with a rating of 2000 CFM or greater shall have return duct smoke detectors, remote LED indicators and fan shutdown control. All ducted equipment, shown on the drawings, rated 15,000 CFM of greater shall have supply and return duct smoke detectors, remote LED indicators and fan shutdown control.

B. All fan reset control shall be independent of fire alarm panel reset control.

C. Provide all control modules; independent reset control modules and duct smoke detectors as required. Provide all required power and control wiring including motor starters.

D. Contractor shall submit control drawings for architect/engineer approval.

3.09 ELEVATOR RECALL

A. The contractor shall provide all new elevator controls as required to provide elevator recall and interface with new fire alarm control panel. Contractor shall engage the services of a qualified elevator contractor to provide controls that upon activation of elevator recall smoke detector adjacent to elevator on first floor and/or elevator recall smoke detector in elevator pit, elevator shall recall to second floor. Upon activation of elevator recall smoke detector located adjacent to elevator on second floor and/or elevator recall smoke detector located at the top of the shaft, elevator shall recall to the first floor and remain there until manually reset or if the fire department override key is used.

B. Provide all new controls, accessories, wiring, conduit and control modules as required.

C. Provide all new controls to interface elevator control panel, fire alarm controls, wiring and programming panel, and smoke detectors.

D. Contractor shall submit control wiring drawings for architect/engineer review.

3.10 GUARANTEE

A. The Contractor shall guarantee all material and installation to be free from inherent mechanical and electrical defects for one (1) year. Manufacturer shall make available to the Owner a local service department, which shall stock standard parts on the premises. Maintenance is to be provided during normal working hours, at no cost to the owner, for a period of twelve (12) months from the date of acceptance of the installation, unless damage is caused by misuse, abuse or accident.

END OF SECTION

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Clearing and protection of vegetation.

B. Removal and disposal of existing paving and site features.

C. Removal of existing debris.

1.02 RELATED REQUIREMENTS

A. Section 312200 - Grading: Grading areas of site as a result of removal operations.

B. Section 312323 - FILL: Filling holes, pits, and excavations generated as a result of removal operations.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SITE CLEARING

A. Comply with other requirements specified in Section 017423 - VEHICLE EXHAUST SYSTEMS.

B. Verify limits of clearing and disturbance, existing plant life to be removed and existing site conditions.

C. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.02 VEGETATION

A. Do not remove or damage vegetation beyond the limits indicated on drawings.

B. In areas where vegetation must be removed but no construction will occur other than paving, remove vegetation with minimum disturbance of the subsoil.

C. Restoration: If vegetation outside removal limits or within specified protective areas is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

3.03 DEBRIS

A. Remove debris, junk, and trash from site.

B. Leave site in clean condition, ready for subsequent work.

C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION 311000

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Removal of subsoil.

B. Rough grading and cutting, filing and rough contouring the site for placement of topsoil or pavement base for final grading.

C. Finish grading.

1.02 RELATED REQUIREMENTS

A. Section 311000 - SITE CLEARING.

B. Section 312316 - EXCAVATION

C. Section 312323 - FILL: Filling and compaction.

D. Section 329219 - SEEDING: Finished ground cover.

PART 2 PRODUCTS

2.01 MATERIALS

A. Topsoil: See Section 312323 - FILL.

B. Seed: See Section 329219 - SEEDING.

C. Other Fill Materials: See Section 312323 - FILL.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Stake and flag locations of known utilities.

C. Locate, identify, and protect from damage above- and below-grade utilities to remain.

D. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.

3.03 ROUGH GRADING

A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.

B. Do not remove topsoil when wet.

C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.

D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

E. When excavating through roots, perform work by hand and cut roots with sharp axe.

F. See Section 312323 for filling procedures.

G. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

3.04 SOIL REMOVAL

A. Stockpile topsoil to be re-used on site; remove remainder from site.

B. Stockpile subsoil to be re-used on site; remove remainder from site.

C. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet (2.5 m); protect from erosion.

3.05 FINISH GRADING

A. Before Finish Grading:
   1. Verify subgrade has been contoured and compacted.
   2. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove soil contaminated with petroleum products.

B. Where topsoil is to be placed, scarify surface to depth of 3 inches (75 mm).

C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).

D. Place topsoil in areas where seeding are indicated.

E. Place topsoil where required to level finish grade.

F. Place topsoil to thickness as scheduled.

G. Place topsoil during dry weather.

H. Remove roots, weeds, rocks, and foreign material while spreading.

I. Near plants spread topsoil manually to prevent damage.

J. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.

K. Lightly compact placed topsoil.

3.06 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.10 foot (1-3/16 inches) (30 mm) from required elevation.

B. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch) (13 mm).

3.07 REPAIR AND RESTORATION

A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.

B. Trees to Remain: If damaged due to this work, trim broken branches and repair bark wounds; if root damage has occurred, obtain instructions from Architect as to remedy.

C. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

3.08 CLEANING

A. Remove unused stockpiled topsoil and subsoil. Grade stockpile area to prevent standing water.

B. Leave site clean and raked, ready to receive landscaping.

END OF SECTION 312200

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, and site structures.

B. Trenching for utilities outside the building to utility main connections.

1.02 RELATED REQUIREMENTS

A. Section 312200 - Grading: Grading.

B. Section 312316.13 - Trenching: Excavating for utility trenches outside the building to utility main connections.

C. Section 312323 - Fill: Fill materials, filling, and compacting.

1.03 SUBMITTALS

A. See Section 013300 - SUBMITTAL PROCEDURES, for submittal procedures.

B. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench mark and intended elevations for the work are as indicated.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. See Section 312200 for additional requirements.

C. Locate, identify, and protect utilities that remain and protect from damage.

D. Notify utility company to remove and relocate utilities as indicated on drawings or per Architect/Engineer.

E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

F. Protect plants, lawns, and trees to remain.

3.03 EXCAVATING

A. Excavate to accommodate new structures and construction operations.

B. Notify H2M of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

C. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.

D. Do not interfere with 45 degree bearing splay of foundations.

E. Cut utility trenches wide enough to allow inspection of installed utilities.

F. Hand trim excavations. Remove loose matter.

G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd (0.25 cu m) measured by volume.

H. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 312323.

I. Grade top perimeter of excavation to prevent surface water from draining into excavation.

J. Remove excavated material that is unsuitable for re-use from site.

K. Stockpile excavated material to be re-used in area designated on site .

L. Remove excess excavated material from site.

3.04 FIELD QUALITY CONTROL

A. See Section 014500 - CONDENSATE DRAIN PIPING, for general requirements for field inspection and testing.

B. Provide for visual inspection of load-bearing excavated surfaces before placement of foundations.

3.05 PROTECTION

A. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

END OF SECTION 312316

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavate trenches for piping and utilities outside building.

B. Compacted bedding and backfill around and over piping and utilities to subgrade elevations.

C. Backfilling and compaction.

1.02 REFERENCES

A. ASTM C136/C136M - Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D1557- Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 kg) Rammer and 18-inch (457 mm) Drop.

1.03 SUBMITTALS

A. Submit under provisions of Section 013300 - SHEET METAL WORK.

B. Test Reports: Submit a sieve analysis for bedding to be used.

1.04 QUALITY ASSURANCE

A. Do not excavate wet or frozen materials without written approval from the H2M.

B. Do not backfill over or with wet or frozen materials.

C. Provide safety barricades around open excavations.

1.05 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the work are as shown on plans.

1.06 COORDINATION

A. Coordinate trenching with installation of pipe or conduit.

B. Coordinate trenching with installation and removal of sheeting.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Bedding: Washed; free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ANSI/ASTM C33-71a Size No. 67; within the following limits:

Sieve Size	Percent Passing
1"	100
3/4"	99
1/2"	63
No. 4	6

B. Subsoil: Reused, excavated material, free of lumps, rocks larger than 3 inches (75 mm) in size, debris and contaminants.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify fill materials to be reused are acceptable.

B. Verify items to be buried during backfilling process have been inspected prior to backfilling.

3.02 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Maintain and protect existing utilities remaining which pass through work area.

C. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving and curbs from excavation equipment and vehicular traffic. Any item damaged by the contractor shall be promptly repaired at the contractor's expense.

E. Protect above and below-grade utilities which are to remain.

F. Cut out soft areas of subgrade not capable of insitu compaction. Backfill with subsoil fill and compact to density equal to or greater than requirements for subsequent backfill material.

3.03 EXCAVATION

A. Excavate subsoil required for piping.

B. Cut trenches to the dimensions shown on the plans.

C. Excavation shall not interfere with normal 45 degree bearing splay of foundations.

D. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

E. Remove lumped subsoil, boulders, and rock.

F. For trenches made in solid rock, excavate to a depth of 1 foot (300 mm) below the proposed pipe invert.

G. Correct unauthorized excavation at no cost to Owner in accordance with Section 312317 - BACKFILLING.

H. Stockpile excavated material in area designated on site and remove excess material not being used from site. Remove excavated material from site.

I. All trenches deeper than 5 ft (1.5 m) shall require sheeting.

3.04 INSTALLATION - BEDDING

A. Support pipe and conduit during placement and compaction of bedding fill.

B. For trenches made in solid rock, place an additional 1 foot (300 mm) of bedding under pipe or conduit.

C. Place bedding to the dimensions and limits as shown on the plans.

D. Place bedding material against and to 1 foot (300 mm) over the top of the pipe or conduit in 6 inch (150 mm) compacted layers.

E. All bedding material shall be compacted to 95 percent maximum dry density in accordance with ASTM D1557. Maintain optimum moisture content to attain required density.

F. Place bedding simultaneously on both sides of the pipe or conduit.

3.05 BACKFILLING

A. Backfill trenches to contours and elevations with unfrozen materials.

B. Backfill to the dimensions and limits shown on the plans with reused subsoil.

C. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

D. Place and compact material in continuous layers not exceeding 6 inches (150 mm) compacted depth.

E. Employ a placement method that does not disturb or damage conduit or pipe.

F. All backfilled materials shall be compacted to 95 percent of maximum dry density in accordance with ASTM D1557. Maintain optimum moisture content to attain required density.

G. Remove temporary sheeting as backfilling progresses.

3.06 TOLERANCES

A. Maximum Variation From Top Surface of Backfilling Under Paved Areas: 1/4 inch (13 mm).

B. Maximum Variation From Top Surface of General Backfilling: 1 inch (25 mm).

3.07 FIELD QUALITY CONTROL

A. Field testing is to be performed under provisions of Section 014500 - CONDENSATE DRAIN PIPING.

B. Tests and analysis of fill material are to be performed in accordance with ASTM D1557.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

D. Unless additional testing is required by the Engineer, compaction tests shall be taken every 100 feet (30 m), at the springline of the pipe and every 2 vertical feet (610 mm) of backfill.

3.08 CLEANING

A. Remove surplus backfill materials from site.

B. Leave fill material stockpile areas completely free of excess fill materials.

3.09 PROTECTION

A. Recompact fills subjected to vehicular traffic.

END OF SECTION 312318

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Filling, backfilling, and compacting for building volume below grade, slabs-on-grade, paving, and site structures.

B. Backfilling and compacting for utilities outside the building.

C. Filling holes, pits, and excavations generated as a result of removal (demolition) operations.

1.02 RELATED REQUIREMENTS

A. Section 015000 - PIPING SPECIALTIES: Slope protection and erosion control.

B. Section 312316 - EXCAVATION: Removal and handling of soil to be re-used.

1.03 REFERENCE STANDARDS

A. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2015.

B. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)).

C. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.

D. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

E. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.04 QUALITY ASSURANCE

A. Do not backfill wet or frozen materials.

1.05 DELIVERY, STORAGE, AND HANDLING

A. When necessary, store materials on site in advance of need.

B. When fill materials need to be stored on site, locate stockpiles where indicated.
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 FILL MATERIALS

A. General Fill (Type D): Subsoil excavated on-site.
   1. Graded.
   2. Free of lumps larger than 3 inches (75 mm), rocks larger than 2 inches (50 mm), and debris, no more than 15% passing No. 200 sieve; no more than 30% retained on 3/4" sieve.

3. Conforming to ASTM D2487 Group Symbol CL.

B. Topsoil: .
1. Graded.
2. Free of roots, rocks larger than 1/2 inch (12 mm), subsoil, debris, large weeds and foreign matter.
3. Acidity range (pH) of 5.5 to 7.5.
4. Containing a minimum of 5 percent and a maximum of 25 percent inorganic matter.
5. Conforming to ASTM D2487 Group Symbol OH.

C. Type C - Sand: Natural river or bank sand; washed, free of silt, clay, friable or soluble materials, or organic matter; graded in accordance with ANSI/ASTM C136, within the following limits:

Screen Size	Percent Passing
No. 4 (4.75 mm)	100%
No. 14 (1.18 mm)	10-100%
No. 50 (0.30 mm)	5-90%
No. 100 (0.15 mm)	4-30%
No. 200 (0.075 mm)	0-1%

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the Work are as indicated.

B. Identify required lines, levels, contours, and datum locations.

C. See Section 312200 - Grading for additional requirements.

3.02 PREPARATION

A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.

B. Compact subgrade to 95% maximum dry density in accordance with ANSI/ASTM D1557.

C. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

3.03 FILLING

A. Fill to contours and elevations indicated using unfrozen materials.

B. Fill up to subgrade elevations unless otherwise indicated.

C. Employ a placement method that does not disturb or damage other work.

D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches (200 mm) compacted depth.

G. Slope grade away from building minimum 2 inches in 10 feet (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.

H. Correct areas that are over-excavated.
   1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.

I. Compaction Density Unless Otherwise Specified or Indicated:
   1. Under paving, slabs-on-grade, and similar construction: 92 percent of maximum dry density.

J. Reshape and re-compact fills subjected to vehicular traffic.

3.04 TOLERANCES

A. Top Surface of General Filling: Plus or minus 1 inch (25 mm) from required elevations.

B. Top Surface of Filling Under Paved Areas: Plus or minus 1 inch (25 mm) from required elevations.

3.05 FIELD QUALITY CONTROL

A. See Section 014500 - CONDENSATE DRAIN PIPING, for general requirements for field inspection and testing.

B. Perform compaction density testing on compacted fill in accordance with ASTM D1556/D1556M, ASTM D2167, or ASTM D6938.

C. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

3.06 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION 312323

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Wood Sheeting.

B. Steel Sheeting

C. Sheeting box.

1.02 RELATED SECTIONS

A. Section 312316 - Excavation.

B. Section 312323.13 - Backfilling.

C. Section 312333 - Trenching.

1.03 REFERENCES

A. Occupational Safety and Health Standards - Excavations; Final Rule (29 CFR Part 1926) - OSHA Standards.

1.04 QUALITY ASSURANCE

A. Perform all work of this section in accordance with OSHA Standards and approved shop drawings.

1.05 COORDINATION

A. Coordinate work under provisions of Section 013100.

B. Coordinate work with all other sections requiring temporary sheeting and bracing.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Wood Sheeting: Hardwood species of size and dimensions capable of being driven to the required depths and capable of supporting excavation sides and soil pressures when braced; free from wormholes, wind shakes, loose knots, decayed or unsound portions or defects which would impair its strength or tightness; 2 3 inches thick minimum.

B. Steel Sheeting: ASTM A328, corrugated "Z" shape cross-section; of size and dimensions capable of being driven to the required depths and capable of supporting excavation sides and soil pressures when braced; structurally sound; special shapes for corner construction and transition points.

Property	**Method**	**Characteristic Value**
Compressive Strength (ksi)	ASTM D695	66.54
Compressive Strength via CLC (ksi)	ASTM D6641	73.07
Compressive Modulus (Mpsi)	ASTM D695	3.88
Tensile Strength (ksi)	ASTM D638	64.77
Tensile Modulus (Mpsi)	ASTM D638	3.86
Flexural Strength (ksi)	ASTM D790	88.19
Flexural Modulus (Mpsi)	ASTM D790	3.35

Izod (ft. lb. /in)	ASTM d256	42.50
SBS (psi)	ASTM D2344	3727

Property	**Method**	**Characteristic Value**
Compressive Strength (ksi)	ASTM D695	21,44
Compressive Strength via CLC (ksi)	ASTM D6641	21.09
Compressive Modulus (Mpsi)	ASTM D695	1.24
Tensile Strength (ksi)	ASTM D638	7.78
Tensile Modulus (Mpsi)	ASTM D638	1.02
Flexural Strength (ksi)	ASTM D790	14.43
Flexural Modulus (Mpsi)	ASTM D790	1.11
Izod (ft. lb. /in)	ASTM d256	4.33
SBS (psi)	ASTM D2344	1843

C. Sheeting Boxes: Steel, of size and dimensions capable of supporting excavation sides and soil pressures; structurally sound.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing soil substrate and site conditions and elevations are as indicated on the plans.

B. Verify elevations and grades are as indicated on the plans.

C. Verify proposed locations of excavations are as indicated on the plans.

D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage or other evidence of movement to ensure that systems are stable.

E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.02 PREPARATION

A. Excavate to a depth no greater than 4 feet from existing grade.

B. Assemble and drive the sheeting in accordance with approved shop drawings.

3.03 INSTALLATION - SHEETING

A. Drive sheeting in place to thoroughly support both sides of the excavation using a sheeting hammer. Use a steam or pneumatic hammer for steel sheeting.

B. Water jetting of sheeting will not be permitted. Do not loosen adjacent ground which might result in collapse.

C. Install walls and braces or shores tight and in accordance with approved shop drawings prepared by the contractor’s engineer.

3.04 INSTALLATION - SHEETING BOX

A. Place box in trench utilizing a means which will not damage structural integrity of the box.

B. Excavate ahead of the sheeting box only enough to advance the sheeting box and only immediately prior to moving the sheeting box.

C. Backfill on both sides of the sheeting box as it is moved.

3.05 REMOVAL OF SHEETING

A. Remove sheeting only as backfilling progresses.

B. Carefully remove sheeting such that compacted backfill is not displaced. Add additional backfill to the areas vacated by the sheeting.

C. All sheeting is to be removed from the site once its use is no longer required.

D. Removing sheeting in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities and utilities.

3.06 CLEANING

A. Clean work under provisions of Section 017423.

B. Clean site of any debris and sheeting materials at completion of the work.

END OF SECTION 314116

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course.

B. Paving aggregates.

1.02 REFERENCE STANDARDS

A. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.

B. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN m/m3)); 2012, with Editorial Revision (2015).

C. NYSDOT Standard Specifications Section 703-02.

D. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2017, with Editorial Revision (2018).

1.03 DELIVERY, STORAGE, AND HANDLING

A. Aggregate Storage, General:
   1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
   2. Prevent contamination.
   3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate Base Course: Angular, crushed, recycled concrete; free of shale, clay, friable materials and debris; graded in accordance with ANSI/ASTM C136 within the following limits:

Sieve Size	**Percent Passing**
1 1/2 inches	100
1 inch	90-100
1/2 inch	65-85
3/8 inch	55-75
No. 4	40-55
No. 8	30-45
No. 16	22-36
No. 30	16-27
No. 40	12-19
No. 100	7-13
No. 200	3-7

B. Material retained on the 1/2 inch (13 mm) sieve is coarse aggregate.

C. Coarse aggregate shall not have more than 10 percent by weight of flat or elongated pieces. A flat or elongated piece is defined as being three times greater in the largest dimension as compared to its least dimension.

D. The portion of the aggregate base course which passes the No. 40 (0.30 mm) screen shall have a plasticity index of one as tested in accordance with ASTM D4318.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that survey bench marks and intended elevations for the work are as indicated.

B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.02 PREPARATION

A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.03 INSTALLATION

A. Place aggregate in maximum 3 inch (75 mm) layers and roller compact to 95% maximum dry density in accordance with ANSI/ASTM D1557.

B. Level and contour surfaces to elevations and gradients indicated.

C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.

D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.

E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.04 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch (6.4 mm) measured with 10 foot (3 m) straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch (6.4 mm).

C. Variation From Design Elevation: Within 1/2 inch (12.8 mm).

3.05 CLEANING

A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.

END OF SECTION 321123

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Asphaltic concrete paving; wearing, binder or base course.

1.02 RELATED SECTIONS

A. Section 321123 - Aggregate Base Course.

1.03 REFERENCES

A. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.

B. AI MS-8 - Asphalt Paving Manual.

C. ASTM D242 - Mineral Filler for Bituminous Paving Mixtures.

D. ASTM D546 - Test Method for Sieve Analysis of Mineral Filler for Road and Paving Materials.

E. NYSDOT Standard Specificatuons - Section 702.

1.04 SUBMITTALS

A. Supplier: Submit name of asphalt supplier to be used on the project prior to placement of any asphalt on the project.

B. Design Data: Submit asphalt mix design for each asphalt type to be used.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products to the site under provisions of Section 016500.

B. Deliver asphalt in sealed, metal containers covered with suitable material to protect the asphalt from the elements.

C. Lightly lubricate the inside surface of the container with a thin oil or soap solution before loading asphalt.

D. All containers must be cleaned of all foreign materials prior to loading.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not place asphalt when base surface temperature is less than 40 degrees F, or if surface is wet or frozen.

B. Do not place asphalt when precipitation is occurring.

C. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials and 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Rollers: Minimum weight of 10 tons; equipped with lubricating devices for the roller wheels.

B. Pavers: Equipped with a vibratory device.

2.02 ACCESSORIES

A. Tack Coat: Homogeneous, medium curing, liquid asphalt.

B. Wheel Lubricant: Oil-water mixture containing maximum 10 percent lubricating oil.

2.03 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. **Binder Course: NYSDOT Type 3; 4.5 to 6.5 percent of asphalt cement by weight in mixture in accordance with the following gradation refer to plans for thickness.**

Sieve Size	Percent Passing
1-1/2 inches	100
1 inch	95-100
1/2 inch	70-90
1/4 inch	48-74
1/8 inch	32-62
No. 20	15-39
No. 40	8-27
No. 80	4-16
No. 200	2-8

C. Wearing Course: NYSDOT Type 6; 5.8 to 7.0 percent of asphalt cement by weight in mixture in accordance with the following gradatio. Refer to plans for thickness.

Sieve Size	Percent Passing
1 inch	100
1/2 inch	95-100
1/4 inch	65-85
1/8 inch	36-65
No. 20	15-39
No. 40	8-27
No. 80	4-16
No. 200	3-6

2.04 SOURCE QUALITY CONTROL

A. Obtain asphalt materials from same source throughout the project.

B. Provide asphalt in accordance with the approved mix design for each type of asphalt.

C. Test samples in accordance with AI MS-2.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate.

B. Verify that compacted subbase is dry and ready to receive work of this section.

C. Verify gradients and elevations of base are correct.

D. Verify that all castings are properly installed and are at the correct elevations.

E. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Apply tack coat at uniform rate of 0.03 to 0.07 gal/sq. yd. to contact surfaces of castings, curbs, gutters and any asphalt or concrete material.

B. Do not apply tack coat to wet or frozen surfaces.

C. Coat top surfaces of castings with oil to prevent bond with asphalt pavement.

3.03 INSTALLATION

A. Install work in accordance with AI MS-8 and NYSDOT Standard Specifications.

B. Maintain asphalt temperature between 250 and 325 degrees F during placement.

C. Place asphalt within 24 hours of applying tack coat.

D. Place asphalt to compacted thicknesses as identified on plans. If a multiple course pavement is to be used, place top course within 24 hours of placing bottom course. If more than 24 hours elapse, a tack coat will be required to be placed over the entire surface of the bottom course prior to any additional paving.

E. Utilize the vibratory device on the paver at all times.

F. Compact pavement by rolling. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

G. Compact pavement to a minimum of 94% maximum density.

H. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks.

I. Seal all joints between new pavement and existing pavement with asphalt cement.

3.04 TOLERANCES

A. Maximum Variation From Flatness: 1/8 inch measured with 10 foot straight edge.

B. Maximum Variation From Scheduled Compacted Thickness: 1/8 inch.

C. Maximum Variation from True Elevation: 1/4 inch.

3.05 PROTECTION

A. Protect finished work under provisions of Section 015000.

B. Immediately after placement, protect pavement from mechanical injury until project is accepted by the Owner.

END OF SECTION 321216

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Painted pavement delineation.

B. Painted pavement symbols.

1.02 RELATED SECTIONS

A. Section 321216 - Asphaltic Concrete Paving.

1.03 REFERENCES

A. New York State Department of Transportation Standard Specifications.

1.04 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Product Data: Provide data on paint.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products to the site under provisions of Section 016500.

B. Deliver all materials to the site in their original containers.

C. Store all materials in a cool, dry place.

D. Do not expose paint to open flames or temperatures which may ignite the paint.

E. Store all materials such that the paint is not contaminated.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not apply paint when the ambient temperature is below 40 degrees F.

B. Do not apply paint to wet or frozen surfaces or when precipitation is occurring.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Paint: Flexible, non-skinning paint; homogeneous, conforming to the requirements of Section 640 of the New York State Department of Transportation Standard Specifications; color as indicated on the plans or directed by Engineer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that pavement is ready to receive work of this section.

B. Beginning of application means applicator accepts existing conditions.

3.02 PREPARATION

A. Remove all dirt, grease, oil or other foreign matter from pavement which might affect the bond between the pavement and the paint.

B. Remove all temporary pavement markings without causing damage to the pavement.

3.03 APPLICATION

A. Apply paint with spray type striping machines to achieve a dry film thickness of 14 mils to 16 mils at the locations and to the dimensions as indicated on the plans.

B. Symbols may be rolled or brushed onto the pavement as long as a dry film thickness of 14 mils to 16 mils is achieved.

C. All stripes and symbols shall have clean, sharp edges.

3.04 TOLERANCES

A. Maximum offset from true position: 1 inch.

3.05 CLEANING

A. Clean adjacent areas which received paint during work of this section.

3.06 PROTECTION

A. Protect finished work under provisions of Section 015000.

B. Protect painted markings from damage or discoloration until project is accepted by the Owner.

END OF SECTION 321728

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Seeding.

B. Mulch, fertilizer and other accessories.

C. Maintenance.

1.02 REFERENCES

A. Not Used

1.03 DEFINITIONS

A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel and Brome Grass.

1.04 SUBMITTALS

A. Product Data: Provide data on seed mixtures and lime.

1.05 QUALITY ASSURANCE

A. Seed: Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.06 REGULATORY REQUIREMENTS

A. Comply with applicable regulatory agencies.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 016500.

B. Deliver grass seed mixture in original sealed containers. Seed in damaged packaging is not acceptable.

C. Deliver materials in waterproof bags showing weight, chemical analysis and name of manufacturer.

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not sow immediately following rain, during windy periods or if ground is frozen.

B. Do not sow when the ambient temperature is expected to drop below 40 degrees F or rise above 90 degrees F during the time in which the seed will establish itself.

C. Typical Planting Season: April 1st through May 15th or September 1st through October 15th.

1.09 COORDINATION

A. Coordinate with grading and placement of topsoil.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Seed: Dry, fresh, re-cleaned seed of the latest crops and of the following proportions:

Seed Species (% by weight)	**lbs/1.000 ft2**	**lbs/acre**
65% Creeping red fescue	2.0-2.6	85-114
20% Perennial ryegrass	0.6-0.8	26-35
15% Fine fescue	0.4-0.6	19-26

B. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; friable loam; free of subsoil, clay or impurities, plants, weeds, roots, grass, stone and foreign matter; acidity range (pH) of 5.8 to 6.5; containing a minimum of 2.75 percent and a maximum of 25 percent organic matter. Topsoil may be reused from on-site if it meets these requirements

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing substrate and site conditions under provisions of 013100 - PROJECT MANAGEMENT AND COORDINATION.

B. Verify that prepared soil base is ready to receive the work of this section.

C. Beginning of installation means installer accepts existing conditions.

3.02 PREPARATION

A. Seed Bed: Scarify soil to a depth of 6 inches in compacted areas. Smooth out unsightly variations, bumps, ridges, and depressions which will hold water. Remove stones, litter, or other objectionable material.

B. Eliminate uneven areas and low spots. Remove and dispose of debris, roots, branches and stones in excess of 1/2 inch in size. Remove and dispose of subsoil contaminated with petroleum products.

C. Scarify subsoil to depth of 6 inches where topsoil is scheduled to be placed. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.03 APPLICATION

A. Do not seed areas in excess of that which can be mulched on same day.

B. Roll seeded area with roller not exceeding 100 lbs per foot of width.

C. Immediately following seeding and compacting, apply mulch at a rate of 92 lbs per 1,000 square feet. Maintain clear of shrubs and trees.

D. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil. Discontinue watering if washing begins to occur.

E. Identify seeded areas with stakes and string around area periphery. Set string height to 24 inches. Space stakes at 8 feet on center.

F. Cover seeded slopes where grade is 30 percent or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.

G. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.

H. Secure outside edges and overlaps at 36 inch intervals with stakes.

I. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

J. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 12 inches.

3.04 MAINTENANCE

A. Maintain grass until job is accepted by the Owner or until the grass exhibits a vigorous growing condition, as determined by at least 2 cuttings, whichever occurs last.

B. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.

C. Neatly trim edges and hand clip where necessary.

D. Immediately remove clippings after mowing and trimming.

E. Water to prevent grass and soil from drying out.

F. Immediately reseed areas which show bare spots.

3.05 PROTECTION

A. Protect seeded areas with warning signs and temporary fencing during maintenance period.

END OF SECTION 329219

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preparing valves or structures for casting rim adjustment.

B. Adjusting drainage or castings to grade.

C. Castings.

1.02 RELATED SECTIONS

A. Section 321216 - Asphaltic Concrete Paving: Placing an asphalt overlay and surface restoration around structure.

1.03 REFERENCES

A. ASTM A48 - Gray Iron Castings.

B. ASTM C55 - Concrete Building Brick.

C. ASTM C270 - Mortar for Unit Masonry.

1.04 SUBMITTALS

A. Product Data: Provide data on extension rings and frames.

1.05 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the plans.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Frames: ASTM A48 Class 30B Gray Iron manufactured by CAMPBELL FOUNDRY COMPANY, NEENAH FOUNDRY COMPANY or specifically approved equal.

B. Mortar: ASTM C270, Type N.

C. Brick: ASTM C55, Grade S-1.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify site conditions and condition of structure.

B. Verify elevations as indicated on the plans.

3.02 PREPARATION

A. Excavate and remove material as required to perform work of this section.

3.03 RAISE CASTING TO GRADE USING BRICK AND MORTAR

A. Excavate existing asphalt and subgrade around casting as required.

B. Remove casting.

C. Remove any existing brick and mortar which is loose, broken, deteriorated or otherwise unsound or unable to support the casting and imposed loads.

D. Place new brick and mortar as required to attain the proposed rim elevation.

E. Maximum distance between brick surfaces to be 1 inch.

F. Place a 1 inch mortar bed between brick and castings and reinstall casting.

G. Ensure casting does not rock. Adjust brick as required.

3.04 LOWER CASTING TO GRADE

A. Excavate existing asphalt and subgrade around casting as required.

B. Remove casting.

C. Remove any existing brick and mortar as required to lower casting to grade or is loose, broken, deteriorated or otherwise unsound or unable to support the casting and imposed loads.

D. If required, chip existing drainage structure with a 40 lb. hammer.

E. Create flat sound surface with brick and mortar to support the casting.

F. Maximum distance between brick surfaces to be 1 inch.

G. Place a 1 inch mortar bed between brick and casting and reinstall casting.

3.05 TOLERANCES

A. Maximum variation from proposed elevation: 1/4 inch.

3.06 DJUSTING

A. Adjust materials as required to achieve tolerance.

B. Replace frame, covers or gratings damaged during the work under this contract.

END OF SECTION 330513.13

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. PVC drainage pipe.

B. Fittings and accessories.

1.02 RELATED SECTIONS

A. Section 02225 - Trenching.

1.03 REFERENCES

A. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity Flow Applications.

B. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

C. ASTM D2855 - Recommended Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

D. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

E. ASTM D3212 - Standard Specifications for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

1.04 SUBMITTALS

A. Submit under provisions of Section 01330.

B. Product Data: Provide data on pipe, fittings and accessories.

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01785.

B. Accurately record actual locations of pipe runs, connections and invert elevations.

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 REGULATORY REQUIREMENTS

A. Conform to applicable codes for materials and installation of the work of this section.

1.07 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the plans and as required by the manufacturer.

1.08 COORDINATION

A. Coordinate pipe installation with trenching and installation of drainage structures.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Pipe: ASTM D3034 SDR35 PVC with gasketed, bell and spigot, push-on joint conforming to ASTM D3212.

B. Joint Lubricant: Manufacturer’s standard.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate.

B. Verify that trench cut is ready to receive work and excavations, dimensions and elevations are as indicated on the plans.

C. Inspect all pipe and fittings before installation. Remove defective pipe from site.

3.02 PREPARATION

A. Remove large stones or other hard matter which could damage piping or impede consistent backfilling or compaction.

B. Excavate under provisions of Section 02225. Excavate sufficient clearance at each bell or coupling to allow uniform bearing along the pipe barrel.

3.03 INSTALLATION

A. Install pipe and accessories in accordance with ASTM D2321.

B. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.

C. Shore pipe to required position; retain in place until after compaction of adjacent fills. Ensure pipe remains in correct position and to required slope.

D. Lay pipe to slope gradients noted on the plans, with maximum variation from true slope of 1/8 inch in 10 feet.

E. Repair surface damage to any pipe protective coating in accordance with manufacturer's recommendations.

F. Backfill under provisions of Section 02225.

G. Construct cleanouts at locations shown and as detailed on the drawings. Use PVC wyes, bends and pipe as appropriate. Extend cleanout pipe to grade and terminate with plug.

3.04 TOLERANCES

A. Maximum Variation from Intended Invert Elevation: 1/2 inch.

B. Maximum Offset of Pipe from True Alignment: 1 inch.

3.05 FIELD QUALITY CONTROL

A. Perform field inspection under provisions of Section 01450.

B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.06 PROTECTION

A. Protect finished work under provisions of Section 01500.

B. Protect pipe from damage or displacement until backfilling operation is in progress.

END OF SECTION 334124.24

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PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precast concrete manhole sections with tongue-and-groove joints, covers, anchorage and accessories.

1.02 1.02 - RELATED SECTIONS

A. Section 312316 - Excavation.

B. Section 312323.13 - Backfill.

1.03 REFERENCES

A. ASTM A48 - Gray Iron Castings.

B. ASTM A615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

C. ASTM C55 - Concrete Building Brick.

D. ASTM C150 - Portland Cement.

E. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets.

F. ASTM C478 - Precast Reinforced Concrete Manhole Sections.

1.04 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Shop Drawings: Indicate dimensions and details of manhole sections and castings.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products to the site under provisions of Section 016500.

B. Store products on firm, level ground.

C. Handle products in a manner which will not induce unnecessary stresses, cause cracks to occur or damage the product in any way.

D. Any cracked or otherwise defective materials will be rejected.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not mix or place mortar if ambient temperature is below 40 degrees F.

1.07 COORDINATION

A. Coordinate the work under provisions of Section 013100.

B. Coordinate with installation of piping and all other work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. OLDCASTLE PRECAST, INC.

B. PRECAST CONCRETE SALES CO.

C. WOODARD'S CONCRETE PRODUCTS.

D. Substitutions shall be permitted only after receiving written approval from the Engineer.

2.02 MATERIALS

A. Manhole Sections: ASTM C478 reinforced precast concrete lipped male/female joint, ASTM C443 gaskets; of the following materials:
   1. Concrete: ASTM C150, normal Portland cement Type I, minimum 4,000 psi strength at 28 days.
   2. Reinforcement: ASTM A615 reinforcing bars.
   3. Castings: ASTM A48, Class 30B, cast iron construction, machined flat bearing surface, non-rocking, removable lid, open checkerboard grille lid design; able to support the AASHTO HS-20-44 highway loading; free from blowholes, shrinkage, distortion, cracks or other defects; smooth and of uniform quality; size and dimensions as indicated on the plans; manufactured by CAMPBELL FOUNDRY COMPANY or specifically approved equal.

2.03 ACCESSORIES

A. Brick: ASTM C55, Grade N, Type I - Moisture Controlled; normal weight; nominal modular size as required.

B. Mortar: A 1:1:5 ratio of Portland cement, masonry cement and sand, respectively. Add water as required to create a workable consistency.

C. Manhole Steps: Cast iron rungs; pattern number 2589-2252 as manufactured by CAMPBELL FOUNDRY COMPANY, or specifically approved equal.

D. Concrete for Formed Invert: ASTM C150 Portland cement Type I, cast in place; 3,000 psi minimum strength at 28 days; wood float finish; dimensions as indicated on the plans.

2.04 FABRICATION

A. Shaft Construction: Concentric with cone top section; lipped male/female joints with rubber gasket; dimensions and reinforcement as indicated on the plans.

B. Pipe Entry: Provide openings as required.

C. Steps: Set or drilled and grouted into manhole wall at 18 inches on center vertically.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing site conditions.

B. Verify existing grades are as indicated on the plans.

C. Verify items provided by other sections of Work are properly sized and located.

D. Verify that rough openings for piping are as required.

3.02 INSTALLATION

A. Form bottom of excavation clean and smooth to the correct elevation.

B. Place base pad, secure and level, to the proper elevation. Utilize a placement method which will not damage or crack the manhole.

C. Place manhole sections plumb and level, trim to correct elevations, anchor to base pad.

D. Cut and fit for pipe. Seal openings in shaft wall around pipe with brick and mortar. Establish elevations and pipe inverts for inlets and outlets as indicated on the plans. Trowel surfaces smooth.

E. Place concrete in base of manhole as required to form invert to the dimensions indicated on the plans. Trowel smooth.

F. Mount castings in a 1 inch mortar bed over access opening. Install firm, level and to the required elevation.

G. If required to achieve proper elevation of casting, adjust with brick and mortar.

3.03 TOLERANCES

A. Maximum Variation from Proposed Rim Elevation: 1/4 inch.

B. Maximum Variation from Proposed Location: 1/2 inch.

3.04 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 014500.

B. Request inspection prior to backfilling around structure and prior to surface restoration.

3.05 PROTECTION

A. Protect finished work under provisions of Section 015000.

B. Protect manhole from damage or displacement until project is accepted by the Owner.

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STORMWATER REPORT

FOR

SMALL PROJECT SWPPP'S

MUTUAL ENGINE & HOSE

Village and Town of Mount Kisco

Westchester County, New York

H2M Project No: MKIV1802

November 2021

Prepared for:

Village and Town of Mount Kisco
104 Main Street
Mount Kisco, New York 10594

Prepared by:

H2M architects + engineers
2 Executive Boulevard, Suite 401
Suffern, New York 10901
845-357-7238

H 2 M architects + engineers

TABLE OF CONTENTS

THE NARRATIVE REPORT

APPENDICES

STORMWATER REPORT

Mutual Engine & Hose

Village and Town of Mount Kisco
Westchester County, New York

1. EROSION AND SEDIMENT CONTROL

This Stormwater Report has been prepared with attention to the specifications put forth in the New York State Department of Environmental Conservation SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-20-001). The site does not require a full SWPPP; and is prepared in accordance with the NYC DEP Requirements for Small Project SWPPP's. Appendix C of the General Permit lists the site inside of the New York City Watershed East of Hudson. This requires the Water Quality Volume be calculated in accordance with Section 10.3 of the New York State Stormwater Design Manual. Erosion and sediment control practices were designed in conformance with the New York State Standards and Specifications for Erosion and Sediment Control.

A. PROJECT DESCRIPTION AND SCOPE

Mutual Engine and Hose is an existing developed emergency service responder station which is proposed for a site development project to expand the station's size and capabilities. The site currently consists of a single two-story masonry building with a small parking lot on a 0.58-acre site. The station is located on Main Street within the Town and Village of Mount Kisco, Westchester County, NY (see Location Map in Appendix A). The project falls in the Designated Main Street Area and requires a SWPPP according to NYC DEP requirements for new impervious surfaces. The proposed area of disturbance is approximately 6,075 square feet (0.14 acres).

The project scope includes the construction of a new 1,574 square foot addition off the north side of the existing firehouse. The firehouse addition will include an apparatus bay for vehicle storage. In order to facilitate the parking demand for the project, additional parking spaces have been added to the east side of the existing parking lot. Because of the existing site grade, a retaining wall is necessary to provide parking space while reducing the amount of site grading needed. A stone lined swale has been installed behind the wall to collect runoff from the hill and maintain a similar drainage pattern to the existing site conditions. These modifications are shown on the detailed construction drawings included in Appendix I.

The primary potential source of pollution from construction activity associated with this project is sediment resulting from soil disturbance and stormwater runoff. Fuel from equipment used during construction activities and/or stored on-site is another potential source of pollution from this project.

Endangered or Threatened Species: According to the NYSDEC EAF Mapper, the project site is not listed as being in the vicinity of rare animals (see Appendix A for map). Additionally, the project is redevelopment on an existing improved site which will only disturb a small, wooded area.

Wetlands and Surface Waters: According to the US Fish and Wildlife Service National Wetlands Inventory Mapper, there are no wetlands or surface waters on the project site (see Appendix A for map). However, there is a riverine approximately 350 feet from the edge of the property. The riverine is separated from the property by Main Street and the Mount Kisco Village Hall. In no case will the project involve soil disturbance within 100 feet of a State regulated wetland.

Historic Places: According to the NYS Historic Preservation Office Cultural Resource Information System (CRIS), the site is 200 feet south of St. Mark's Episcopal Church which is a building listed on the NYS Board of Historic Preservation for inclusion on the State or National Register of Historic Places (see Appendix A for map). This church is located approximately 200 feet north of the project site and is separated from the site by a separate lot.

Floodplain/Floodway: According to FEMA FIRM Panel No. 36119C0153F, dated 9/28/2007, the project site is not located within a mapped floodplain or floodway (see Appendix A for map).

B. SOILS

According to the Soil Survey of Westchester County, New York (USDA-NRCS, Web Soil Survey), the soils found at the project site are comprised of CtC (Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes), HrF (Hollis-Rock outcrop complex, 35 to 60 percent slopes), Uf (Urban Land), and UlC (Urban land-Charlton-Chatfield complex, rolling, very rocky). Soils at this site belong to Hydrologic Soil Group B and D. A soils report for this site is included in Appendix B of this report.

C. CONSTRUCTION SCHEDULE

The following general construction schedule provides the anticipated sequence of the proposed construction activities that may result in soil disturbance. Stabilization of disturbed areas shall be

performed as the project progresses in order to minimize the potential for contamination of stormwater runoff.

Sequence of Construction

1) Installation of silt fencing and inlet protection as shown on the Erosion & Sediment Control Plan.
2) Clearing and grubbing of the project site areas indicated for development and removal of existing site features as necessary for the installation of the proposed improvements.
3) Excavation for foundation work.
4) Site grading including behind proposed parking area and building.
5) Installation of new retaining wall and stone lined swale.
6) Installation of new underground infiltration chambers and site drainage piping. Immediate installation of stone on disturbed areas and inlet protection on all areas tributary to storage chambers to protect them from contamination.
7) Installation and extension of all utility service lines.
8) Construction of new building addition.
9) Final grading of disturbed areas to finished grade.
10) Installation of new aggregate base course in areas of new pavement and driveways. Installation of new concrete curb.
11) Installation of new concrete pads, concrete sidewalk and driveway apron, and asphalt pavements. Installation of site signage and striping.
12) Seeding of disturbed areas and other final landscaping measures.
13) Following final stabilization of disturbed areas, removal of remaining temporary erosion and sediment controls.
14) Silt removal and cleaning of inlets protected during construction.

D. TEMPORARY AND PERMANENT EROSION AND SEDIMENT CONTROL PRACTICES

Temporary and permanent erosion and sediment control measures shall be installed and maintained by the general contractor (or subcontractor) in accordance with the engineering plans and details, and the New York State Standards and Specifications for Erosion and Sediment Control (NYS Soil and Water Conservation Committee, 2016). Descriptions for these measures are identified in the engineering plans and details in Appendix I.

E. MAINTENANCE AND INSPECTION

Installation and maintenance of all temporary and permanent erosion and sediment control measures will be the responsibility of the general contractor. The general contractor shall ensure

that a copy of the approved SWPPP is present on-site and that all sub-contractors are aware of the terms of the approved SWPPP and have signed the proper Certification Form.

The contractor shall have a trained contractor (as defined by GP-0-20-001) inspect the erosion and sediment control practices and pollution prevention measures within the active work area daily to ensure that they are being maintained in effective operating conditions 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. The trained contractor may stop conducting the maintenance inspections in accordance with the provisions of Part IV.B of GP-0-20-001.

A qualified inspector shall conduct regular site inspections of all erosion and sediment control practices and pollution prevention measures, post construction stormwater management practices, areas of disturbance, points of discharge to surface waters within or immediately adjacent to the construction site, and points of discharge from the construction site. Specifically, the qualified inspector shall inspect all sediment barriers, inlet protection and silt fencing; catch basins and field inlets for accumulation of sediments; any un-stabilized, disturbed areas, mulch, and permanent vegetative controls; and staging areas and storage areas for construction materials, waste materials, and construction chemicals. The inspector shall notify the general contractor of any necessary repairs to damaged or ineffective measures, and any necessary corrective action, including, but not limited to the removal of sediment, stabilization of disturbed areas, or placement of additional measures to ensure proper functioning of the erosion and sediment control practices. The general contractor shall be responsible for immediate implementation of the corrective actions. The inspections shall be conducted at least once every seven days. The qualified inspector may reduce the frequency of or stop conducting the inspections in accordance with the provisions of Part IV.C.3 of GP-0-20-001. The qualified inspector shall prepare an inspection report for each inspection. An example SWPPP inspection form is provided in Appendix C. All inspection reports shall be maintained on site with the SWPPP.

F. SOLID WASTE MANAGEMENT

Construction debris and waste expected to be generated during the project include concrete compounds, wood, cardboard, metals, masonry, PVC, packing material, and domestic waste (*i.e.* beverage containers, coffee cups, plastic bags and wrappers, etc.). Temporary waste containers (*i.e.* roll-off containers) of sufficient size and number shall be placed within the equipment/material storage areas, to be determined by the general contractor, and accessible on the project site in order to facilitate disposal of construction debris. Waste containers shall have lids or shall be

covered during periods of rain to prevent accumulation of water within the containers and to prevent loss of debris from wind. Waste containers shall have watertight bottoms. Waste containers shall not be cleaned or hosed out on the project site. Solid waste containers shall be removed bi-weekly or more frequently as needed. No on-site disposal of any construction materials shall be permitted.

Work areas shall be maintained in an orderly and clean manner to prevent windblown litter from exiting the site. Littering on the project site shall be prohibited. Trash receptacles shall be placed in locations where workers congregate for lunches and breaks. Litter shall be bagged before placement in large waste containers. Potential toxic and hazardous materials, if any, shall not be disposed of in solid waste containers and shall be segregated in separate containers for transport to an approved off-site receiving area.

G. CHEMICAL STORAGE AND SPILL PREVENTION/RESPONSE

The general contractor is responsible for proper storage of potentially hazardous chemicals on-site and enforcement of proper spill prevention and control measures. Proper storage, clean-up, and spill reporting instructions will be present in the project trailer and will be posted in a conspicuous and accessible location.

Potentially hazardous chemicals and materials that may be used on site include solvents, adhesives, lubricants, gasoline, diesel fuel, asphalt and concrete compounds. All chemicals shall be stored in their original containers, and according to manufacturer's specifications. Materials shall be stored in covered storage with an impervious lined bottom to prevent leaching of chemicals into the ground. The storage shall be secured to prevent unauthorized entry during non-working hours. An ample supply of appropriate absorbent spill clean-up material will be kept in or near the storage area. The storage area is to be kept clean and well-organized.

In the event of a chemical spill, the contractor should contain the spill in accordance with the manufacture's recommended methods and must report the spill to the NYS Spill Hotline (1-800-457-7362) within 2 hours of discovery.

H. STORMWATER DISCHARGES FROM INDUSTRIAL ACTIVITY

There are no stormwater discharges associated with industrial activity at the construction site (i.e. asphalt plants and/or concrete plants) proposed as part of this project.

2. POST-CONSTRUCTION STORMWATER MANAGEMENT

The post-construction stormwater management practices for this project have been designed in conformance with applicable sizing criteria of the New York State Department of Environmental Conservation SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-20-001) and the performance criteria of the technical standards of the NYS Stormwater Management Design Manual.

As mentioned in Section 1 of the report, the project site lies inside the NYC Watershed East of Hudson. Therefore, the total Water Quality Volume is calculated using the 1-year, 24-hour design storm over the post-developed watershed and is in accordance with Section 10.3 of the Design Manual. The specific sizing criteria for this site is taken from Part I.C.2.b. of the SPDES General Permit.

A. STORMWATER MANAGEMENT PRACTICES

Clearing limits are identified on the construction drawings in order to establish areas of natural features to be preserved and protected while the remainder of the site is being developed. The required clearing limits for this site are quite limited for this project. The preservation of natural areas associated with this project also serves to limit the number of impervious surfaces on the site.

Soil restoration practices in accordance with Table 5.3 of the NYS Stormwater Management Design Manual will be applied across areas of soil disturbance to be vegetated under post-development conditions in order to recover the original properties and porosity of the soil. All soils at this site belong to Hydrologic Soil Groups B and D.

The primary post-construction SMPs incorporated into the design for this site are sized to provide runoff reduction capacity for 100% of the WQv, channel protection volume, overbank flood control criteria and extreme flood control criteria required by GP-0-20-001 and the NYS Stormwater Management Design Manual. Construction drawings indicating the quantity, dimensions, material specifications, and installation details for the proposed SMP's are provided in Appendices H and I.

B. STORMWATER MODELING AND ANALYSIS

Pre-Development Conditions

A Pre-Development Drainage Area Map is provided in Appendix I identifying watershed boundaries, flow paths and design points. In the existing condition, the project site is developed

with an existing fire house structure. The site generally slopes west with grades ranging from 70% on the eastern side of the property to 1% in the parking area. The pre-development site has been classified as a single watershed (WS#1) with one study point (Study Point 1) just past the western end of the parking lot. Study Point 1 is the catch basin located just north of the drop curb at the entrance to the site's parking area. The site does not have existing SMP's. The drainage on the site for WS#1 is predominantly pipe or sheet flow to catch basins.

Post-Development Conditions

A Post-Development Drainage Area Map is provided in Appendix I identifying watershed boundaries, flow paths, design points and SMP's. In the post-development condition, the project site will be developed with approximately 1,600 square feet (0.04 acres) of new building and 1,100 square feet (0.03 acres) of new pavement. Because some impervious site features are scheduled to be removed, the net new impervious area for the site is approximately 1,700 square feet (0.04 acres). Upon completion of construction, the remainder of the site will either be seeded and stabilized or will maintain the natural vegetation of the pre-development condition. The post-development site has been separated into two watersheds. WS#1 represents runoff bypassing the new underground infiltration system and passing directly to Study Point 1. This area flows east to west and consists of the concrete apron and a small easterly portion of the parking lot area. WS#2 represents the drainage area contributing stormwater to the underground infiltration system from developed and existing portions of the site. This area flows east to west as sheet flow until entering the stone swale or new drain inlets onsite. Any discharge from the infiltration chambers is then directed to Study Point 1.

As previously mentioned, the site lies in the NYC Watershed; however, the site's sub-watershed is the New Croton Reservoir watershed. In accordance with Section 18-39 (c) (1) there must be an analysis of coliform runoff. The site is fully developed with no existing SMP's and will be increasing in impervious area by approximately 6%. The proposed SMP for the site is underground infiltration chambers. According to StormTech, the isolator row of the underground storage system will remove 80% of the TSS. According to the NYS Design Manual, infiltration systems are listed as F=Fair (>70% removal) for bacteria. The addition of the proposed SMP will reduce the overall coliform runoff for the site post development. Calculation demonstrating coliform reduction are included in Appendix G.

Stormwater Calculations

Stormwater runoff from watershed areas in the pre- and post-development conditions and the post-construction stormwater management practices have been modeled for the 1, 10 and 100-

year, 24-hour storm events using the Hydraflow Hydrographs. Time of Concentration (Tc) values for pre and post-development conditions were determined using the TR-55 methodology. When Tc values are equal or less than 6 minutes, this value is assigned per standard practice. Runoff rates have been calculated using the SCS Unit Hydrograph method. The sizing and layout of the underground storage system was completed using StormTech's Design Manual.

For the purposes of modeling the SMPs, an infiltration rate of 12 inches per hour was used for the proposed underground storage system. This value is taken based on Whitestone's infiltration test results on September 27th and 28th, 2018. Additional testing was performed on November 1, 2018, by H2M which yielded a rate of 1 inch/minute. An infiltration rate of fc > 24 inches per hour was calculated but a more conservative rate will be used for design to assure water quality and quantity goals are met. The full report and analysis can be found in Appendix B. As modeled, stormwater runoff discharges from the underground storage systems is reported in the Hydraflow output as a peak overflow rate. Post-development peak runoff and overflow rates for watershed areas draining to the same design point are summed for the purpose of comparison with pre-development conditions.

TR-55 worksheets calculating Tc values for each watershed are provided in Appendix F along with Hydraflow stormwater modeling analysis reports. A summary comparing pre and post-development runoff rates and volumes for the different storm events is provided in Table 01 below.

Table 01 – Stormwater Modeling Summary

Study Point	Watershed ID	Runoff Volume (cf)			Peak Runoff/SMP Overflow Rate (cfs)		
		1-Yr	10-Yr	100-Yr	1-Yr	10-Yr	100-Yr
	Pre-Development Condition						
1	**WS#1**	**3,573**	**8,696**	**18,046**	**0.875**	**2.120**	**4.267**
	Post-Development Condition						
1	WS#1	262	496	894	0.078	0.144	0.256
	WS#2	3,422	8,329	17,284	0.838	2.030	4.087
	Total*	**1,397**	**4,891**	**12,410**	**0.761**	**1.981**	**4.091**
Net Change (+/-)		**-2,176**	**-3,805**	**-5,636**	**-0.114**	**-0.139**	**-0.176**
Net Reduction (%)		**61%**	**44%**	**31%**	**13%**	**6.5%**	**4.1%**

**Total taken after WS#2 has passed through the underground storage system.*

SMP Sizing Criteria

Post-construction SMPs have been designed in conformance with the sizing criteria included in the NYS Stormwater Management Design Manual. Specifically, post-construction SMPs have been designed to achieve the Water Quality Volume (WQv), Runoff Reduction Volume (RRv), Channel Protection Volume (Cpv), Overbank Flood (Qp), and Extreme Storm (Qf) sizing requirements of the Design Manual.

1) Water Quality Volume (WQv) & Runoff Reduction Volume (RRv)

In most cases WQv is calculated in accordance with Section 4.2 of the Design Manual. However, because the site is located inside the East of Hudson Watershed, a phosphorus limited watershed, a more conservative approach is required. The WQv calculation is taken from Section 10.3 of the Design Manual. As per Section 10.3, WQv is defined as the volume of runoff generated from the 1-year, 24-hour design storm over the post-developed watershed as opposed to 90th percentile rain event. The one-year storm event rainfall P_{1yr}=2.80 inches is taken from Figure 4.2 of the Design Manual (See Appendix G) and results in a larger, more conservative WQv than using the 90% Rainfall Event Number $P_{90\%}$=1.5 inches from Figure 4.1 (See Appendix I).

$$WQv = \frac{\left[\left(P_{1yr}\right)(Rv)(A)\right]}{12}$$

Where:

P_{1yr}= 1-Year 24-Hour Storm Number (2.78 in)

R_v = 0.05 + 0.009 (I), where I is percent impervious cover = 0.95

A = site area in acres (Contributing impervious area) = 0.04

WQv = Water Quality Volume in acre – feet = 0.009 ac-ft

As per the NYC DEP, the entire site must be attenuated for the 1, 10 and 100-year storm. However, the area contributing to the Water Quality Volume is to be taken as the total new impervious area. As per Part I.C.2.b.i. of the General Permit, the WQv must be reduced by application of RR techniques and Standard SMPs. The RRv techniques used must satisfy the RRv min requirements from Chapter 10 of the NYS Design Manual. The remaining WQv must be treated through standard SMP's. Table 02 lists the WQv and RRv calculated using Chapter 10 of the NYS Design Manual. Appendix G contains WQv and RRv calculations.

Table 02 –WQv and RRv Summary

New Impervious Area (ac)	Percent Impervious (%)	1-Year 24 - hr. Design Storm	Volumetric Runoff Coefficient, Rv	WQv Required (ft^3)	Minimum Runoff Reduction, RRVmin (ft^3)
0.040	100	2.80	0.95	386	77

The Hydraflow Hydrographs Report contained in Appendix F indicates the total volume infiltrated and stored during the 1-year storm event. Watershed #2 discharges 3,422 cubic feet of stormwater to the underground infiltration system. During the 1-year storm event, the infiltration system discharges 1,135 cubic feet of stormwater. This equates to 2,287 cubic feet of stormwater either stored or infiltrated which does not discharge to Study Point No. 1. This value exceeds the WQv necessary and satisfies this requirement through runoff reduction.

2) Channel Protection Volume (CPv)

According to Part I.C.2.c.ii. of the General Permit, CPv is not required for any areas that do not increase the discharge rate from the project site. Therefore, the CPv was sized based on any new development areas which would increase the impervious area for the site. According to Section 10.3 of the Stormwater Design Manual this sizing is the same volume as the WQv for phosphorus limited watersheds.

As indicated in Table 03 below, the proposed underground storage chambers will allow for 24-hour extended detention of the CPv for the new development areas. The volume provided is taken from Hydraflow Report in Appendix F and is based on the storage and infiltration provided for the 1-year 24-hour storm by the underground chambers. The 2,287 cubic feet is the amount of storage that will be stored by the chambers. Therefore, this project will reduce 100% of the CPv for the post-development condition, and the Channel Protection objectives of the Design Manual will be satisfied.

Table 03 – CPv Summary

New Development Impervious Area (Acres)	CPv, Equal to WQv, (ft^3)	Volume Provided (ft^3)
0.031	386	2,287

When stormwater enters the underground infiltration system it will pass through a pretreatment catch basin which will collect any larger debris and sediment in the water. Stormwater will then pass into the StormTech Isolator Row. The Isolator Row will filter out 80% of the Total Suspended Solids and 49% of the Phosphorus. As this is a phosphorus limited watershed, it

is critical that all the required WQv is treated. All water quality volume requirements are met by the infiltration chambers. The Isolator Row will provide additional water quality protection. As indicated in Table 03 above, the infiltration chambers will treat 100% of the WQv for the post-development condition for phosphorus. WQv and RRv sizing information can be found on the worksheets located in Appendix G.

3) Overbank Flood Control (Qp)

In accordance with Chapter 4 of the NYS Stormwater Management Design Manual, the proposed SMPs shall meet the Qp sizing criteria, which requires control of post-development peak discharges for the 10-year, 24-hour storm event to pre-development rates. According to Figure 4.3 of the Design Manual, the 10-year storm event has a rainfall depth of 5.10 inches at this site.

Pre and post-development watershed areas have been modeled using Hyraflow Hydrographs for the 10-year storm for each design point of analysis. A summary comparing pre and post-development runoff peak rates at each design point for the 10-year, 24-hour storm event can be found in Table 01. As indicated in Table 01, the calculated post-development peak flow rates do not exceed the pre-development rates at any design point. Therefore, the Overbank Flood protection objectives required in the Design Manual are satisfied for this project.

4) Extreme Flood Control (Qf)

In accordance with Chapter 4 of the NYS Stormwater Management Design Manual, the proposed SMPs shall meet the Qf sizing criteria, which requires control of post-development peak discharges for the 100-year, 24-hour storm event to pre-development rates. According to Figure 4.4 of the Design Manual, the 100-year storm event has a rainfall depth of 9.00 inches at this site.

Again, pre and post-development watershed areas have been modeled using Hydraflow Hydrographs for the 100-year storm for each design point of analysis. A summary comparing pre and post-development runoff peak rates at each design point for the 100-year, 24-hour storm event is can be found in Table 01. As indicated in Table 01, the calculated post-development peak flow rates do not exceed the pre-development rates at any design point. Therefore, the Extreme Flood protection objectives required in the Design Manual are considered to be satisfied for this project.

C. SOIL TESTING RESULTS AND LOCATIONS

Test boring locations and the reported boring log information from soil testing performed for this site are provided in Appendix B. This includes the Whitestone Deep and Infiltration Test Report and the Soil Boring Report performed by Melick-Tully & Associates.

D. OPERATIONS AND MAINTENANCE PLAN

Upon completion of construction the Owner will be responsible for inspection, maintenance and repair of the post-construction SMPs. The stormwater management practices shall be inspected at least twice annually. Debris, trash, sediment and other waste material found within the systems should be removed and disposed of at suitable disposal/recycling sites and in compliance with applicable local, state, and federal waste regulations by the entity responsible.

Catch Basins:

1) Catch basins shall be inspected a minimum of twice a year.
2) Cleaning of sump shall occur twice a year or when sediment depth is greater than 6", whichever occurs more frequently. All sediment, trash and debris shall be removed using a vac truck or other method of removal.

Underground Storage Chambers:

1) Maintenance of the StormTech Isolator Row to occur at a minimum of twice a year. The Isolator Row should be cleaned using the JetVac process and must be in accordance with the Inspection and Maintenance Section of the StormTech Design Manual.
2) The drain inlets must be cleaned quarterly or after a large storm event. Cleaning must occur when sediment is at a depth of 6". All sediment should be removed from the drain inlet.
3) The sump must be cleaned quarterly or after a large storm event. Cleaning must occur when sediment is at a depth of 6". All sediment should be removed from the sump via excavation, pump or vacuum.
4) The Owner or person responsible for the maintenance of the underground storage chamber is responsible for understanding and following the minimum requirements of the Inspection and Maintenance section of the StormTech Design Manual. Appendix H contains all necessary StormTech Design and Maintenance Manuals.

Appendix A

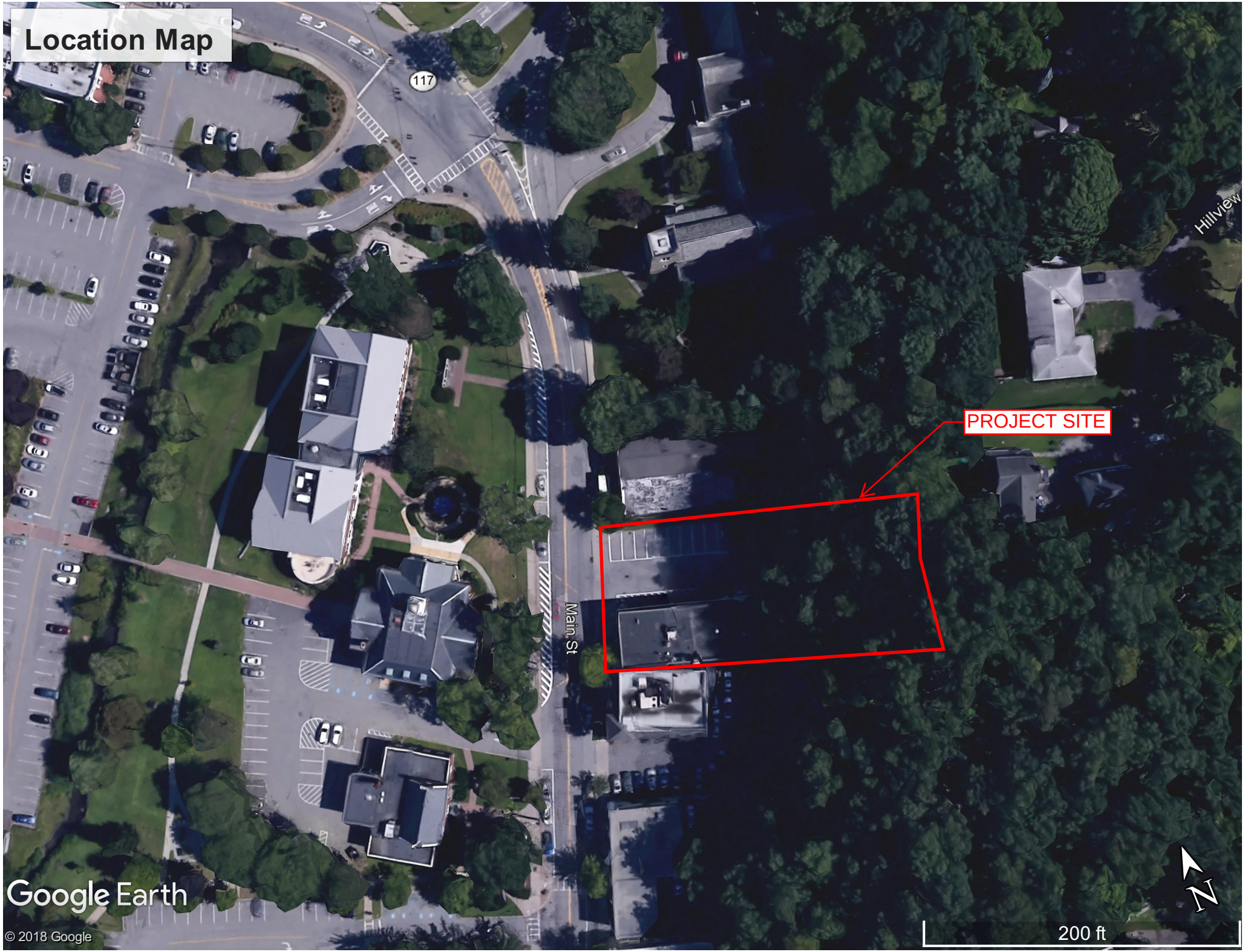
Location Map

FEMA FIRMette

NYS DEC Environmental Resource Map

US Fish and Wildlife Service Wetland Map

Historic Sites Map


Location Map
117
Hillview
PROJECT SITE
Main St
Google Earth
© 2018 Google
N
200 ft

EAF Mapper Summary Report

Monday, November 22, 2021 11:12 AM

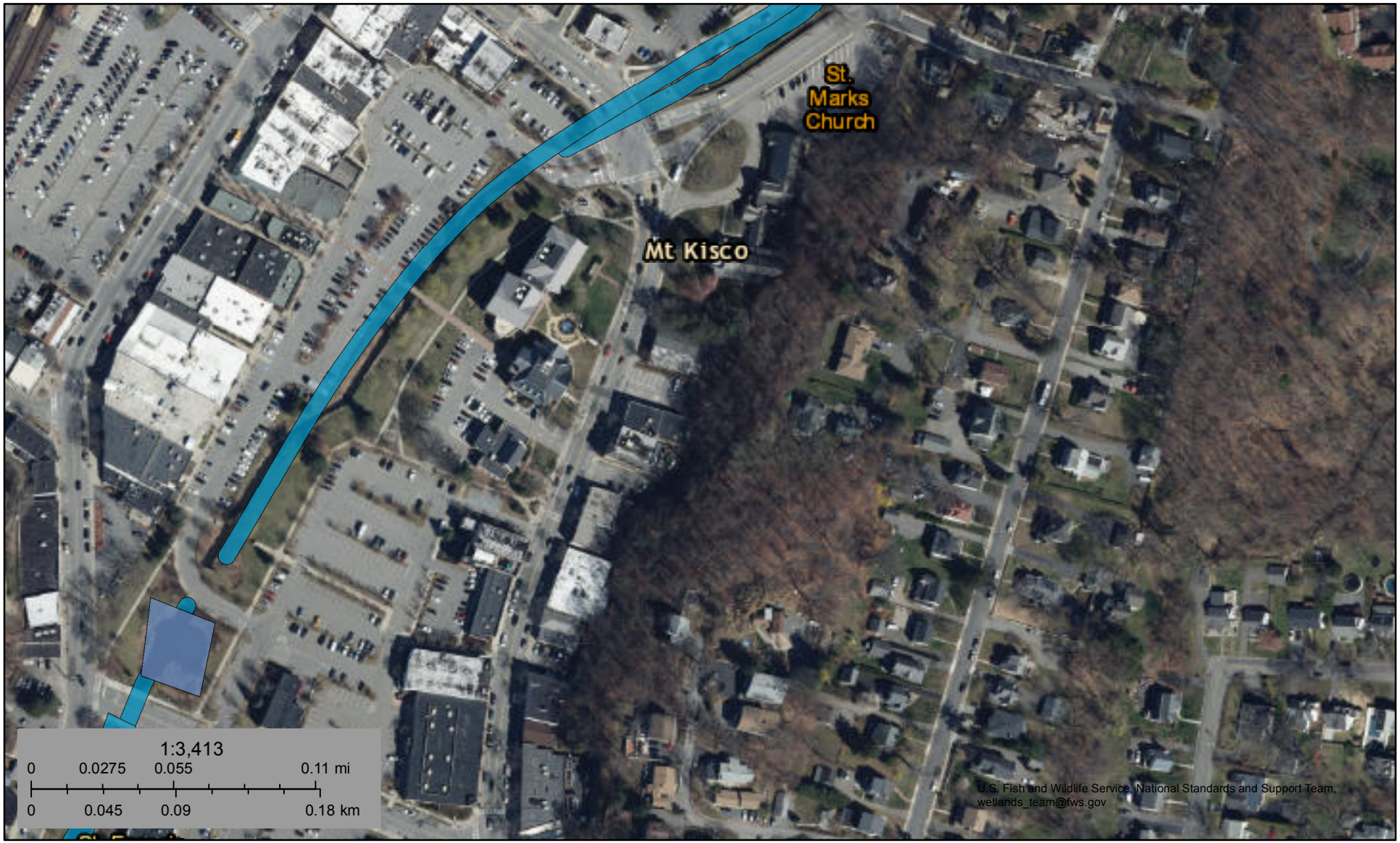
Disclaimer: The EAF Mapper is a screening tool intended to assist project sponsors and reviewing agencies in preparing an environmental assessment form (EAF). Not all questions asked in the EAF are answered by the EAF Mapper. Additional information on any EAF question can be obtained by consulting the 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.

Part 1 / Question 7 [Critical Environmental Area]	No
Part 1 / Question 12a [National or State Register of Historic Places or State Eligible Sites]	No
Part 1 / Question 12b [Archeological Sites]	No
Part 1 / Question 13a [Wetlands or Other Regulated Waterbodies]	Yes - Digital mapping information on local and federal wetlands and waterbodies is known to be incomplete. Refer to EAF Workbook.
Part 1 / Question 15 [Threatened or Endangered Animal]	No
Part 1 / Question 16 [100 Year Flood Plain]	No
Part 1 / Question 20 [Remediation Site]	Yes

U.S. Fish and Wildlife Service

National Wetlands Inventory

MKIV 1802



September 5, 2018

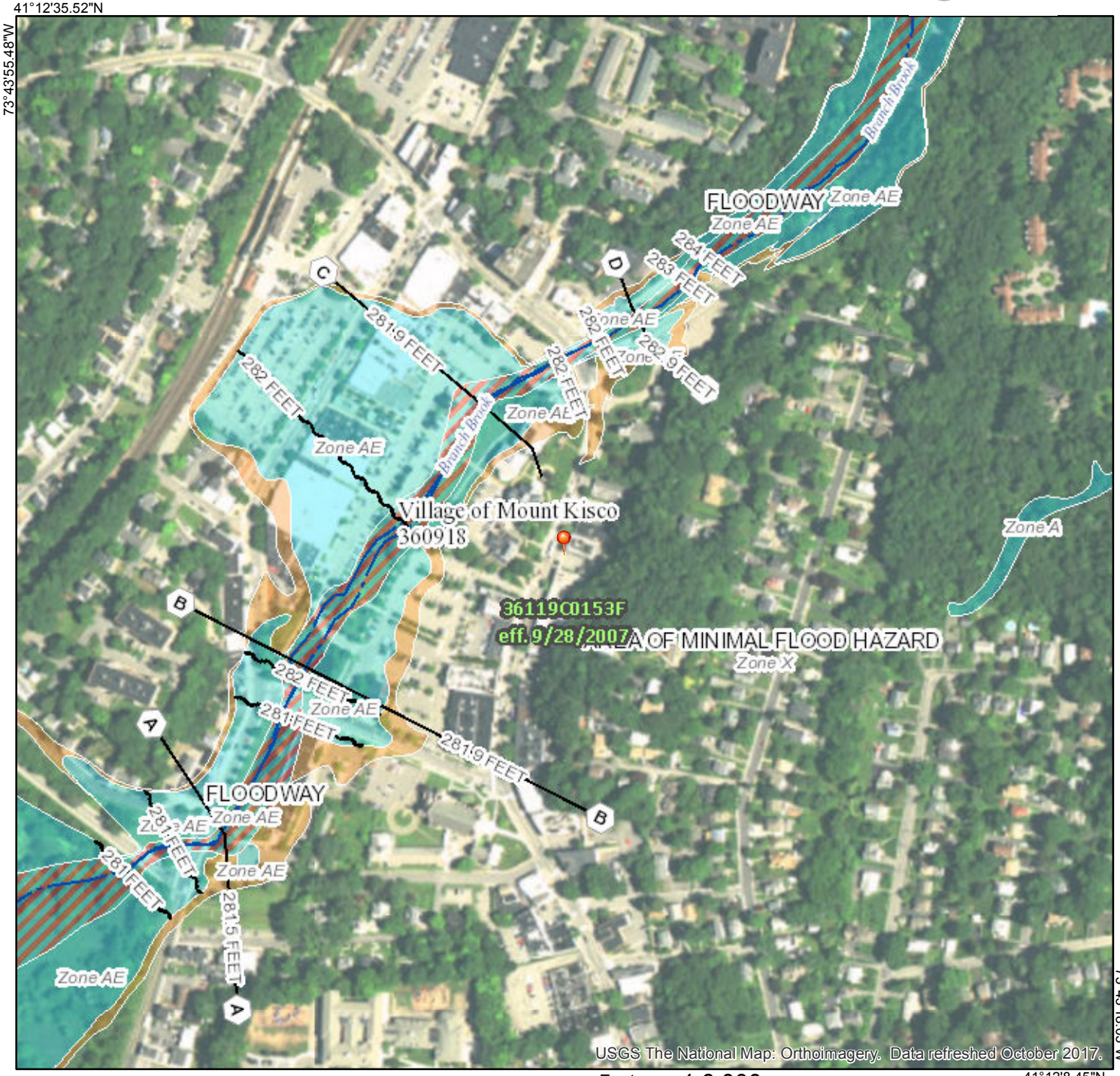
Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine


USN Building Points (View)
Eligible
Listed
Not Eligible
Not Eligible - Demolished
Undetermined
National Register Building Sites (View)
Survey Building Areas (View)
Jeff Feigel Sq
N Bedford Rd
Brookside Ave
St. Marks Church
S Moger Ave
Main St
Hill View Cir
Grove St
Britton Ln
Stewart Pl
Blackeby Pl
Westchester County Justice Court
117
0
100
200ft
County of Westchester, Westchester County GIS, UConn/CTDEEP, Esri, HERE, Garmin, INCREMENT P, NGA, USGS
esri

National Flood Hazard Layer FIRMette

FEMA



0 250 500 1,000 1,500 2,000 Feet

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/5/2018 at 10:54:49 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Appendix B

Soils Report
Soils Boring Report
Deep and Infiltration Testing Reports

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 Westchester County, New York

MKIV1802

November 22, 2021

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.

Contents

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

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

Map Scale: 1:454 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 5 10 20 30

Feet: 0 20 40 80 120

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

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 1:12,000.

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: Westchester County, New York
Survey Area Data: Version 17, Sep 1, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Oct 16, 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
CtC	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	0.0	0.7%
HrF	Hollis-Rock outcrop complex, 35 to 60 percent slopes	0.4	61.0%
Uf	Urban land	0.2	38.3%
Totals for Area of Interest		**0.6**	**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.

Westchester County, New York

CtC—Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w69g
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Chatfield, extremely stony, and similar soils: 39 percent
Hollis, extremely stony, and similar soils: 26 percent
Rock outcrop: 17 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands

Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Nose slope, crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 0 to 15 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 12 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Sutton, extremely stony

Percent of map unit: 3 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 1 percent
Landform: Ground moraines, hills, drainageways, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

HrF—Hollis-Rock outcrop complex, 35 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2w69q
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis, very stony, and similar soils: 60 percent
Rock outcrop: 20 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis, Very Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope, nose slope
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 35 to 60 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges, hills
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 35 to 60 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Chatfield, very stony
Percent of map unit: 10 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Charlton, very stony
Percent of map unit: 5 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Leicester, very stony
Percent of map unit: 4 percent
Landform: Ground moraines, hills, drainageways, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Sutton, very stony
Percent of map unit: 1 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Uf—Urban land

Map Unit Setting

National map unit symbol: bd7j
Elevation: 50 to 2,400 feet
Mean annual precipitation: 46 to 50 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 115 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Minor Components

Udorthents

Percent of map unit: 5 percent
Hydric soil rating: No

Riverhead

Percent of map unit: 2 percent
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 2 percent
Hydric soil rating: No

Unadilla

Percent of map unit: 2 percent
Hydric soil rating: No

Chatfield

Percent of map unit: 2 percent
Hydric soil rating: No

Sutton

Percent of map unit: 2 percent
Hydric soil rating: No

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Melick-Tully
& Associates

A Division of GZA

SUBSURFACE SOIL INVESTIGATION

PROPOSED BUILDING ADDITIONS
VILLAGE OF MOUNT KISCO,
WESTCHESTER COUNTY, NEW YORK

April 20, 2018
File No. 26.0091286.02

PREPARED FOR:
Village of Mount Kisco
c/o H2M Architects/Engineers
Purchase, New York

Melick-Tully, A Division of GZA
117 Canal Road | South Bound Brook, NJ 08880
732-356-3400

GZA has 32 Offices Nationwide
www.melick-tully.com www.gza.com

Melick-Tully
& Associates
A Division of GZA

GEOTECHNICAL
ENVIRONMENTAL
ECOLOGICAL
WATER
CONSTRUCTION MANAGEMENT

117 Canal Road
South Bound Brook, NJ 08880
732-[illegible]400
www.melick-tully.com
www.gza.com

April 20, 2018
File No. 26.0091286.02

Village of Mount Kisco
c/o H2M Architects/Engineers
2700 Westchester Avenue, Suite 415
Purchase, New York 10577

Attention: Mr. Cole Podolsky, LEED AP
Project Designer

Report
Subsurface Soil Investigation
Proposed Building Additions
Mutual Fire Station
Village of Mount Kisco, Westchester County, New York

Introduction

This report presents the results of a subsurface soil investigation performed by Melick-Tully and Associates, a Division of GZA GeoEnvironmental, Inc. and affiliated with GZA GeoEnvironmental of New York (MTA) for additions to the existing Mutual fire station. The Mutual fire station is located at 99 Main Street in the Village of Mount Kisco, Westchester County, New York as shown on the Site Location Map, Plate 1.

Proposed Construction

Plans provided to us indicate that the existing Mutual fire station would be improved by constructing two interconnected additions to the northeast side of the existing fire house. The addition attached to the existing fire house would be approximately 16 feet by 28 feet in overall plan dimensions and a larger addition connected to the north of the smaller addition would be approximately 34 feet by 40 feet in outside plan dimensions. We understand that the additions would be two story slab-on-grade structures. Structural loading was not

provided to us at the time of this report; however, we believe that the additions would impose light to moderate foundation loads and light to moderate floor slab loads.

Grading plans were not provided to us at this time; however, we understand that the additions would be located close to the level of the existing floor slab at Elevation +285.4 feet requiring cuts of up to approximately 12 feet in the rear of the larger addition to reach the proposed floor slab subgrade level.

Purpose and Scope of Work

The purpose of our services was to:

1) explore the subsurface soil, rock and groundwater conditions as close as practical to the boring locations identified by H2M within the proposed building addition areas;

2) estimate the relevant geotechnical engineering properties of the encountered materials;

3) evaluate the site foundation requirements considering the anticipated structural loads and encountered subsurface conditions;

4) recommend an appropriate type of foundation for support of the proposed additions and provide geotechnical-related foundation design and installation criteria, including an estimate of the Site Class as defined by the Building Code of New York State, 2017 Edition, for seismic design purposes;

5) provide recommendations for the support and the need for subdrainage of the ground level floor slab;

6) estimate the post-construction settlements of the recommended floor and foundation systems;

7) provide estimated soil parameters as requested in your RFP including but not limited to equivalent soil pressures, subgrade moduli, internal angles of friction and unit weights of soil;

8) recommend pavement improvements including milling and resurfacing or full depth replacement; and

9) discuss appropriate earthwork considerations consistent with the proposed construction and encountered subsurface conditions.

To accomplish these purposes, a subsurface exploration program consisting of four supervised test borings was performed at the site, as requested. The borings were advanced using all-terrain vehicle mounted hollow-stem auger drilling equipment and extended to depths of approximately 3 to 6 feet below the existing surface grades.

All borings terminated upon refusal on the underlying schist bedrock. The approximate locations of the explorations are shown on the Plot Plan, Plate 2.

All work was performed under the direct technical observation of a representative from MTA. Our representative located the explorations in the field using the existing site features, maintained continuous logs of the borings as the work proceeded and supervised the soil sampling operations. Closely-spaced soil samples were obtained from the borings using the general procedures of the Standard Penetration Test.

Detailed descriptions of the materials encountered in the explorations are shown on the individual Logs of Borings, Plates 3A through 3D. The soils were visually classified in general accordance with the Unified Soil Classification System (USCS) presented on Plate 4. The soil samples obtained from the explorations were brought to our office where they were further examined in our soil mechanics laboratory. Two of the samples were subjected to geotechnical laboratory testing consisting of grain-size analyses and moisture content determinations. The results of the grain-size tests are presented on Plate 5, Gradation Curves. The results of the moisture content tests are presented on Plate 5 and on the appropriate exploration logs.

The results of our subsurface exploration program, our visual examination of the soil samples and our review of the laboratory test results have provided the basis for our engineering analyses and design recommendations. The following discussions of our findings are subject to the limitations attached as Appendix II to this report.

Site Conditions

Surface Features: The western portion of the proposed addition area is currently paved and existing improvements including a masonry block retaining wall, a macadam drainage swale, a dumpster enclosure and a drainage inlet with PVC piping are present. The eastern portion of the addition area is grass covered and moderately wooded. A number of rock outcrops were visible at the surface in the unimproved portion of the

site east of the proposed additions. The asphalt parking area to the north of the existing firehouse is in various states of disrepair, and numerous cracks were evident.

Topographic information shown on plans provided to us indicate that the paved western edge of the proposed additions is relatively flat with an elevation of approximately +286 feet. The eastern portion of the addition behind the improvements slope gently to steeply upward from west to east, to a high of approximately Elevation +297 feet in the southeast corner of the northern addition footprint. Grades continue sloping up to the east at approximately 1.5H:1V to about Elevation +346 feet before the grade flattens out and continues at a more gradual slope to about +356 feet near the southeast property corner.

Subsurface Conditions: The following generalized strata were encountered in the explorations and are listed in order of increasing depth:

1) Surface Treatments: A surficial layer of topsoil approximately 4 inches thick was encountered in Borings No. MB-3 and MB-4 in the unimproved areas in the eastern portion of the proposed additions. In Borings No. MB-1 and MB-2, the surface treatments consisted of a layer of asphalt pavement approximately 2 to 4 inches in thickness over a 2-inch stone subbase course.

2) Fill: Fill materials consisting of silty sand were encountered in Boring No. MB-3 extending to a depth of 18 inches below grade.

3) Silty Sand: The surface treatments and fill materials were underlain by silty sands in Borings No. MB-1, MB-2 and MB-3. The sandy materials extended to depths of approximately 3 to 6 feet below the existing surface grades. In Boring No. MB-4, the topsoil was underlain by fractured schist bedrock.

4) Schist Bedrock: Schist bedrock was encountered below the sandy soils in Borings No. MB-1 through MB-3 and beginning below the topsoil in Boring No. MB-4. Refusal to further auger and/or sampler penetration was encountered in all four of the borings at depths of approximately 3 to 6 feet below the existing surface grades. Rock outcrops were evident in the unimproved area to the east of the existing firehouse.

Groundwater was not encountered in any of the borings to the maximum depths explored of up to 6 feet below grade at the time of our study.

Findings and Recommendations

General: Based on the results of our study, it is our opinion that:

1) The foundations of the proposed additions may derive their support from the schist bedrock encountered at depths of approximately 3 to 6 feet below grade. The floor slabs could be supported by competent portions of the surficial sandy soils, or schist bedrock.

2) Schist bedrock was encountered at levels of 3 to 6 feet in the borings, and cuts of up to 12 feet below the existing surface grades are anticipated to reach the proposed addition floor level. This excavation will extend below the surface of the rock in the east portions of the additions. Consequently, blasting or other means of rock removal will be required to achieve the proposed grades.

3) The moisture contents of the overburden soils were observed to be at or slightly above levels which would allow for immediate reuse as backfill. We believe that some scarification and drying of the near surface soils will be required for use as backfill, or for floor slab support in the west portion of the addition.

4) Groundwater was not encountered to the maximum depths explored of up to 6 feet below the existing surface grades at the time of our study; however, perched groundwater traveling across the top of relatively sound bedrock and/or surface runoff may be encountered during construction. Note that Borings MB-3 and MB-4 encountered refusal above the proposed floor levels.

Further discussion of these and other items considered relevant to the proposed additions are presented in subsequent sections of this report.

Site Preparation: The site should be cleared and grubbed of all trees and vegetation. The existing improvements including the drainage swale, underground stormwater piping, concrete block retaining wall and trash enclosure should be removed, and the resulting demolition rubble legally disposed of off-site. The existing topsoil in the eastern portion of the proposed addition areas should be stripped and the existing asphalt pavement in the western portion of the proposed additional areas should be broken up and the resulting asphalt fragments legally disposed of off-site.

After clearing and stripping and removal of the existing improvements, excavation should proceed to reach the building subgrade levels.

Schist bedrock was encountered in all four of the borings at depths of approximately 3 to 6 feet below the existing surface grades, and rock outcrops were evident in the slope to the east of the existing firehouse and additions. We believe that excavations could extend only slightly below the refusal levels encountered using rippers or larger excavation equipment equipped with rock removal teeth. It should be anticipated that deeper cuts where rock is encountered will require blasting or presplitting and extensive hammering to achieve the proposed foundation and floor slab subgrade levels. The rock removal should extend to a depth to account for any subslab utilities and the building foundations.

Any subgrade materials in the western portion of the addition which appear to be soft or unstable should be scarified, aerated and dried and recompacted in place or excavated to the surface of competent soils and replaced with controlled compacted fill. We believe that portions of the sandy material could be stockpiled for reuse as backfill as required; however, moisture contents run on the sands indicate that they are at or above moisture contents which would allow immediate reuse for controlled compacted fill. Consequently, some aeration and drying of the sandy soils may be required. Any fill installed to achieve the floor slab subgrade levels or to backfill the proposed improvements should be spread in layers on the order of 8 to 10 inches in loose thickness and uniformly compacted to 95 percent of its maximum dry density as determined by the ASTM D-1557 test procedure.

All construction excavations should be performed in accordance with the most recent OSHA Excavation guidelines and governing safety codes. Based on the results of our explorations, we believe that the existing site soils will be considered a Type "C" soil as defined by the latest OSHA Excavation regulations. Excavation side slopes should be flattened as necessary to maintain safe excavations at all times. Steeper slopes could be permitted for excavations penetrating the bedrock. Fracturing and orientation of the bedding should be fully evaluated during construction to determine if stable rock conditions prevail.

We recommend that test pits be performed on the east side of the addition to better define the depth of overburden soils to bedrock to aid in the design of the excavation support system required to construct the rear walls.

Groundwater was not encountered to the maximum depths explored of up to 6 feet below the existing surface grades at the time of our study. We believe that perched groundwater seepage atop the existing bedrock could be encountered and that surface runoff from the slope to the east of the building could enter into construction excavations. We recommend that the contract documents require the contractor to maintain relatively dry excavations at all times.

Below-Grade Walls: We understand that the rear (east) walls of the proposed additions would be constructed as retaining walls. We recommend that any below-grade walls be provided with a vertical drainage system to prevent the buildup of hydrostatic pressure behind the wall. The vertical drain should consist of synthetic drainage material (Enkadrain or equivalent) or a column of crushed stone which extends from the top of the wall foundation to within 2 feet of the proposed ground surface. If stone is used, it should be separated from the adjacent soils by a geotextile fabric. The vertical drainage layer should be connected to a foundation drain consisting of a minimum 6-inch diameter porous concrete or perforated ADS pipe surrounded on all sides by a minimum of 6 inches of free-draining crushed stone wrapped in filter fabric. The foundation drain should be sloped to drain by gravity to the storm sewer system. The civil engineer should grade the slope with a swale or other means to prevent runoff from accumulating against the east wall of the addition.

The below-grade walls should be designed to resist lateral earth pressure imposed by the adjacent soils as well as surcharge loads due to sloping backfill, surface improvements, temporary construction traffic, material stockpiles, etc. Walls which are free to rotate slightly during backfilling may be designed to resist lateral earth pressure assuming an active earth pressure condition. Provided the sandier portions of the on-site soils are

used as backfill and compacted to at least 95 percent of their maximum dry density as determined by the ASTM D-1557 test procedure, a total unit weight of 135 pounds per cubic foot and a friction angle of 32 degrees may be used. A friction factor between concrete and the schist bedrock of 0.60 could be used to resist sliding.

Typical soil parameters for the overburden soils could be estimated based on the following table:

Typical Soil Parameters

			Lateral Equivalent Soil Pressures (psf/ft)				
Soil Type	**Bearing Capacity**	**Subgrade Modulus ($lbs/in^{(3)}$)**	**Active***	**Passive**	**At-Rest***	**Friction Angle (degrees)**	**Estimated Total Unit Weight (pcf)**
Silty Sand (SM)	6,000 psf	150	41	439	63	32	135

*The active and at-rest soil pressures should be adjusted to account for the sloping backfill to the east of the wall once grading plans are developed and a more complete evaluation of the depth to bedrock is determined from test pits.

Foundation Design Criteria: Following the site preparation procedures previously described, foundations for the proposed addition may consist of conventional shallow foundations which derive their support from the schist bedrock anticipated to be present at the foundation subgrade levels. Foundations on the schist bedrock may be designed for allowable bearing pressures of 8,000 psf.

Exterior foundations are generally required to extend to depths of 4 feet below the lowest adjacent exterior grade for frost penetration. However, if the footings are on rock, footings could be constructed at shallower levels. Interior foundations in permanently heated portions of the structure could be established at more convenient levels. We recommend that a geotechnical engineer from MTA be present at the site to determine the suitability of the foundation subgrade materials before placing concrete.

We estimate that foundations supported on the relatively sound schist bedrock would be negligible.

Seismic Design Criteria: Based on our review of the soil boring information, it is our opinion that the site subsurface conditions are representative of a Site Class "B" as defined by the Building Code of New York State,

2017 Edition, for seismic design purposes. Considering a Site Class "B" the published USGS design maps estimate a short acceleration period (S_s) equal to .253 and a 1-second acceleration (S_1) equal to 0.070. A copy of the USGS design map summary report is included as Appendix I.

Floor Slab Design Criteria: We believe the proposed floor slabs could be supported atop the sandy overburden soils in the western portion of the site compacted to a dense and unyielding condition. Any areas observed to be soft or unstable should be removed to suitable bearing materials and be replaced with granular controlled compacted fill. We recommend that the schist bedrock in the eastern portion of the addition area be overexcavated a minimum of 12 inches and be replaced with controlled compacted fill or clean stone in order to provide a uniform subgrade support for the slab. The slab should be underlain by a minimum of 6 inches of 3/4-inch clean crushed stone or washed gravel to provide a stable working base during construction. The subslab stone layer should be connected to the storm sewer system so that any water which accumulates in the stone could be removed.

We believe that floor slabs constructed in accordance with our recommendations would experience total settlements on the order of 1/4 of 1 inch, or less.

Pavement Rehabilitation: Two pavement cores, one each in Borings MB-1 and MB-2 indicated a variable pavement section of between 2 and 4 inches of asphalt over 2 inches of processed stone. No estimates of vehicle trips were provided to us to evaluate the thickness design. Based on our observations, it appears that significant cracking of the pavement is evident, especially over the existing storm drain trenches. Due to the extensive cracking throughout the parking area, especially over the existing storm system, and the variable thickness of the asphalt, it does not appear that partial removal and replacement of the pavement section would be adequate. We recommend that the existing pavement be removed for its full depth and the asphalt fragments legally disposed of off-site. We recommend that the exposed subgrade materials be graded to allow

a uniform asphalt pavement section be installed. We recommend that the exposed stone base course exposed after removal of the pavement and grading be proofrolled with a loaded tandem dump truck to observe any soft subgrades which may require removal and replacement. Any areas which are observed to deflect under the proofrolling should be removed for their full depth, and any soft or disturbed soils removed and replaced with a processed stone material compacted to 95 percent of its maximum dry density as determined by the ASTM D-1557 test procedure prior to replacing the pavement.

Please feel free to contact us if you have any questions regarding this report.

The following Plates and Appendices are attached and complete this report:

Plate 1 – Site Location Map
Plate 2 – Plot Plan
Plates 3A through 3D – Logs of Borings
Plate 4 – Unified Soils Classification System
Plate 5 – Gradation Curves
Appendix I – Seismic Design Summary Report
Appendix II – Limitations

Respectfully submitted,

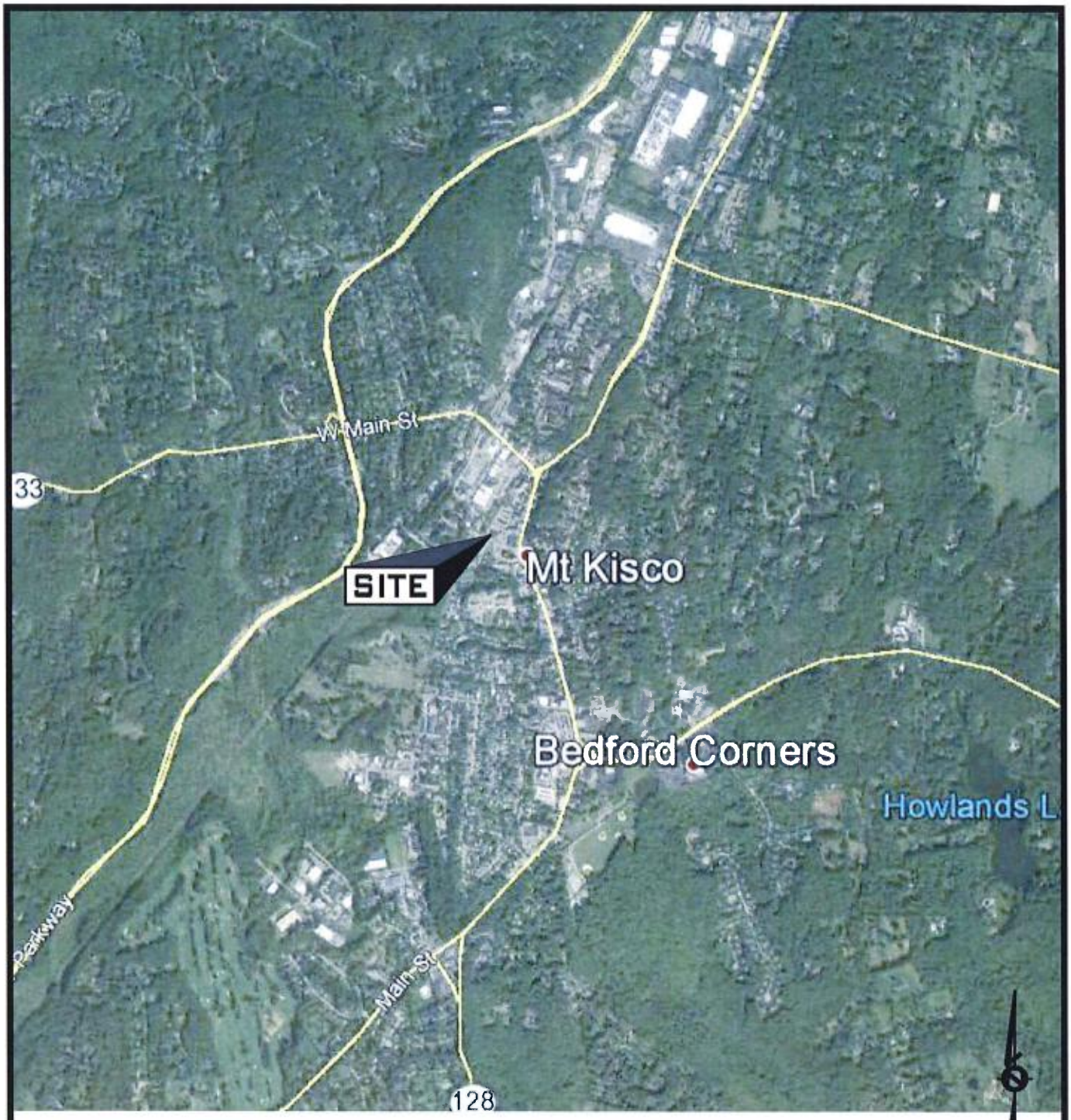
MELICK-TULLY and ASSOCIATES,
a Division of GZA GeoEnvironmental, Inc.

James H. Beattie, P.E.
Senior Consultant

Todd E. Horowitz, P.E.
Associate Principal

Ernest R. Hanna, P.E.
Consultant/Reviewer

JHB:TEH/pm
(3 copies submitted)



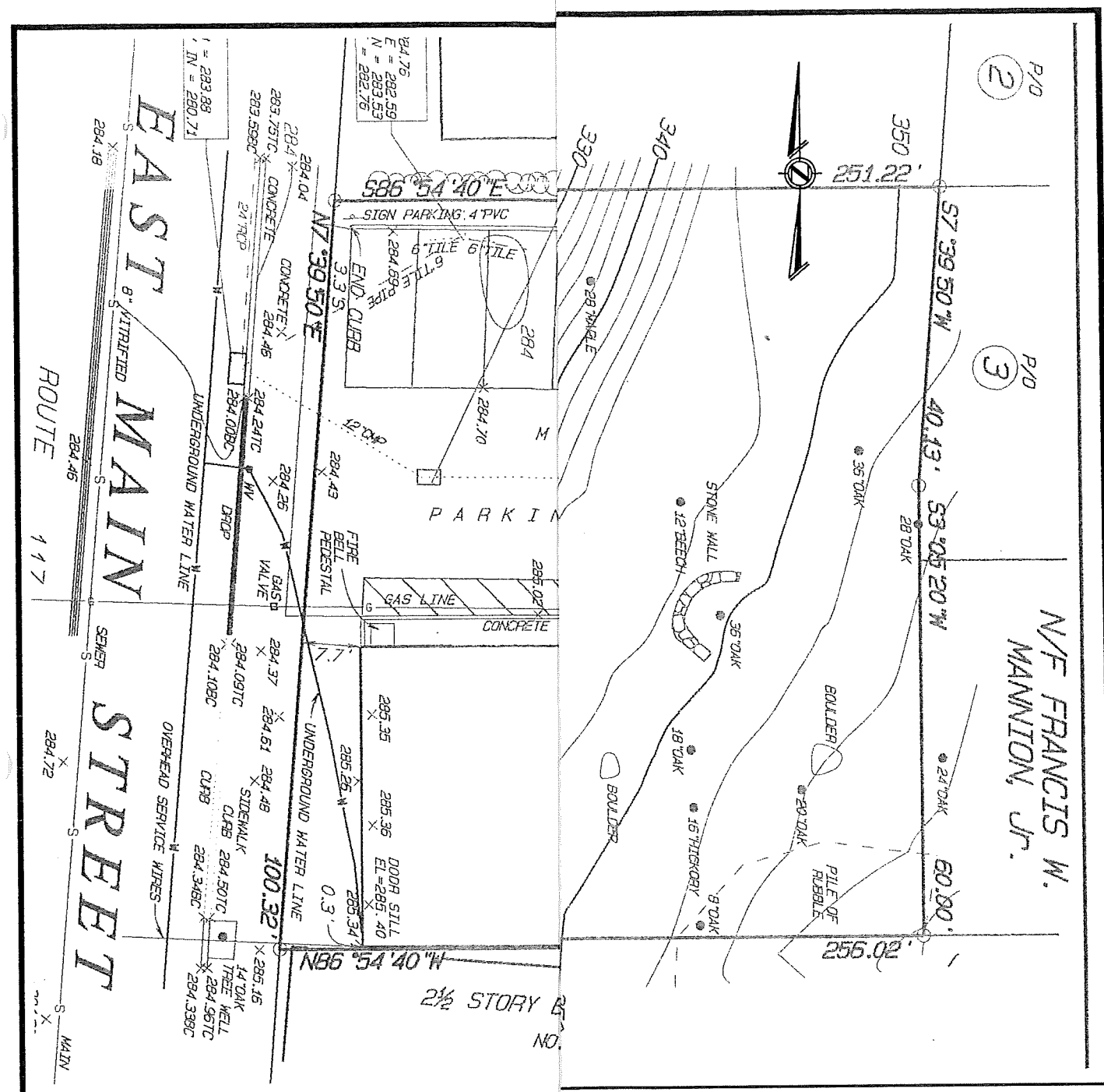
Aerial Photo courtesy of Google Earth Pro

MELICK–TULLY AND ASSOCIATES
A Division of GZA
Geotechnical Engineers & Environmental Consultants
117 Canal Road
South Bound Brook, New Jersey 08880
(732) 356-3400

SITE LOCATION MAP

BUILDING ADDITIONS AT GREEN STREET
MOUNT KISKO, NEW YORK
H2M ARCHITECTS & ENGINEERS

JOB NO.	FILE NO.	DR. BY	CHK. BY	DATE	SCALE	PLATE
26.0091286.00	–	VJD	JHB	3/30/18	1"=2,000'	1



KEY:

MB-1 NUMBER AND APP
BORINGS PERFORM

(3.5) APPROXIMATE DEP
OF SOUND SCHIS

PLOT PLAN

PROPOSED ADDITIONS (MUTUAL F.D.)
MOUNT KISCO, NEW YORK
H2M ARCHITECTS & ENGINEERS

MELICK-TULLY AND ASSOCIATES
A Division of GZA
Geotechnical Engineers & Environmental Consultants
117 Canal Road
South Bound Brook, New Jersey 08880
(732) 356-3400

JOB NO.	FILE NO.
26.0091286.02	-

DR. BY	CHK. BY	DATE	SCALE	PLATE
VJD	JHB	4/12/18	1"=20'	2

LOG OF BORING

BORING NO. MB-1

COMPLETION DATE: 3/5/18 | SURFACE ELEVATION: +285.5 ft. (±) | WATER LEVEL: *

JOB NUMBER: 26.0091286.02 | READING DATE: 3/5/18

DEPTH	SAMPLES	N-VALUE	MOISTURE CONTENT (%)	SYMBOL	DESCRIPTION	DEPTH
					2" Asphalt over 2" stone	
					Brown fine to coarse sand, little silt, trace fine gravel (possible fill)(moist)(very dense)	
	S1	59/6"		SM		
	S2	50/0"			- auger and sampler refusal encountered @ 3'-6" atop schist bedrock	
5					Boring completed @ 3'-6" atop schist bedrock *Groundwater not encountered	5
10						10

NOTES FOR COLUMNS:
1. SAMPLE AT AVERAGE SAMPLING DEPTH
2. INDICATES THE NUMBER OF BLOWS TO ADVANCE A 2" OD SAMPLER A DISTANCE OF 12 INCHES USING A 140 POUND WEIGHT FALLING 30 INCHES

SOIL DESCRIPTION MODIFIERS:
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND OVER 35%

Typist/Date: JHB/pm 4/18

Sheet: 1 of 1 PLATE: 3A

MELICK-TULLY AND ASSOCIATES,
a Division of GZA GeoEnvironmental Inc.

LOG OF BORING

BORING NO. MB-2

COMPLETION DATE: 3/5/18 | SURFACE ELEVATION: +285.0 ft. (±) | WATER LEVEL: *

JOB NUMBER: 26.0091286.02 | READING DATE: 3/5/18

DEPTH	SAMPLES	N-VALUE	MOISTURE CONTENT (%)	SYMBOL	DESCRIPTION	DEPTH
					4" Asphalt over 2" stone	
				SM	Brown fine to coarse sand, some silt, little fine gravel (moist)(dense)	
	S1	31	10.5			
	S2	50/0"			- auger and sampler refusal @ 3'	
					Boring completed @ 3' atop schist bedrock	
					*Groundwater not encountered	
5						5
10						10

NOTES FOR COLUMNS:
1. SAMPLE AT AVERAGE SAMPLING DEPTH
2. INDICATES THE NUMBER OF BLOWS TO ADVANCE A 2" OD SAMPLER A DISTANCE OF 12 INCHES USING A 140 POUND WEIGHT FALLING 30 INCHES

SOIL DESCRIPTION MODIFIERS:
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND OVER 35%

Typist/Date: JHB/pm 4/18

Sheet: 1 of 1 PLATE: 3B

MELICK-TULLY AND ASSOCIATES,
a Division of GZA GeoEnvironmental Inc.

LOG OF BORING

BORING NO. MB-3

COMPLETION DATE: 3/6/18 | SURFACE ELEVATION: +293.0 ft. (±) | WATER LEVEL: *

JOB NUMBER: 26.0091286.02 | READING DATE: 3/6/18

DEPTH	SAMPLES	N-VALUE	MOISTURE CONTENT (%)	SYMBOL	DESCRIPTION	DEPTH
					4" Topsoil	
	S1	50/0"			FILL - Light brown/white fine to medium sand, some silt, little fine to coarse gravel (moist)(very dense)	
				SM	Brown fine to coarse sand, some silt, some fine gravel (moist)(very dense)	
5	S2	50/2"	15.9		- schist rock fragments in spoon - auger refusal encountered @ 6' atop schist bedrock	5
					Boring completed @ 6' *Groundwater not encountered	
10						10

NOTES FOR COLUMNS:
1. SAMPLE AT AVERAGE SAMPLING DEPTH
2. INDICATES THE NUMBER OF BLOWS TO ADVANCE A 2" OD SAMPLER A DISTANCE OF 12 INCHES USING A 140 POUND WEIGHT FALLING 30 INCHES

SOIL DESCRIPTION MODIFIERS:
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND OVER 35%

Typist/Date: JHB/pm 4/18

Sheet: 1 of 1 PLATE: 3C

MELICK-TULLY AND ASSOCIATES,
a Division of GZA GeoEnvironmental Inc.

LOG OF BORING

BORING NO. MB-4

COMPLETION DATE: 3/6/18 | SURFACE ELEVATION: +291.0 ft. (±) | WATER LEVEL: *

JOB NUMBER: 26.0091286.02 | READING DATE: 3/6/18

DEPTH	SAMPLES	N-VALUE	MOISTURE CONTENT (%)	SYMBOL	DESCRIPTION	DEPTH
					4" Topsoil	
					White fractured schist bedrock	
	S1	15				
	S2	23				
	S3	50/0"				
					- auger refusal encountered @ 4'-6" atop schist bedrock	
5						5
					Boring completed @ 4'-6"	
					*Groundwater not encountered	
10						10

NOTES FOR COLUMNS:
1. SAMPLE AT AVERAGE SAMPLING DEPTH
2. INDICATES THE NUMBER OF BLOWS TO ADVANCE A 2" OD SAMPLER A DISTANCE OF 12 INCHES USING A 140 POUND WEIGHT FALLING 30 INCHES

SOIL DESCRIPTION MODIFIERS:
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND OVER 35%

Typist/Date: JHB/pm 4/18

Sheet: 1 of 1 PLATE: 3D

MELICK-TULLY AND ASSOCIATES,
a Division of GZA GeoEnvironmental Inc.

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50% of material is LARGER than No. 200 Sieve	GRAVEL & GRAVELLY SOILS More than 50% of coarse fraction RETAINED on No. 4 Sieve	CLEAN GRAVELS (Little or no fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
		GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, gravel-sand-silt mixtures.
			GC	Clayey gravels, gravel-sand-clay mixtures.
	SAND AND SANDY SOILS More than 50% of coarse fraction PASSING a No. 4 Sieve	CLEAN SAND (Little or no fines)	SW	Well-graded sands, gravelly sands, little or no fines.
			SP	Poorly-graded sands, gravelly sands, little or no fines.
		SANDS WITH FINES (Appreciable amount of fines)	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures.
FINE GRAINED SOILS More than 50% of material is SMALLER than No. 200 Sieve.	SILTS AND CLAYS	Liquid limit LESS than 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS	Liquid limit GREATER than 50	MH	Inorganic silts, micaceous or diatomaceous fine sand or silty soils.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			PT	Peat, humus, swamp soils with high organic contents

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

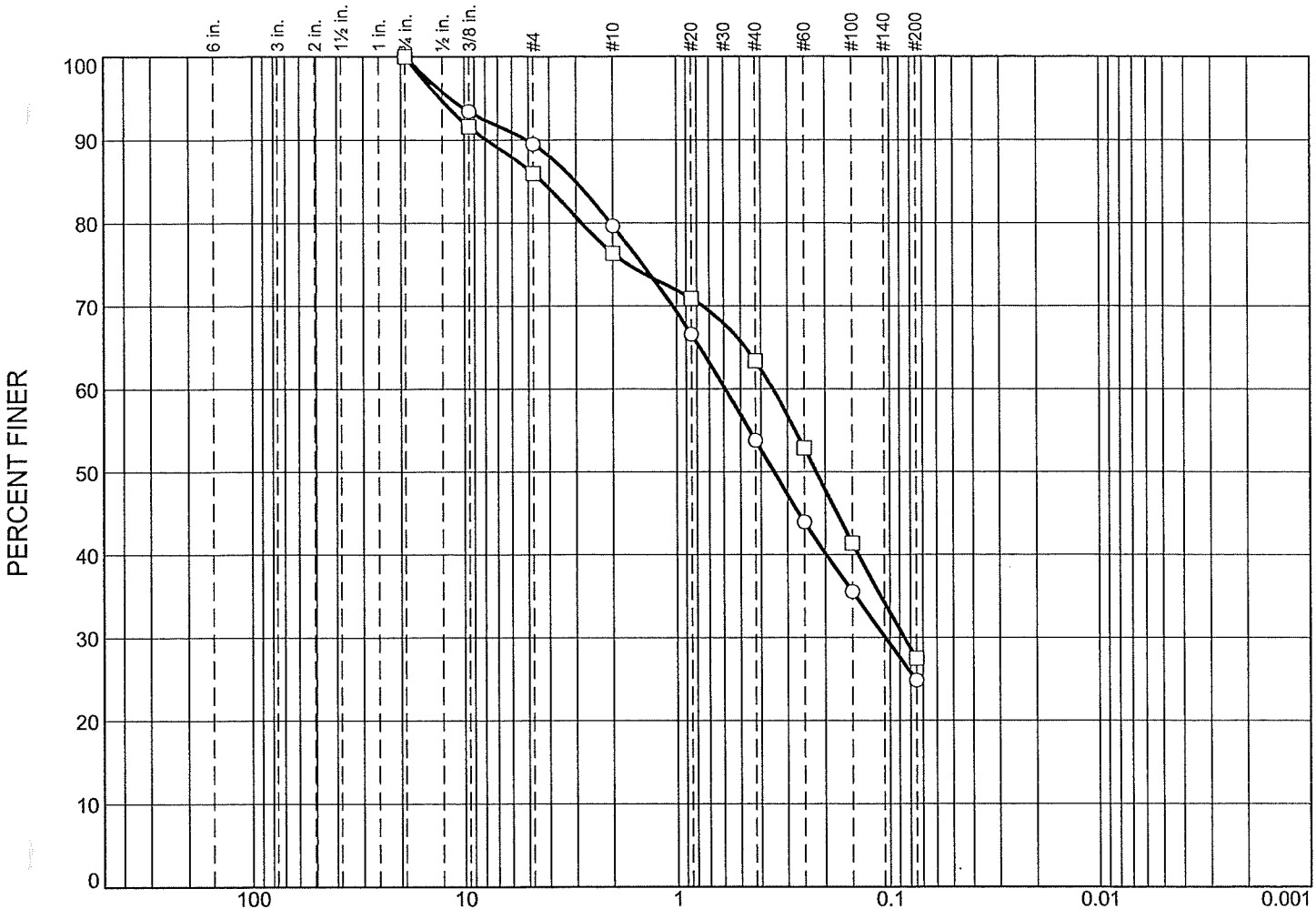
GRADATION*		COMPACTNESS* sand and/or gravel		CONSISTENCY* clay and/or silt	
% Finer by Weight		Relative Density		Range of Shearing Strength in Pounds per Square Foot	
Trace	0% to 10%	Loose	0% to 40%	Very Soft	less than 250
Little	10% to 20%	Medium Dense	40% to 70%	Soft	250 to 500
Some	20% to 35%	Dense	70% to 90%	Medium	500 to 1000
And	35% to 50%	Very Dense	90% to 100%	Stiff	1000 to 2000
				Very Stiff	2000 to 4000
				Hard	Greater than 4000

**Values are from laboratory or field test data, where applicable. When no testing was performed, values are estimated.*

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

Gradation Curve(s)



	% Cobbles	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	
○	0.0	0.0	10.5	9.8	25.9	29.0	24.8
□	0.0	0.0	14.0	9.7	12.9	35.9	27.5

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	MB-2	S-1A	1-3	Fine to coarse Sand, some Silt, little fine Gravel. (MC=10.5%)	SM
□	MB-3	S-2	2-4	Fine to coarse Sand, some Silt, some fine Gravel.(MC=15.9%)	SM

Melick-Tully & Associates, P.C.

South Bound Brook, NJ

Client: H2M Architects & Engineers

Project: Building Additions at Three Fire Stations, Mt. Kisco, NY

Project No.: 26.0091286.02 **Plate** 5

APPENDIX I – Seismic Design Summary Report

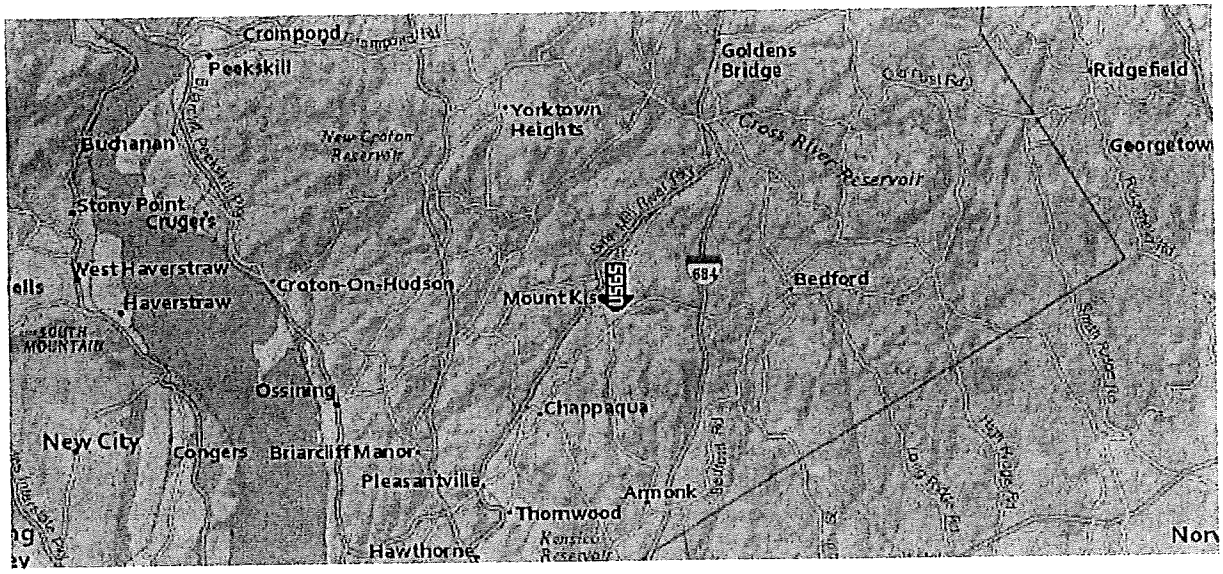
USGS Design Maps Summary Report

User-Specified Input

Building Code Reference Document ASCE 41-13 Retrofit Standard, BSE-2N
(which utilizes USGS hazard data available in 2008)

Site Coordinates 41.205°N, 73.729°W

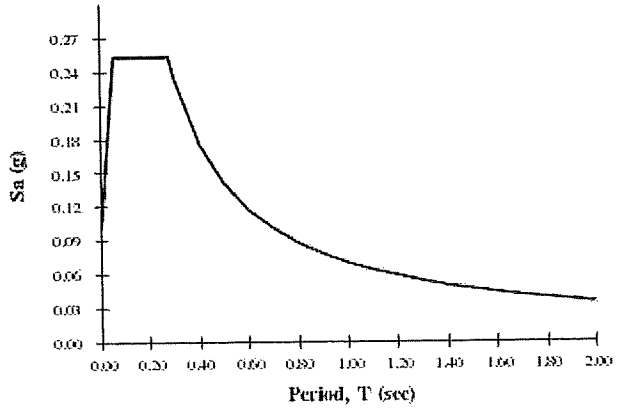
Site Soil Classification Site Class B – "Rock"



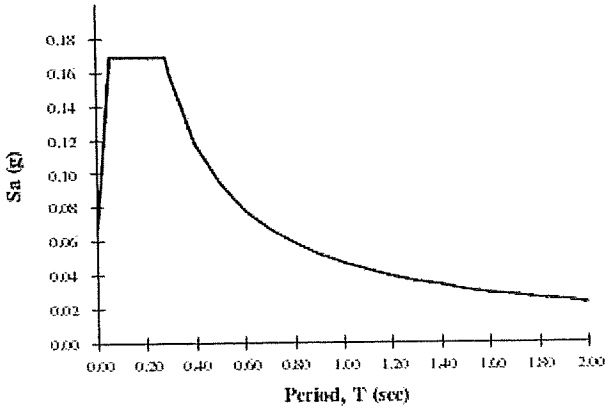
USGS-Provided Output

$S_{S,BSE-2N}$	0.253 g	$S_{XS,BSE-2N}$	0.253 g
$S_{1,BSE-2N}$	0.070 g	$S_{X1,BSE-2N}$	0.070 g

Horizontal Spectrum



Vertical Spectrum



APPENDIX II - Limitations

APPENDIX II

Limitations

A. Subsurface Information

Locations: The locations of the explorations were approximately determined by tape measurement from an aerial photo provided to us by H2M. Elevations of the explorations were approximately determined by interpolation between contours shown on topographic plans provided to us by the architect. The locations and elevations of the explorations should be considered accurate only to the degree implied by the method used.

Interface of Strata: The stratification lines shown on the individual logs of the subsurface explorations represent the approximate boundaries between soil types, and the transitions may be gradual.

Field Logs/Final Logs: A field log was prepared for each exploration by a member of our staff. The field log contains factual information and interpretation of the soil conditions between samples. Our recommendations are based on the final logs as shown in this report and the information contained therein, and not on the field logs. The final logs represent our interpretation of the contents of the field logs, and the results of the laboratory observations and/or tests of the field samples.

Water Levels: Water level readings have been made in the explorations at times and under conditions stated on the individual logs. These data have been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater will occur due to variations in rainfall, temperature, and other factors.

Pollution/Contamination: Unless specifically indicated to the contrary in this report, the scope of our services was limited only to investigation and evaluation of the geotechnical engineering aspects of the site conditions, and did not include any consideration of potential site pollution or contamination resulting from the presence of chemicals, metals, radioactive elements, etc. This report offers no facts or opinions related to potential pollution/contamination of the site.

Environmental Considerations: Unless specifically indicated to the contrary in this report, this report does not address environmental considerations which may affect the site development, e.g., wetlands determinations, flora and fauna, wildlife, etc. The conclusions and recommendations of this report are not intended to supersede any environmental conditions which should be reflected in the site planning.

B. Applicability of Report

This report has been prepared in accordance with generally accepted soils and foundation engineering practices for the exclusive use of The Village of Mt. Kisco for specific application to the design of the proposed additions. No other warranty, expressed or implied, is made.

This report may be referred to in the project specifications for general information purposes only, but should not be used as the technical specifications for the work, as it was prepared for design purposes exclusively.

C. Reinterpretation of Recommendations

Change in Location or Nature of Facilities: In the event that any changes in the nature, design or location of the additions are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

Changed Conditions During Construction: The analyses and recommendations submitted in this report are based in part upon the data obtained from four widely-spaced test borings performed for this study. The nature and extent of variations between the explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

Changes in State-of-the-Art: The conclusions and recommendations contained in this report are based upon the applicable standards of our profession at the time this report was prepared.

D. Use of Report by Prospective Bidders

This soil and foundation engineering report was prepared for the project by Melick-Tully and Associates, a Division of GZA GeoEnvironmental Inc. (MTA) for design purposes and may not be sufficient to prepare an accurate bid. Contractors utilizing the information in the report should do so with the express understanding that its scope was developed to address design considerations. Prospective bidders should obtain the owner's permission to perform whatever additional explorations or data gathering they deem necessary to prepare their bid accurately.

E. Construction Observation

We recommend that MTA be retained to provide on-site soils engineering services during the earthwork construction and foundation phases of the work. This is to observe compliance with the design concepts and to allow changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

WHITESTONE
ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants

MT. BETHEL CORPORATE CENTER
35 TECHNOLOGY DRIVE
WARREN, NJ 07059
908.668.7777
whitestoneassoc.com

October 16, 2018

via email

H2M ARCHITECTS & ENGINEERS
2 Executive Boulevard, Suite 401
Suffern, New York 10901

Attention: Dennis Lindsay, P.E.
Vice President

Regarding: SWM AREA EVALUATION
EXISTING FIRE STATIONS - PROPOSED SWM AREAS
29 GREEN STREET & 99 MAIN STREET
MOUNT KISCO, WESTCHESTER COUNTY, NEW YORK
WHITESTONE PROJECT NO.: GJ1815852.000

Dear Mr. Lindsay:

Whitestone Associates, Inc. (Whitestone) has completed a stormwater management (SWM) area evaluation at the above-referenced sites. The results of the evaluation presented below are based on the soil conditions disclosed by the soil borings performed during Whitestone's field investigation.

1.0 PROJECT DESCRIPTION

1.1 Site Location & Existing Conditions

The subject sites are located at 29 Green Street and 99 Main Street in Mount Kisco, Westchester County, New York. The sites currently are occupied by the Green Street Fire Station (29 Green Street) and Mutual Fire Station (99 Main Street). The Mutual Fire Station includes a partially-wooded area along the eastern boundary followed by an evident outcrop.

1.2 Site Geology

The subject sites are situated within the Manhattan Prong of the New England Uplands Physiographic Province of the Northeastern United States. The sites reportedly are underlain by the Precambrian to Middle Proterozoic-aged Fordham Gneiss. Fordham Gneiss is comprised of gneiss with variable mineral content that general consists of garnet, biotite, quartz, plagioclase, sillimanite, amphibolite and hornblende. The subject site is overlain by residual soils formed from the weathering of the underlying bedrock. Overburden materials also include sporadic organic deposits and man-made fill associated with past and present development of the subject sites.

1.3 Proposed Construction

Based on information provided by H2M including the September 2018 *Dimensional Site Plans* prepared by H2M, the proposed site redevelopments associated with this evaluation will included construction of

underground SWM areas. Within the Green Street Fire Station, the proposed SWM area is anticipated to consist of an underground infiltration chamber and drywell. The SWM area is anticipated to have a footprint of approximately 1,350 square feet. The infiltration chamber and drywell are anticipated to be approximately 4.5 feet and 6.8 feet below existing grades, respectively. Within the Mutual Fire Station, the proposed SWM area is anticipated to consist of an underground infiltration chamber. The infiltration chamber is anticipated to have a footprint of approximately 1,000 square feet and will be approximately 3.4 feet below existing grades.

2.0 FIELDWORK

Whitestone's scope of services consisted of conducting an engineering evaluation of the subsurface conditions disclosed by two soil borings (identified as B-1 and B-2) with four offset borings (identified as B-1A, B-1B, B-2A, and B-2B) for in-situ infiltration tests. The borings were performed with a truck-mounted drill rig using hollow stem augers and split-spoon sampling. Borings B-1 and B-2 were terminated at depths of approximately 14.0 feet below ground surface (fbgs) and 15.0 fbgs, respectively. The soil borings were performed within the proposed SWM areas. The subsurface tests subsequently were backfilled to the surface with excavated soils from the investigation and surficially restored with Portland cement concrete, as necessary. The locations of the subsurface tests are shown on the accompanying *Boring Location Plan* included as Figure 1. *Records of Subsurface Exploration* are provided in Appendix A.

The borings were conducted in the presence of a Whitestone geologist who performed field tests, recorded visual classifications, and collected samples of the various strata encountered. The borings were located in the field using normal taping procedures and estimated right angles. These locations are presumed to be accurate within a few feet.

Groundwater level observations were recorded during and immediately after the completion of field operations prior to backfilling the tests. Seasonal variations, temperature effects, man-made effects, and recent rainfall conditions may influence the levels of the groundwater, and the observed levels will depend on the permeability of the soils. Groundwater elevations derived from sources other than seasonally observed groundwater monitor wells may not be representative of true groundwater levels.

3.0 SUMMARY OF FINDINGS

General: The SWM area evaluation included a total of two borings (identified as B-1 and B-2) with two offset borings at each location to perform in-situ infiltration tests (identified as B-1A, B-1B, B-2A, and B-2B).

Estimated Seasonal High Groundwater Levels: The methods used in determining the seasonal high groundwater level include evaluating the soil morphology (to the extent possible within a soil boring) and identifying irregular spots or blotches of different colors or minerals unlike that of the surrounding soil (mottles). A summary of the estimated seasonal high groundwater observations and infiltration test results associated with the SWM area evaluation are included in the following table.

INFILTRATION TEST SUMMARY					
Boring #	Surface Elevation (feet*)	ESHGW (fbgs/feet*)	USDA Classification @ Test	Infiltration Test	
				Depth (fbgs/feet*)	Rate (in/hour)
B-1	285.0	6.5/278.5	--	--	--
B-2	281.5	5.0/276.5	--	--	--
B-1A	285.0	--	Loamy Sand	6.0/279.0	> 24.0
B-1B	285.0	--	Loamy Sand	6.0/279.0	0.0
B-2A	281.5	--	Sandy Loam (Fill)	4.0/277.5	0.0
B-2B	281.0	--	Sandy Loam (Fill)	3.0/278.0	0.0

* Datum not specified; USDA - United States Department of Agriculture

Soil Infiltration Rates: Falling head infiltration tests were performed within the proposed SWM areas at borings B-1A, B-1C, B-2A, and B-2B. Infiltration testing was performed in general accordance with *New York State Stormwater Design Manual* (Appendix D) stormwater management testing requirements. The infiltration test performed within B-1A resulted in an infiltration rate of greater than 24.0 inches per hour (iph). The results of the in-situ testing within the remaining tests indicated that 24.0 inches of water did not drain completely within 24 hours of filling. Therefore, an infiltration rate of 0.0 iph is assigned for those tests. Infiltration test results associated are provided in Appendix B. Based on the results of the testing and variable rates at borings B-1A and B-2A, infiltration is not recommended.

4.0 CLOSING

Whitestone appreciates the opportunity to be of continued service to H2M Architects and Engineers. Please contact us at (908) 668-7777 with any questions or comments regarding the information provided herein.

Sincerely,

WHITESTONE ASSOCIATES, INC.

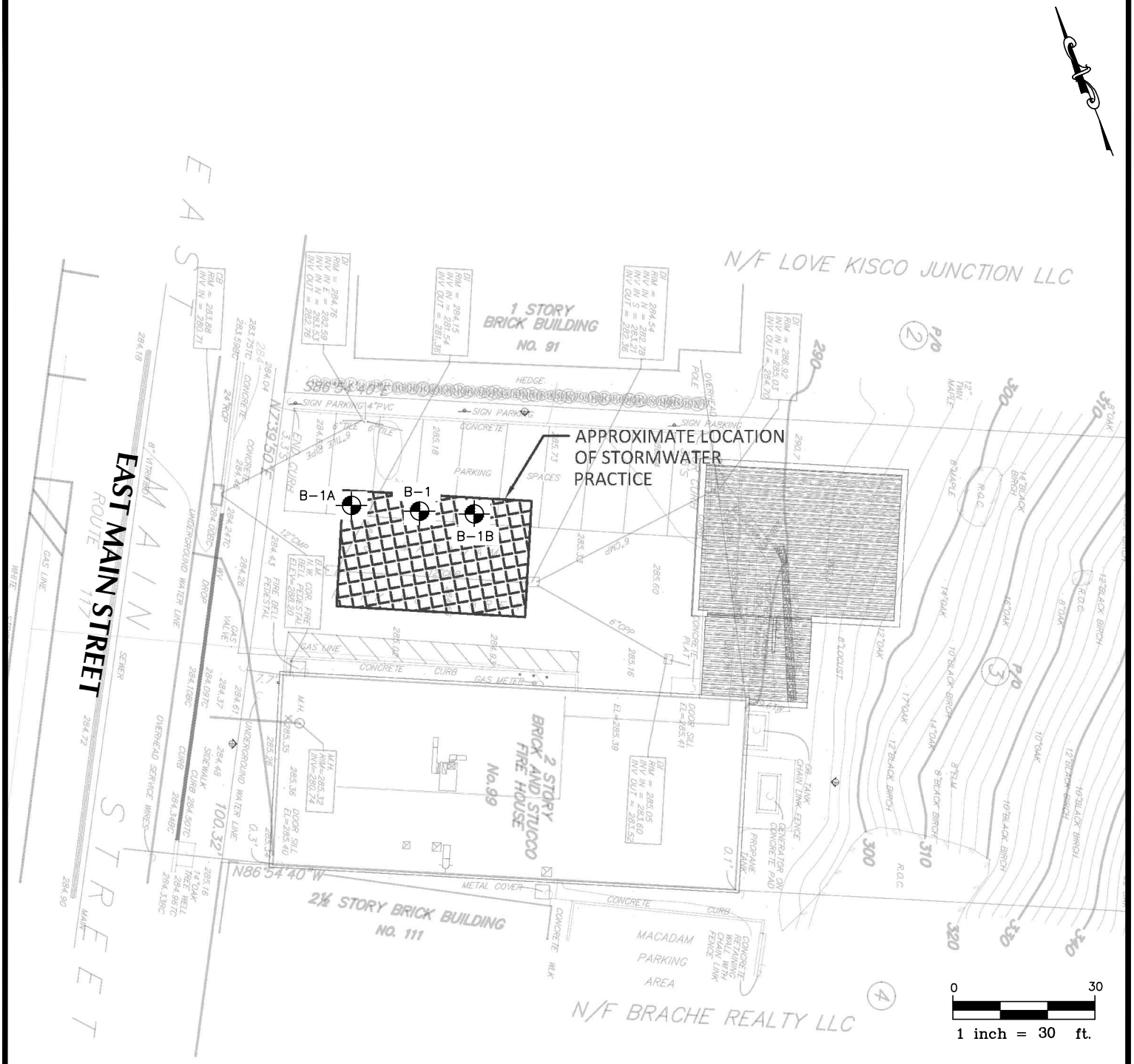
Mudar Khantamr, P.E.
Project Manager

Laurence W. Keller, P.E.
Principal, Geotechnical Services

MH/pwd L:\Job Folders\2018\1815852GJ\Reports and Submittals\15852 SWM.docx
Enclosures
Copy: Sean Peters, H2M Architects & Engineers
Natalie Barber, H2M Architects & Engineers

WHITESTONE ASSOCIATES, INC.

FIGURE 1
Boring Location Plan



LEGEND

B-1 BORING LOCATION (APPROX.)

REFERENCE

THIS PLAN IS BASED ON A SEPTEMBER 2018 DIMENSIONAL SITE PLAN PREPARED BY H2M ARCHITECTS & ENGINEERS.

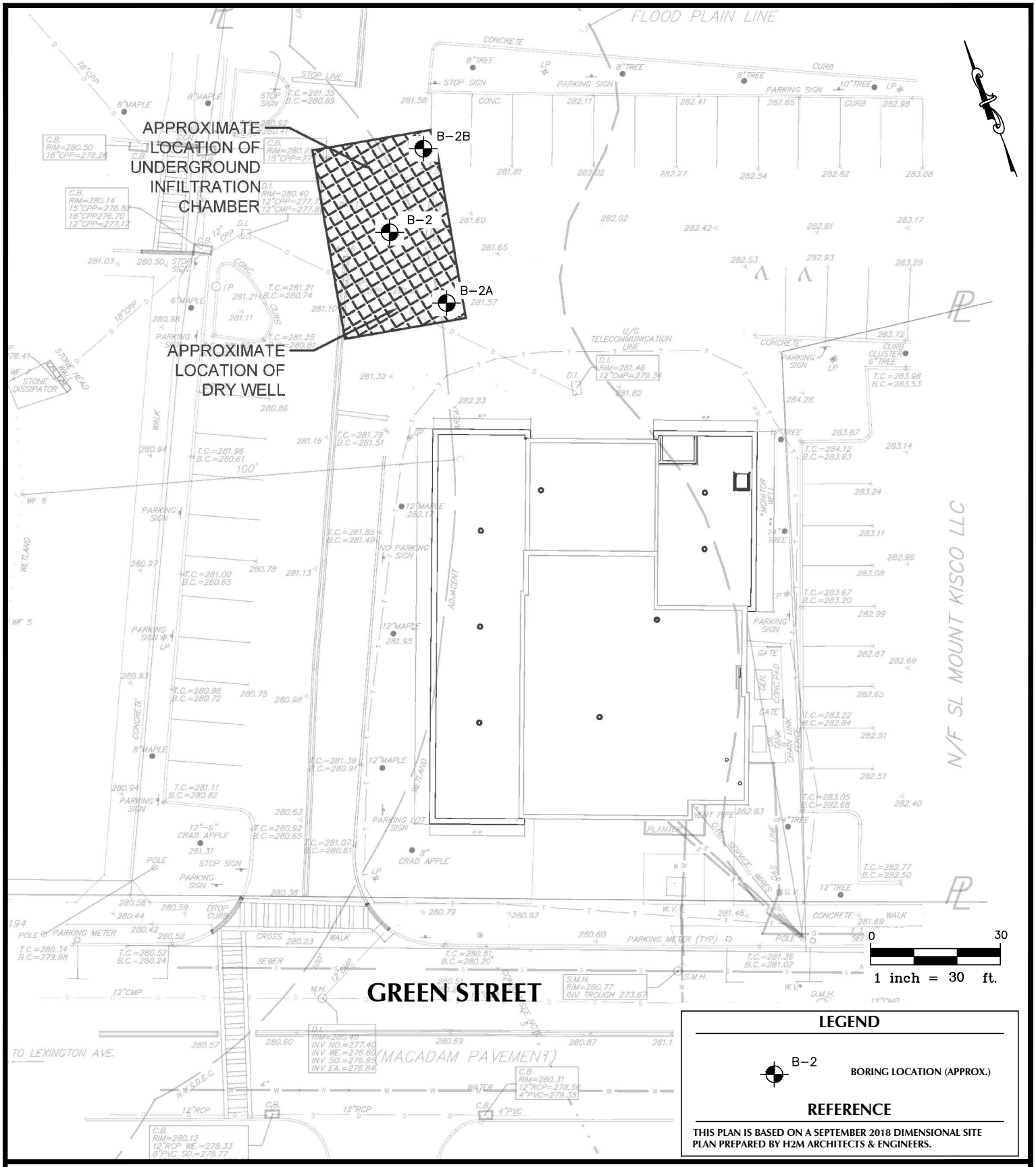
PROJECT #:	GJ1815852.000
DESIGNED BY:	GR
PROJ. MGR.:	MK
DATE:	10/12/18
FIGURE:	1A
SCALE:	1" = 30'

DRAWING TITLE: **BORING LOCATION PLAN**

CLIENT: **H2M ARCHITECTS & ENGINEERS**

PROJECT:
EXISTING FIRE STATION - PROPOSED SWM AREAS
29 GREEN STREET & 99 MAIN STREET
MOUNT KISCO, WESTCHESTER COUNTY, NY

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants
35 TECHNOLOGY DRIVE, WARREN, NJ 07059
908.668.7777 WHITESTONEASSOC.COM



LEGEND

B-2 — BORING LOCATION (APPROX.)

REFERENCE

THIS PLAN IS BASED ON A SEPTEMBER 2018 DIMENSIONAL SITE PLAN PREPARED BY H2M ARCHITECTS & ENGINEERS.

PROJECT #:	GJ1815852.000
DESIGNED BY:	GR
PROJ. MGR.:	MK
DATE:	10/12/18
FIGURE:	1B
SCALE:	1" = 30'

DRAWING TITLE: **BORING LOCATION PLAN**

CLIENT: **H2M ARCHITECTS & ENGINEERS**

PROJECT:
EXISTING FIRE STATION - PROPOSED SWM AREAS
29 GREEN STREET & 99 MAIN STREET
MOUNT KISCO, WESTCHESTER COUNTY, NY

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants
35 TECHNOLOGY DRIVE, WARREN, NJ 07059
908.668.7777 WHITESTONEASSOC.COM

WHITESTONE ASSOCIATES, INC.

APPENDIX A
Records of Subsurface Exploration

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-1

Project:	Existing Fire Stations - Proposed SWM Areas	**WAI Project No.:**	GJ1815852.000
Location:	29 Green Street & 99 Main Street; Mount Kisco, Westchester County, NY	**Client:**	H2M Architects & Engineers
Surface Elevation:	± 285.0 feet	**Date Started:**	9/27/2018
Termination Depth:	14.0 feet bgs	**Date Completed:**	9/27/2018
Proposed Location:	SWM (Main Street)	**Logged By:**	MH
Drill / Test Method:	HSA / SPT	**Contractor:**	PR
		Equipment:	Mobile B-57

Water Depth | Elevation (feet bgs) | (feet)		Cave-In Depth | Elevation (feet bgs) | (feet)	
During:	6.5(P) | 278.5		
At Completion:	NE | ---	**At Completion:**	9.0 | 276.0
24 Hours:	--- | ---	**24 Hours:**	--- | ---

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	PAVEMENT		3.5" Asphalt, 3" Stone Subbase	
0.5 - 2.5	S-1	X	14 - 8 - 12 - 14	16	20	0.6	RESIDUAL		Grayish-Brown (10YR 4/2) SILT, Moist, Trace Gravel, Firm, Cemented, No Roots, No Mottling, Gradual Boundary (ML)	
2.5 - 4.5	S-2	X	17 - 11 - 9 - 8	2	20				Gravel in Spoon, No True Recovery of Soil, Assumed as Above (ML)	Hard Augering on Cobbles, Boulders @ 2.5 fbgs to 4.5 fbgs Gravel in Spoon Tip
						5.0				
5 - 7	S-3	X	16 - 13 - 7 - 5	14	20				Grayish-Brown (10YR 4/2) Micaceous LOAMY SAND, Very Moist @ 6.0 fbgs, Firm, Friable, No Roots, No Mottling (SM)	Infiltration Test @ 6.0 fbgs Wet @ 6.5 fbgs to 7.0 fbgs
7 - 9	S-4	X	7 - 12 - 12 - 10	10	24	9.0			As Above, Very Moist (SM)	Spoon Exterior Wet
9 - 11	S-5	X	39 - 18 - 20 - 22	12	38	10.0	WEATHERED ROCK		Grayish-Brown (10YR 4/2) Micaceous WEATHERED ROCK (Schist), Moist, Hard, Abrupt Boundary (WR)	
13 - 14	S-6	X	21 - 27 - 50/0"	8	77/6"	14.0			As Above (WR)	
						15.0			Boring Log B-1 Terminated at a Depth of 14.0 Feet Below Ground Surface Due to Auger Refusal	
						20.0				
						25.0				

NOTES: bgs = below ground surface, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-2

Page 1 of 1

Project:	Existing Fire Stations - Proposed SWM Areas	**WAI Project No.:**	GJ1815852.000
Location:	29 Green Street & 99 Main Street; Mount Kisco, Westchester County, NY	**Client:**	H2M Architects & Engineers

Surface Elevation:	± 281.5 feet	**Date Started:**	9/27/2018		**Water Depth | Elevation (feet bgs) | (feet)**		**Cave-In Depth | Elevation (feet bgs) | (feet)**
Termination Depth:	15.0 feet bgs	**Date Completed:**	9/27/2018				
Proposed Location:	SWM (Green Street)	**Logged By:**	MH	**During:**	7.0 | 274.5		
Drill / Test Method:	HSA / SPT	**Contractor:**	PR	**At Completion:**	5.0 | 276.5	**At Completion:**	6.0 | 275.5
		Equipment:	Mobile B-57	**24 Hours:**	--- | ---	**24 Hours:**	--- | ---

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0	PAVEMENT		4.5" Asphalt, 4" Subbase Stone (Dark Gray to Black)	
						0.7	FILL			
1 - 3	S-1		22 - 19 - 15 - 16	14	34				Gray (7.5YR 5/1) SANDY LOAM, 15% Gravel, Friable, Firm, Trace Roots, No Mottling (FILL)	
3 - 5	S-2		12 - 10 - 5 - 4	10	15				As Above, 5% Gravel (FILL)	
						5.0	ORGANIC			
5 - 7	S-3		1 - 1 - 1 - 1	16	2				Dark Grayish-Brown (10YR 4/3) Fibrous PEAT, Very Moist, No Gravel, 75% Roots, No Mottling (PT)	Organic Odor
7 - 9	S-4		1 - 5 - 6 - 7	18	11	8.0			As Above, Wet (PT)	
							RESIDUAL			
9 - 11	S-5		9 - 8 - 6 - 7	18	14	10.0			Gray (7.5YR 5/2) LOAMY SAND, Trace Gravel, Wet, Friable, Granular, No Roots, No Mottling (SM)	
						11.0				
11 - 13	S-6		10 - 12 - 13 - 16	18	25				Gray (7.5YR 5/2) LOAMY SAND, No Gravel, Wet, Granular, Friable, No Roots, No Mottling (ML)	
13 - 15	S-7		11 - 8 - 7 - 12	18	15				As Above (ML)	
						15.0				
						20.0			Boring Log B-2 Terminated at a Depth of 15.0 Feet Below Ground Surface	
						25.0				

NOTES: bgs = below ground surface, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE ASSOCIATES, INC.

APPENDIX B
Infiltration Test Results

WHITESTONE ASSOCIATES, INC.

INFILTRATION TEST

Client:	H2M Architects & Engineers	**Test Hole No.:**	B-1A (Main Street)
Project:	Proposed SWM Areas	**Date:**	9/27/2018 - 9/28/2018
Location:	29 Green Street and 99 Main Street, Mount Kisco, Westchester, New York	**Weather:**	Sunny, 70°
File No.	GJ1815852.000	**Field Engineer:**	Max Hengler
Surf. Elev.	285.00	**Test Depth Ft. | Elev.:**	6.00 | 279.00

Reading No.	Time		Water Level Reading (inches)		Water Level Fall (Inches)	Time Interval (Hours)	Rate of Flow (Inches/Hour)
	Start	Finish	Start	Finish			
PS	9/27/18 10:20 AM	9/28/18 10:20 AM	24.0	0.0	24.0	0.5	> 24.0
1	10:20 AM	10:55 AM	24.0	0.0	24.0	0.5	> 24.0
2	11:01 AM	11:04 AM	24.0	0.0	24.0	0.05	> 24.0
3	11:05 AM	11:08 AM	24.0	0.0	24.0	0.05	> 24.0
4	11:08 AM	11:11 AM	24.0	0.0	24.0	0.05	> 24.0

Field i = > 24.0 in/hr

NOTES: PS = Pre Soak; NS = Not Surveyed

WHITESTONE ASSOCIATES, INC.

INFILTRATION TEST

Client:	H2M Architects & Engineers	**Test Hole No.:**	B-1B (Main Street)
Project:	Proposed SWM Areas	**Date:**	9/27/2018 - 9/28/2018
Location:	29 Green Street and 99 Main Street, Mount Kisco, Westchester, New York	**Weather:**	Sunny, 70°
File No.	GJ1815852.000	**Field Engineer:**	Max Hengler
Surf. Elev.	285.00	**Test Depth Ft. | Elev.:**	6.00 | 279.00

Reading No.	Time		Water Level Reading (inches)		Water Level Fall (Inches)	Time Interval (Hours)	Rate of Flow (Inches/Hour)
	Start	Finish	Start	Finish			
PS	9/27/18 10:55 AM	9/28/18 10:55 AM	24.0	18.0	6.0	24	0.0

Field i = 0.0 in/hr

NOTES: PS = Pre Soak; NS = Not Surveyed

WHITESTONE ASSOCIATES, INC.

INFILTRATION TEST

Client:	H2M Architects & Engineers	**Test Hole No.:**	B-2A (Green Street)
Project:	Proposed SWM Areas	**Date:**	9/27/2018 - 9/28/2018
Location:	29 Green Street and 99 Main Street, Mount Kisco, Westchester, New York	**Weather:**	Sunny, 70°
File No.	GJ1815852.000	**Field Engineer:**	Max Hengler
Surf. Elev.	281.50	**Test Depth Ft. | Elev.:**	4.00 | 277.50

Reading No.	Time		Water Level Reading (inches)		Water Level Fall (Inches)	Time Interval (Hours)	Rate of Flow (Inches/Hour)
	Start	Finish	Start	Finish			
PS	9/27/18 1:00 PM	9/28/18 1:00 PM	24.0	24.0	0.0	24	0.0

Field i = 0.0 in/hr

NOTES: PS = Pre Soak; NS = Not Surveyed

WHITESTONE ASSOCIATES, INC.

INFILTRATION TEST

Client:	H2M Architects & Engineers	**Test Hole No.:**	B-2B (Green Street)
Project:	Proposed SWM Areas	**Date:**	9/27/2018 - 9/28/2018
Location:	29 Green Street and 99 Main Street, Mount Kisco, Westchester, New York	**Weather:**	Sunny, 70°
File No.	GJ1815852.000	**Field Engineer:**	Max Hengler
Surf. Elev.	281.00	**Test Depth Ft. | Elev.:**	3.00 | 278.00

Reading No.	Time		Water Level Reading (inches)		Water Level Fall (Inches)	Time Interval (Hours)	Rate of Flow (Inches/Hour)
	Start	Finish	Start	Finish			
PS	9/27/18 1:15 PM	9/28/18 1:15 PM	24.0	24.0	0.0	24	0.0

Field i = 0.0 in/hr

NOTES: PS = Pre Soak; NS = Not Surveyed

WHITESTONE ASSOCIATES, INC.

APPENDIX C
Supplemental Information (USCS, Terms & Symbols)

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants

MT. BETHEL CORPORATE CENTER
35 TECHNOLOGY DRIVE
WARREN, NJ 07059
908.668.7777
whitestoneassoc.com

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMITS LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMITS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS FOR SAMPLES WITH 5% TO 12% FINES

GRADATION*

% FINER BY WEIGHT

TRACE..... 1% TO 10%
LITTLE..... 10% TO 20%
SOME..... 20% TO 35%
AND..... 35% TO 50%

COMPACTNESS*
Sand and/or Gravel

RELATIVE DENSITY

LOOSE. ..... 0% TO 40%
MEDIUM DENSE.... 40% TO 70%
DENSE..... 70% TO 90%
VERY DENSE..... 90% TO 100%

CONSISTENCY*
Clay and/or Silt

RANGE OF SHEARING STRENGTH IN POUNDS PER SQUARE FOOT

VERY SOFT..... LESS THAN 250
SOFT..... ..... 250 TO 500
MEDIUM..... 500 TO 1000
STIFF..... 1000 TO 2000
VERY STIFF..... 2000 TO 4000
HARD..... GREATER THAN 4000

** VALUES ARE FROM LABORATORY OR FIELD TEST DATA, WHERE APPLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.*

L:\Geotechnical Forms and References\Reports\USCSTRMSSYM NJ.docx

Other Office Locations:

CHALFONT, PA 215.712.2700
SOUTHBOROUGH, MA 508.485.0755
ROCKY HILL, CT 860.726.7889
WALL, NJ 732.592-2101
STERLING, VA 703.464.5858
EVERGREEN, CO 303.670.6905

WHITESTONE ASSOCIATES, INC.
Environmental & Geotechnical Engineers & Consultants

MT. BETHEL CORPORATE CENTER
35 TECHNOLOGY DRIVE
WARREN, NJ 07059
908.668.7777
whitestoneassoc.com

GEOTECHNICAL TERMS AND SYMBOLS

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N: Standard Penetration Value: Blows per ft. of a 140 lb. hammer falling 30" on a 2" O.D. split-spoon.
Qu: Unconfined compressive strength, TSF.
Qp: Penetrometer value, unconfined compressive strength, TSF.
Mc: Moisture content, %.
LL: Liquid limit, %.
PI: Plasticity index, %.
δd: Natural dry density, PCF.
▼: Apparent groundwater level at time noted after completion of boring.

DRILLING AND SAMPLING SYMBOLS

NE: Not Encountered (Groundwater was not encountered).
SS: Split-Spoon - 1 ⅜" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
AU: Auger Sample.
OB: Diamond Bit.
CB: Carbide Bit
WS: Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Term (Non-Cohesive Soils)	Standard Penetration Resistance
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Term (Cohesive Soils)	Qu (TSF)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm (Medium)	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.+	Coarse Sand	5mm-0.6mm	Silt	0.074mm-0.005mm
Cobbles	8 in.-3 in.	Medium Sand	0.6mm-0.2mm	Clay	-0.005mm
Gravel	3 in.-5mm	Fine Sand	0.2mm-0.074mm		

Other Office Locations:

CHALFONT, PA 215.712.2700 | SOUTHBOROUGH, MA 508.485.0755 | ROCKY HILL, CT 860.726.7889 | WALL, NJ 732.592-2101 | STERLING, VA 703.464.5858 | EVERGREEN, CO 303.670.6905

Memorandum

TO: **FILE**

FROM: **SEAN PETERS, EIT**

DATE: **11/22/2021**

RE: **MUTUAL 11/01/31 ADDITIONAL INFILTRATION TESTING**

On September 27th and 28th, 2021 Whitestone Associates conducted infiltration and deep testing at the Mutual Fire Company. The infiltration testing results were inconclusive as one test hole (B1-A) yielded an infiltration rate of >24 inches/hour and the other location (B-1B) failed.

In order to further clarify infiltration at the site, H2M performed additional infiltration with the assistance of the Village DPW. The results of the third test location (B1-C) are summarized below:

Trial #	**Rate (min/inch)**
1	1
2	1.5
3	1
4	1
5	1

Stabilized at 1 min/inch

Testing was conducted on November 1, 2018 at a depth of approximately 4'-3" below grade. The following general soil profile was observed:

Depth	**Soil Profile**
0-6.5"	Pavement and gravel subbase
6.5"-39"	Silty fill, some sand
39"-51"	Mostly sand, occasional cobbles.

Photos:

Appendix C

Stormwater Inspection Report

CONSTRUCTION STORMWATER INSPECTION REPORT

SECTION A: Site Information

Permit No.:	**Date of Inspection:**	**Time of Inspection:**	**Date of Last Inspection:**
Project Name:		**Stage of Construction**	**Weather Conditions**
Site Location:		**Site Description:**	
Contact at Site:		**Title:**	
Phone No.:		**e-mail:**	

SECTION B: Applicant's Information

Name:	**e-mail:**
Phone No.	**Fax No.:**
Address:	

SECTION C: General Contractor's Information

Name:	**e-mail:**
Phone No.	**Fax No.:**
Address:	

SECTION D: Engineer's Information

Name:	**e-mail:**
Phone No.	**Fax No.:**
Address:	

SECTION E: Document Verification

Criteria	**NA**	**YES**	**NO**	**Comments**
NOI posted at construction site				
SPDES General Permit retained at construction site				
SWPPP retained at construction site				
• Updated as site conditions change				
• Contains monthly/quarterly written summaries of compliance status				

SECTION F: Area of Disturbance

Criteria	NA	YES	NO	Comments
Less than 5 acres of disturbed soil				
• If no, was there prior written approval?				
Disturbance within limits of approved plans				

SECTION G: Water Quality

Polluted discharges	NA	No	Yes	Comments:
Discharges show visible signs of:	__ Sediment __ Floatables __ Oil/Grease __Turbidity __Other_____			
Receiving waters impacted:	__ Lake __ Bay __ Stream __Wetland __Other_____			

SECTION H: General Site Conditions

Criteria	Condition*				Comments
	NA	S	M	U	
Litter/debris management					
Sediment and erosion control facilities					
Impact on adjacent property					
Dust control					

*** NA**=Not Applicable; **S**=Satisfactory; **M**=Marginal; **U**=Unsatisfactory

SECTION I: Temporary Stream Crossings

Criteria	Condition*				Comments
	NA	S	M	U	
Pipe size spanning creeks					
Non-woven geotextile fabric installed beneath approaches					
Aggregate fill					
Rock on approaches removes sediment from vehicles and prevents Sediment from entering streams					

*** NA**=Not Applicable; **S**=Satisfactory; **M**=Marginal; **U**=Unsatisfactory

SECTION J: Runoff Control Practices

Criteria	Condition*				Comments
	NA	S	M	U	
Excavation dewatering					
• Upstream berms (one-foot min. freeboard)					
• Downstream berms					
• Clean water from upstream pool pumped to downstream pool					
• Sediment-laden water discharged to silt trapping device					
Level spreader installation (constructed on undisturbed soil)					
• Flow sheets do not erode downstream edge					
Interceptor dikes and swales installation					
• Side slopes 2:1 or flatter					
• Stabilized by geotextile fabric, seed or mulch					
• Sediment-laden runoff is directed to sediment trapping device					
Stone check dams installation					
• Stable channel					
• Lack of a permanent pool behind dam					
• Regular removal of accumulated sediment					
Rock outlet protection installation					
• Installed concurrently with pipe installation					

*** NA**=Not Applicable; **S**=Satisfactory; **M**=Marginal; **U**=Unsatisfactory

SECTION K: Soil Stabilization

Criteria	Condition*				Comments
	NA	S	M	U	
Topsoil and stockpiles					
• With vegetation					
• With mulch					
• Sediment control installed at toe of slope					
Revegetation					
• Temporary seeding and mulch applied to idle areas					
• Minimum of 4 inches topsoil applied under permanent seedings					

*** NA**=Not Applicable; **S**=Satisfactory; **M**=Marginal; **U**=Unsatisfactory

SECTION L: Sediment Control Practices

Criteria	Condition*				Comments
	NA	S	M	U	
Stabilized construction entrance installation					
• Drainage prevents ponding					
• Stone removes mud from vehicles					
• All traffic uses the entrance					
Silt fence installation					
• On contour and 10' from toe of slope					
• Not across conveyance channels					
• End stakes wrapped together at joints					
• Fabric is buried min 6"					
• Posts are stable, fabric is tight and not damaged					
• Sediment accumulation (note % of design capacity in comments)					
Storm drain inlet protection					
• Drainage area is less than 1 acre					
• Sediment accumulation (note % of design capacity in comments)					
• Excavated drop inlet protection					
- 900 cu. ft. per acre of disturbed land					
- 2:1 side slopes					
• Stone and block drop inlet protection					
- Concrete blocks installed lengthwise					
- Wire screen placed between #3 crushed stone & concrete blocks					
• Filter fabric drop inlet protection					
- 2"x4" frame					
- Posts (stable; spaced max. 3' apart)					
- Fabric *undamaged; embedded 1' to 1.5' below ground; stapled to frame/posts at max. spacing of 8"					
• Curb drop inlet protection					
- 2"x4" frame					
- Continuous wire mesh across throat (30" min. width, 4' longer than throat) shaped and nailed to 2"x4" weir					
- Weir nailed to 2"x4" spacers (9" long, 6' max. apart)					
- Placed across inlet and secured by 2"x4"					

***** **NA**=Not Applicable; **S**=Satisfactory; **M**=Marginal; **U**=Unsatisfactory

SECTION L: Sediment Control Practices (Con't)

Criteria	Condition*				Comments
	NA	S	M	U	
Temporary sediment trap installation					
• Geotextile fabric placed beneath rock fill					
• Sediment accumulation (note % of design capacity in comments)					
Temporary sediment basin installation					
• Side slopes stabilized with seed or mulch					
• Structure flushed and surface restored upon removal of facility					
• Sediment accumulation (note % of design capacity in comments)					
Inspections occur at least every 7 calendar days					
Inspections occur at within 24 hours of any storm event of 0.5" or greater					
Effectiveness of erosion and sediment control practices is evaluated at time of inspection and documented					
Inspection reports maintained in log book at site and are available for review					
Sediment is removed from traps/ponds when design capacity is reduced by 50%					
Site inspections are being performed by a qualified inspector					
Reports are properly signed/certified					

*** NA**=Not Applicable; **S**=Satisfactory; **M**=Marginal; **U**=Unsatisfactory

SECTION N: Additional Comments/Notes

SECTION O: Overall Inspection Rating

☐ **Satisfactory** ☐ **Marginal** ☐ **Unsatisfactory**

Form Completed By:

Name (Print):	Signature:	Date:

Appendix D

Copy of Electronic Notice of Intent (eNOI) & Supplemental Signatory Forms

NYC Environmental Protection

APPENDIX B
NEW YORK CITY DEPARTMENT OF ENVIRONMENTAL PROTECTION APPLICATION FOR REVIEW AND APPROVAL OF STORMWATER POLLUTION PREVENTION PLANS

Project Name: Village of Mount Kisco - Mutual Engine & Hose

Applicant/Designated representative:
Name: Edward Brancati (Village Manager)
Address: 104 Main Street
Mount Kisco, NY 10594
Phone: 914-864-0033
e-mail: ebrancati@mountkiscony.gov

Design Professional:
Name: Sean Hoffman
Address: 2 Executive Boulevard, Suite 401
Suffern, NY 10901
Phone: 845-357-7238
e-mail: shoffman@h2m.com

Project Location: Address: 99 Main Street
Town: Mount Kisco
Subdivision name: N/A
Reservoir Basin: Lower Hudson River

Tax Map Parcel: 80.25-3
County: Westchester
Lot number: 1

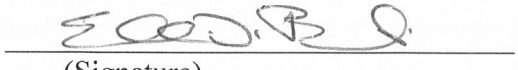
Submissions must include plans and supporting documents.

All applications must include narratives, plans, details, and specifications providing the following information:
- Project Description
- Description of Existing Conditions
- Description of Proposed Conditions
- Operations and Maintenance Plans

General Requirements for submission are set forth in Section 3 of the accompanying Guide. Supplemental required information for each type of approval is described in Section 4. Also see Appendix D for a checklist of items to be included in the submission. For additional detail, please see Appendixes E and F of this document, Sections 18-23 and 18-39 of the Watershed Regulations, and Part III of the New York State Department of Environmental Conservation (DEC) SPDES General Permit for Stormwater Discharges from Construction Activity, GP-0-10-001 ("General Permit").

Notice of Cost-Sharing Funds
Certain costs incurred in the design, implementation, and maintenance of Stormwater Pollution Prevention Plans may be eligible for DEP funding. Refer to Section 5.0 and Appendix H of the accompanying Guide.

I believe this application to be complete and in compliance with the Watershed Regulations.



(Signature)

11/16/21
(Filing Date)

Edward W. Brancati, Village Manager
(Print Name)

NOI for coverage under Stormwater General Permit for Construction Activity

version 1.31

(Submission #: HPD-EMGE-FH4Q6, version 1)

Details

Originally Started By	Sean Peters
Submission ID	HPD-EMGE-FH4Q6
Submission Reason	New
Status	Draft

Form Input

Owner/Operator Information

Owner/Operator Name (Company/Private Owner/Municipality/Agency/Institution, etc.)
Village of Mount Kisco

Owner/Operator Contact Person Last Name (NOT CONSULTANT)
Brancati

Owner/Operator Contact Person First Name
Edward W.

Owner/Operator Mailing Address
104 Main Street

City
Mount Kisco

State
New York

Zip
10594

Phone
9148640001

Email
ebrancati@mountkiscony.gov

Federal Tax ID
NONE PROVIDED

Project Location

Project/Site Name
Mutual Engine & Hose

Street Address (Not P.O. Box)
99 Main Street

Side of Street
East

City/Town/Village (THAT ISSUES BUILDING PERMIT)
Village of Mount Kisco

State
NY

Zip
10549

DEC Region
3

County
WESTCHESTER

Name of Nearest Cross Street
N Bedford Road

Distance to Nearest Cross Street (Feet)
350

Project In Relation to Cross Street
South

Tax Map Numbers Section-Block-Parcel
80.25-3-1

Tax Map Numbers
NONE PROVIDED

1. Coordinates

Provide the Geographic Coordinates for the project site. The two methods are:
- Navigate to the project location on the map (below) and click to place a marker and obtain the XY coordinates.
- The "Find Me" button will provide the lat/long for the person filling out this form. Then pan the map to the correct location and click the map to place a marker and obtain the XY coordinates.

Navigate to your location and click on the map to get the X,Y coordinates
41.20624585025661,-73.72652674007001

Project Details

2. What is the nature of this project?
Redevelopment with increase in impervious area

3. Select the predominant land use for both pre and post development conditions.

Pre-Development Existing Landuse
Other: Municipal

Post-Development Future Land Use
Other: Municipal

3a. If Single Family Subdivision was selected in question 3, enter the number of subdivision lots.
NONE PROVIDED

---

4. In accordance with the larger common plan of development or sale, enter the total project site acreage, the acreage to be disturbed and the future impervious area (acreage)within the disturbed area.

*** ROUND TO THE NEAREST TENTH OF AN ACRE. ***

Total Site Area (acres)
0.58

Total Area to be Disturbed (acres)
0.14

Existing Impervious Area to be Disturbed (acres)
0.11

Future Impervious Area Within Disturbed Area (acres)
0.13

5. Do you plan to disturb more than 5 acres of soil at any one time?
No

---

6. Indicate the percentage (%) of each Hydrologic Soil Group(HSG) at the site.

A (%)
0

B (%)
1

C (%)
0

D (%)
99

7. Is this a phased project?
No

8. Enter the planned start and end dates of the disturbance activities.

Start Date
1/1/2022

End Date
12/30/2022

9. Identify the nearest surface waterbody(ies) to which construction site runoff will discharge.
Catch Basin - Main Street

9a. Type of waterbody identified in question 9?
Other Type Off Site (enter description below)

Other Waterbody Type Off Site Description
MS4 Collection System

9b. If "wetland" was selected in 9A, how was the wetland identified?
NONE PROVIDED

10. Has the surface waterbody(ies in question 9 been identified as a 303(d) segment in Appendix E of GP-0-20-001?
No

11. Is this project located in one of the Watersheds identified in Appendix C of GP-0-20-001?
Yes

12. Is the project located in one of the watershed areas associated with AA and AA-S classified waters?
No

If No, skip question 13.

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?
No

If Yes, what is the acreage to be disturbed?
NONE PROVIDED

14. Will the project disturb soils within a State regulated wetland or the protected 100 foot adjacent area?
No

15. Does the site runoff enter a separate storm sewer system (including roadside drains, swales, ditches, culverts, etc)?
Yes

16. What is the name of the municipality/entity that owns the separate storm sewer system?
Village of Mount Kisco

17. Does any runoff from the site enter a sewer classified as a Combined Sewer?
No

18. Will future use of this site be an agricultural property as defined by the NYS Agriculture and Markets Law?
No

19. Is this property owned by a state authority, state agency, federal government or local government?
Yes

20. Is this a remediation project being done under a Department approved work plan? (i.e. CERCLA, RCRA, Voluntary Cleanup Agreement, etc.)
No

Required SWPPP Components

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

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)?
No

If you answered No in question 22, skip question 23 and the Post-construction Criteria and Post-construction SMP Identification sections.

23. Has the post-construction stormwater management practice component of the SWPPP been developed in conformance with the current NYS Stormwater Management Design Manual?
NONE PROVIDED

24. The Stormwater Pollution Prevention Plan (SWPPP) was prepared by:
NONE PROVIDED

SWPPP Preparer
NONE PROVIDED

Contact Name (Last, Space, First)
NONE PROVIDED

Mailing Address
NONE PROVIDED

City
NONE PROVIDED

State
NONE PROVIDED

Zip
NONE PROVIDED

Phone
NONE PROVIDED

Email
NONE PROVIDED

Download SWPPP Preparer Certification Form
Please take the following steps to prepare and upload your preparer certification form:

1) Click on the link below to download a blank certification form
2) The certified SWPPP preparer should sign this form

3) Scan the signed form
4) Upload the scanned document
Download SWPPP Preparer Certification Form

Please upload the SWPPP Preparer Certification
NONE PROVIDED
Comment
NONE PROVIDED

Erosion & Sediment Control Criteria

25. Has a construction sequence schedule for the planned management practices been prepared?
Yes

26. Select all of the erosion and sediment control practices that will be employed on the project site:

Temporary Structural
Dust Control
Silt Fence
Storm Drain Inlet Protection
Temporary Swale

Biotechnical
None

Vegetative Measures
Seeding
Topsoiling

Permanent Structural
Retaining Wall
Rock Outlet Protection
Riprap Slope Protection
Diversion
Land Grading

Other
NONE PROVIDED

Post-Construction Criteria

*** 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.
NONE PROVIDED

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).
NONE PROVIDED

28. Provide the total Water Quality Volume (WQv) required for this project (based on final site plan/layout). (Acre-feet)
NONE PROVIDED

29. Post-construction SMP Identification

Use the Post-construction SMP Identification section to identify the RR techniques (Area Reduction), RR techniques(Volume Reduction) and Standard SMPs with RRv Capacity that were used to reduce the Total WQv Required (#28).

Identify the SMPs to be used by providing 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 the Post-Construction SMP Identification section 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.

30. Indicate the Total RRv provided by the RR techniques (Area/Volume Reduction) and Standard SMPs with RRv capacity identified in question 29. (acre-feet)
NONE PROVIDED

31. Is the Total RRv provided (#30) greater than or equal to the total WQv required (#28)?
NONE PROVIDED

If Yes, go to question 36. If No, go to question 32.

32. Provide the Minimum RRv required based on HSG. [Minimum RRv Required = (P) (0.95) (Ai) / 12, Ai= (s) (Aic)] (acre-feet)
NONE PROVIDED

32a. Is the Total RRv provided (#30) greater than or equal to the Minimum RRv Required (#32)?
NONE PROVIDED

If Yes, go to question 33.
Note: Use the space provided in question #39 to summarize the specific site limitations and justification for not reducing 100% of WQv required (#28). A detailed evaluation of the specific site limitations and justification for not reducing 100% of the WQv required (#28) must also be included in the SWPPP.

If No, sizing criteria has not been met; therefore, NOI can not be processed. SWPPP preparer must modify design to meet sizing criteria.

33. SMPs
Use the Post-construction SMP Identification section to identify the Standard SMPs and, if applicable, the Alternative SMPs to be used to treat the remaining total WQv (=Total WQv Required in #28 - Total RRv Provided in #30).

Also, provide the total impervious area that contributes runoff to each practice selected.

NOTE: Use the Post-construction SMP Identification section 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. (acre-feet)
NONE PROVIDED

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 - 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).
NONE PROVIDED

35. Is the sum of the RRv provided (#30) and the WQv provided (#33a) greater than or equal to the total WQv required (#28)?
NONE PROVIDED

If Yes, go to question 36.

If No, sizing criteria has not been met; therefore, 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)
NONE PROVIDED

CPv Provided (acre-feet)
NONE PROVIDED

36a. The need to provide channel protection has been waived because:
NONE PROVIDED

37. Provide the Overbank Flood (Qp) and Extreme Flood (Qf) control criteria or select waiver (#37a), if applicable.

Overbank Flood Control Criteria (Qp)

Pre-Development (CFS)
NONE PROVIDED

Post-Development (CFS)
NONE PROVIDED

Total Extreme Flood Control Criteria (Qf)

Pre-Development (CFS)
NONE PROVIDED

Post-Development (CFS)
NONE PROVIDED

37a. The need to meet the Qp and Qf criteria has been waived because:
NONE PROVIDED

38. Has a long term Operation and Maintenance Plan for the post-construction stormwater management practice(s) been developed?
NONE PROVIDED

If Yes, Identify the entity responsible for the long term Operation and Maintenance
NONE PROVIDED

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.
NONE PROVIDED

Post-Construction SMP Identification

Runoff Reduction (RR) Techniques, Standard Stormwater Management Practices (SMPs) and Alternative SMPs

Identify the Post-construction SMPs to be used by providing 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.

RR Techniques (Area Reduction)

Round to the nearest tenth

Total Contributing Acres for Conservation of Natural Area (RR-1)
NONE PROVIDED

Total Contributing Impervious Acres for Conservation of Natural Area (RR-1)
NONE PROVIDED

Total Contributing Acres for Sheetflow to Riparian Buffers/Filter Strips (RR-2)
NONE PROVIDED

Total Contributing Impervious Acres for Sheetflow to Riparian Buffers/Filter Strips (RR-2)
NONE PROVIDED

Total Contributing Acres for Tree Planting/Tree Pit (RR-3)
NONE PROVIDED

Total Contributing Impervious Acres for Tree Planting/Tree Pit (RR-3)
NONE PROVIDED

Total Contributing Acres for Disconnection of Rooftop Runoff (RR-4)
NONE PROVIDED

RR Techniques (Volume Reduction)

Total Contributing Impervious Acres for Disconnection of Rooftop Runoff (RR-4)
NONE PROVIDED

Total Contributing Impervious Acres for Vegetated Swale (RR-5)
NONE PROVIDED

Total Contributing Impervious Acres for Rain Garden (RR-6)
NONE PROVIDED

Total Contributing Impervious Acres for Stormwater Planter (RR-7)
NONE PROVIDED

Total Contributing Impervious Acres for Rain Barrel/Cistern (RR-8)
NONE PROVIDED

Total Contributing Impervious Acres for Porous Pavement (RR-9)
NONE PROVIDED

Total Contributing Impervious Acres for Green Roof (RR-10)
NONE PROVIDED

Standard SMPs with RRv Capacity

Total Contributing Impervious Acres for Infiltration Trench (I-1)
NONE PROVIDED

Total Contributing Impervious Acres for Infiltration Basin (I-2)
NONE PROVIDED

Total Contributing Impervious Acres for Dry Well (I-3)
NONE PROVIDED

Total Contributing Impervious Acres for Underground Infiltration System (I-4)
NONE PROVIDED

Total Contributing Impervious Acres for Bioretention (F-5)
NONE PROVIDED

Total Contributing Impervious Acres for Dry Swale (O-1)
NONE PROVIDED

Standard SMPs

Total Contributing Impervious Acres for Micropool Extended Detention (P-1)
NONE PROVIDED

Total Contributing Impervious Acres for Wet Pond (P-2)
NONE PROVIDED

Total Contributing Impervious Acres for Wet Extended Detention (P-3)
NONE PROVIDED

Total Contributing Impervious Acres for Multiple Pond System (P-4)
NONE PROVIDED

Total Contributing Impervious Acres for Pocket Pond (P-5)
NONE PROVIDED

Total Contributing Impervious Acres for Surface Sand Filter (F-1)
NONE PROVIDED

Total Contributing Impervious Acres for Underground Sand Filter (F-2)
NONE PROVIDED

Total Contributing Impervious Acres for Perimeter Sand Filter (F-3)
NONE PROVIDED

Total Contributing Impervious Acres for Organic Filter (F-4)
NONE PROVIDED

Total Contributing Impervious Acres for Shallow Wetland (W-1)
NONE PROVIDED

Total Contributing Impervious Acres for Extended Detention Wetland (W-2)
NONE PROVIDED

Total Contributing Impervious Acres for Pond/Wetland System (W-3)
NONE PROVIDED

Total Contributing Impervious Acres for Pocket Wetland (W-4)
NONE PROVIDED

Total Contributing Impervious Acres for Wet Swale (O-2)
NONE PROVIDED

Alternative SMPs (DO NOT INCLUDE PRACTICES BEING USED FOR PRETREATMENT ONLY)

Total Contributing Impervious Area for Hydrodynamic
NONE PROVIDED

Total Contributing Impervious Area for Wet Vault
NONE PROVIDED

Total Contributing Impervious Area for Media Filter
NONE PROVIDED

"Other" Alternative SMP?
NONE PROVIDED

Total Contributing Impervious Area for "Other"
NONE PROVIDED

Provide the name and manufaturer of the alternative SMPs (i.e. proprietary practice(s)) being used for WQv treatment.

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.

Manufacturer of Alternative SMP
NONE PROVIDED

Name of Alternative SMP
NONE PROVIDED

Other Permits

40. Identify other DEC permits, existing and new, that are required for this project/facility.
None

If SPDES Multi-Sector GP, then give permit ID
NONE PROVIDED

If Other, then identify
NONE PROVIDED

41. Does this project require a US Army Corps of Engineers Wetland Permit?
No

If "Yes," then indicate Size of Impact, in acres, to the nearest tenth
NONE PROVIDED

42. 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.
NONE PROVIDED

MS4 SWPPP Acceptance

43. Is this project subject to the requirements of a regulated, traditional land use control MS4?
Yes - Please attach the MS4 Acceptance form below

If No, skip question 44

44. Has the "MS4 SWPPP Acceptance" form been signed by the principal executive officer or ranking elected official and submitted along with this NOI?
NONE PROVIDED

MS4 SWPPP Acceptance Form Download
Download form from the link below. Complete, sign, and upload.
MS4 SWPPP Acceptance Form

MS4 Acceptance Form Upload
> NONE PROVIDED
> **Comment**
> NONE PROVIDED

Owner/Operator Certification

Owner/Operator Certification Form Download
Download the certification form by clicking the link below. Complete, sign, scan, and upload the form.
Owner/Operator Certification Form (PDF, 45KB)

Upload Owner/Operator Certification Form
> NONE PROVIDED
> **Comment**
> NONE PROVIDED

Short Environmental Assessment Form
Part 1 - Project Information

Instructions for Completing

Part 1 - Project Information. The applicant or project sponsor is responsible for the completion of Part 1. Responses become part of the application for approval or funding, are subject to public review, and may be subject to further verification. Complete Part 1 based on information currently available. If additional research or investigation would be needed to fully respond to any item, please answer as thoroughly as possible based on current information.

Complete all items in Part 1. You may also provide any additional information which you believe will be needed by or useful to the lead agency; attach additional pages as necessary to supplement any item.

Part 1 - Project and Sponsor Information

Name of Action or Project:
FIRE DEPARMENT CONSTRUCTION AND RENOVATIONS

Project Location (describe, and attach a location map):
29 Green Street, Mount Kisco, NY 10549; 322 Lexington Avenue, Mount Kisco, NY 10549; 99 Main Street, Mount Kisco, NY 10549

Brief Description of Proposed Action:
Renovation, expansion and various improvements of three (3) fire department facilities in the Village/Town of Mount Kisco.

Name of Applicant or Sponsor:	Telephone: (914) 241-0500
VILLAGE/TOWN OF MOUNT KISCO	E-Mail: ebrancati@mountkiscony.gov

Address:
104 Main Street

City/PO:	State:	Zip Code:
Mount Kisco	NY	10549

	NO	YES
1. Does the proposed action only involve the legislative adoption of a plan, local law, ordinance, administrative rule, or regulation? If Yes, attach a narrative description of the intent of the proposed action and the environmental resources that may be affected in the municipality and proceed to Part 2. If no, continue to question 2.	☑	☐
2. Does the proposed action require a permit, approval or funding from any other governmental Agency? If Yes, list agency(s) name and permit or approval: Potential: NYCDEP approval (Designated Main Street Area), NYS and Westchester County Departments of Transportation, and NYSDEC.	☐	☑

3.a. Total acreage of the site of the proposed action? 1+ acres
b. Total acreage to be physically disturbed? <1 acres
c. Total acreage (project site and any contiguous properties) owned or controlled by the applicant or project sponsor? 1+ acres

4. Check all land uses that occur on, adjoining and near the proposed action.
☐ Urban ☐ Rural (non-agriculture) ☐ Industrial ☑ Commercial ☐ Residential (suburban)
☐ Forest ☐ Agriculture ☐ Aquatic ☐ Other (specify): _____
☐ Parkland

	NO	YES	N/A
5. Is the proposed action, a. A permitted use under the zoning regulations?	☐	☑	☐
b. Consistent with the adopted comprehensive plan?	☐	☑	☐

	NO	YES
6. Is the proposed action consistent with the predominant character of the existing built or natural landscape?	☐	☑

	NO	YES
7. Is the site of the proposed action located in, or does it adjoin, a state listed Critical Environmental Area? If Yes, identify: _____	☑	☐

	NO	YES
8. a. Will the proposed action result in a substantial increase in traffic above present levels?	☑	☐
b. Are public transportation service(s) available at or near the site of the proposed action?	☐	☑
c. Are any pedestrian accommodations or bicycle routes available on or near site of the proposed action?	☐	☑

	NO	YES
9. Does the proposed action meet or exceed the state energy code requirements? If the proposed action will exceed requirements, describe design features and technologies: _____	☐	☑

	NO	YES
10. Will the proposed action connect to an existing public/private water supply? If No, describe method for providing potable water: _____	☐	☑

	NO	YES
11. Will the proposed action connect to existing wastewater utilities? If No, describe method for providing wastewater treatment: _____	☐	☑

	NO	YES
12. a. Does the site contain a structure that is listed on either the State or National Register of Historic Places?	☑	☐
b. Is the proposed action located in an archeological sensitive area?	☑	☐

	NO	YES
13. a. Does any portion of the site of the proposed action, or lands adjoining the proposed action, contain wetlands or other waterbodies regulated by a federal, state or local agency?	☐	☑
b. Would the proposed action physically alter, or encroach into, any existing wetland or waterbody? If Yes, identify the wetland or waterbody and extent of alterations in square feet or acres: _____	☑	☐

14. Identify the typical habitat types that occur on, or are likely to be found on the project site. Check all that apply:

☐ Shoreline ☐ Forest ☐ Agricultural/grasslands ☐ Early mid-successional
☐ Wetland ☐ Urban ☑ Suburban

	NO	YES
15. Does the site of the proposed action contain any species of animal, or associated habitats, listed by the State or Federal government as threatened or endangered?	☑	☐

	NO	YES
16. Is the project site located in the 100 year flood plain?	☑	☐

	NO	YES
17. Will the proposed action create storm water discharge, either from point or non-point sources? If Yes, a. Will storm water discharges flow to adjacent properties? ☑ NO ☐ YES	☐	☑
b. Will storm water discharges be directed to established conveyance systems (runoff and storm drains)? If Yes, briefly describe: ☐ NO ☑ YES Existing municipal storm water connections to be maintained.		

	NO	YES
18. Does the proposed action include construction or other activities that result in the impoundment of water or other liquids (e.g. retention pond, waste lagoon, dam)? If Yes, explain purpose and size:	☑	☐
19. Has the site of the proposed action or an adjoining property been the location of an active or closed solid waste management facility? If Yes, describe:	☑	☐
20. Has the site of the proposed action or an adjoining property been the subject of remediation (ongoing or completed) for hazardous waste? If Yes, describe:	☑	☐

I AFFIRM THAT THE INFORMATION PROVIDED ABOVE IS TRUE AND ACCURATE TO THE BEST OF MY KNOWLEDGE

Applicant/sponsor name: Village/Town of Mount Kisco: J. Michael Cindrich, Mayor Date: 9/15/17

Signature: J. Michael Cindrich

PRINT FORM

Agency Use Only [If applicable]

Project:

Date:

Short Environmental Assessment Form
Part 2 - Impact Assessment

Part 2 is to be completed by the Lead Agency.
Answer all of the following questions in Part 2 using the information contained in Part 1 and other materials submitted by the project sponsor or otherwise available to the reviewer. When answering the questions the reviewer should be guided by the concept "Have my responses been reasonable considering the scale and context of the proposed action?"

	No, or small impact may occur	Moderate to large impact may occur
1. Will the proposed action create a material conflict with an adopted land use plan or zoning regulations?	☑	☐
2. Will the proposed action result in a change in the use or intensity of use of land?	☑	☐
3. Will the proposed action impair the character or quality of the existing community?	☑	☐
4. Will the proposed action have an impact on the environmental characteristics that caused the establishment of a Critical Environmental Area (CEA)?	☑	☐
5. Will the proposed action result in an adverse change in the existing level of traffic or affect existing infrastructure for mass transit, biking or walkway?	☑	☐
6. Will the proposed action cause an increase in the use of energy and it fails to incorporate reasonably available energy conservation or renewable energy opportunities?	☑	☐
7. Will the proposed action impact existing: a. public / private water supplies?	☑	☐
b. public / private wastewater treatment utilities?	☑	☐
8. Will the proposed action impair the character or quality of important historic, archaeological, architectural or aesthetic resources?	☑	☐
9. Will the proposed action result in an adverse change to natural resources (e.g., wetlands, waterbodies, groundwater, air quality, flora and fauna)?	☑	☐
10. Will the proposed action result in an increase in the potential for erosion, flooding or drainage problems?	☑	☐
11. Will the proposed action create a hazard to environmental resources or human health?	☑	☐

PRINT FORM

Agency Use Only [If applicable]

Project:

Date:

Short Environmental Assessment Form
Part 3 Determination of Significance

For every question in Part 2 that was answered "moderate to large impact may occur", or if there is a need to explain why a particular element of the proposed action may or will not result in a significant adverse environmental impact, please complete Part 3. Part 3 should, in sufficient detail, identify the impact, including any measures or design elements that have been included by the project sponsor to avoid or reduce impacts. Part 3 should also explain how the lead agency determined that the impact may or will not be significant. Each potential impact should be assessed considering its setting, probability of occurring, duration, irreversibility, geographic scope and magnitude. Also consider the potential for short-term, long-term and cumulative impacts.

N/A

☐ Check this box if you have determined, based on the information and analysis above, and any supporting documentation, that the proposed action may result in one or more potentially large or significant adverse impacts and an environmental impact statement is required.

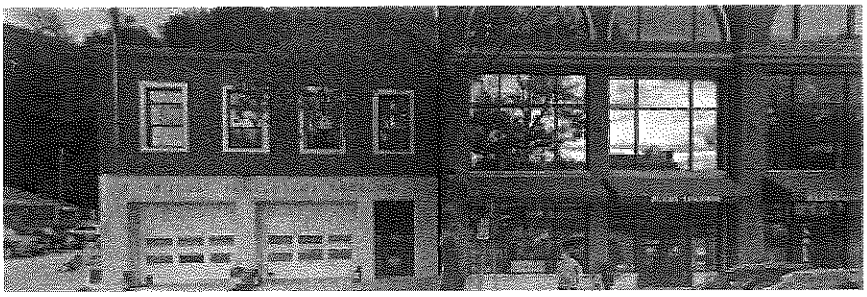
☑ Check this box if you have determined, based on the information and analysis above, and any supporting documentation, that the proposed action will not result in any significant adverse environmental impacts.

Board of Trustees, Village/Town of Mount Kisco	9-19-2017
Name of Lead Agency	Date
J. Michael Cindrich	Mayor
Print or Type Name of Responsible Officer in Lead Agency	Title of Responsible Officer
Signature of Responsible Officer in Lead Agency	Signature of Preparer (if different from Responsible Officer)

PRINT FORM

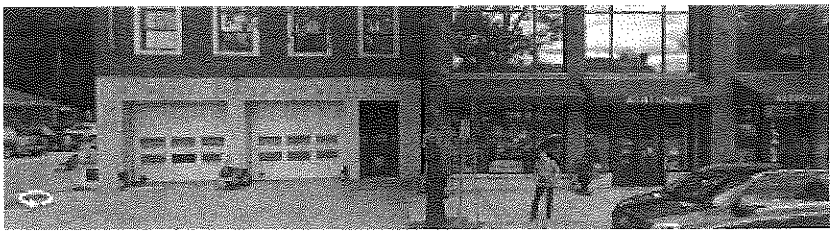
Google Maps 99 Main St

Imagery ©2017 Google, Map data ©2017 Google United States 20 ft

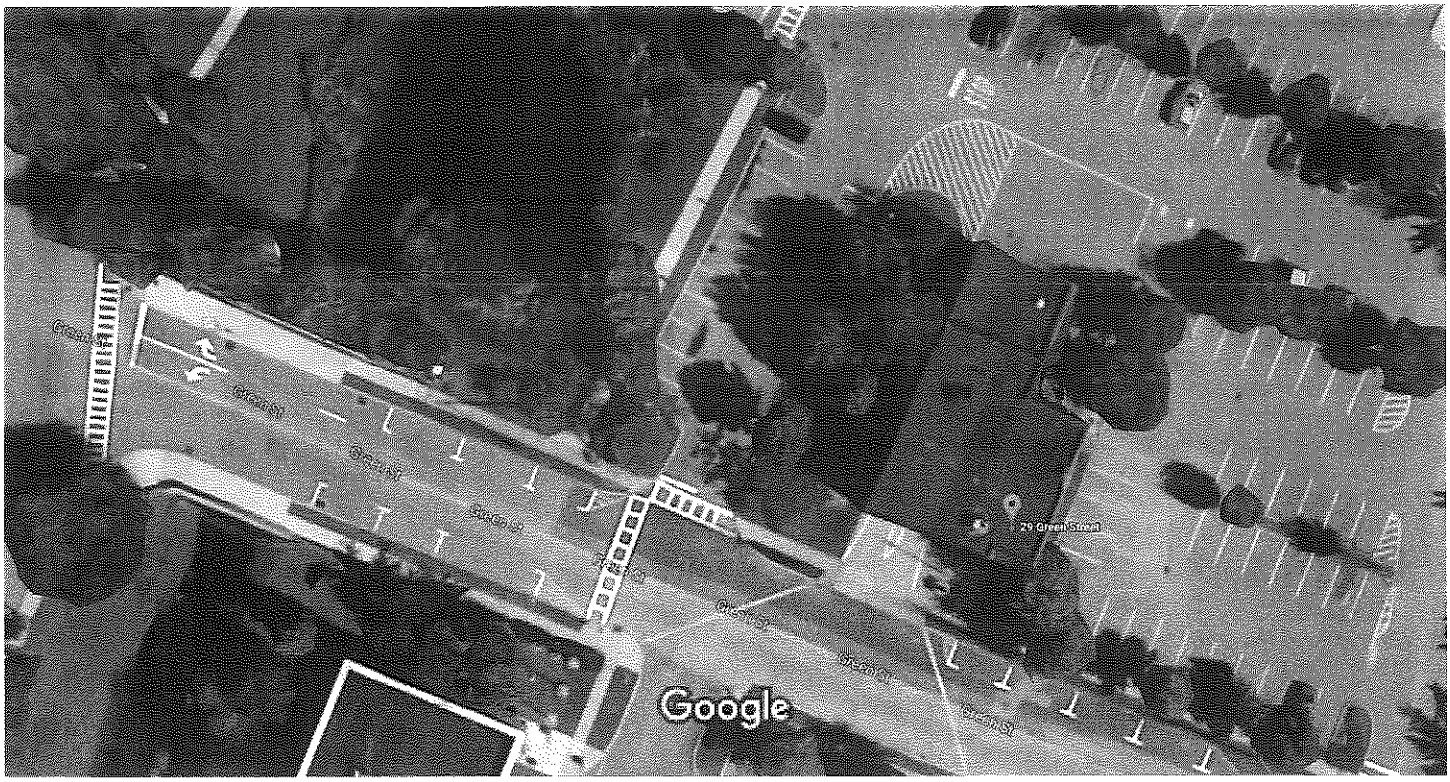


99 Main St

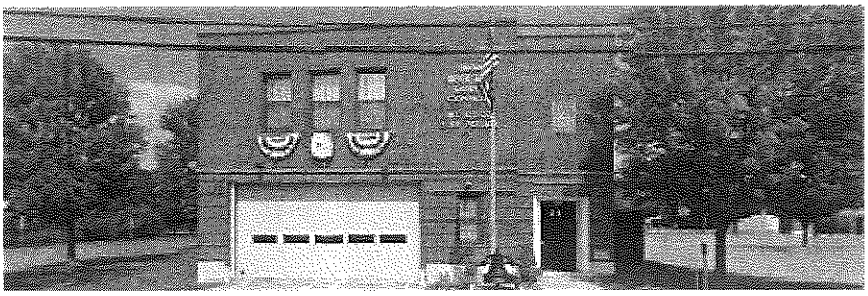
Mt Kisco, NY 10549



Google Maps 29 Green St

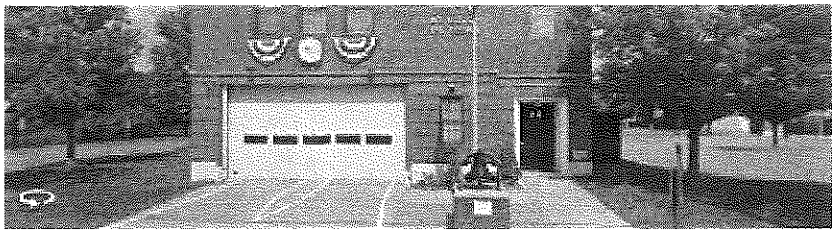


Imagery ©2017 Google, Map data ©2017 Google United States 20 ft



29 Green St

Mt Kisco, NY 10549



At this location

Union Hook and Ladder Company

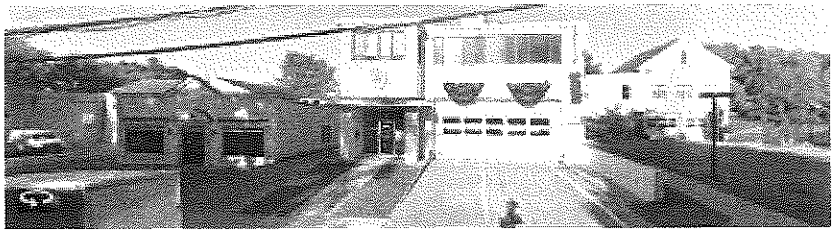
Fire Station · 29 Green St

Google Maps 322 Lexington Ave

Imagery ©2017 Google, Map data ©2017 Google United States 50 ft

322 Lexington Ave

Mt Kisco, NY 10549

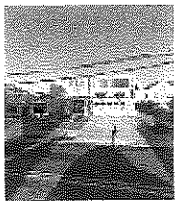


At this location

Independent Fire Company

4.5 ★★★★★ (2)

Volunteer Organization · 322 Lexington Ave



VILLAGE MANAGER
Edward W. Brancati

VILLAGE/TOWN OF MOUNT KISCO

WESTCHESTER COUNTY, NEW YORK
104 Main Street, Mount Kisco, NY 10549-0150
Tel (914) 241-0500 • Fax (914) 241-9018
www.mountkiscony.gov

4) Old Business:

a. Resolution adopting the SEQRA Findings regarding the renovations, expansion and various improvement to all (3) Fire Department facilities in the Village/Town of Mount Kisco.

The following resolution was offered by Trustee Grunthal and seconded by Trustee Farber adopting the Short Environmental Assessment Review Form which has no negative findings and authorizing the Mayor to sign same, regarding the renovations, expansion and various improvement to all (3) Fire Department facilities in the Village/Town of Mount Kisco;

WHEREAS, the Village is the Owner of three (3) properties comprising Village Firehouses located at 99 Main Street (80.25-3-1- Mutual Engine & Hose), 29 Green Street (P/O 80.25-2-1- Union Hook & Ladder Company) and 322 Lexington Avenue (P/O 80.48-1-5- Independent Fire Company) (hereafter referred to as the "subject properties"); and

WHEREAS, the Village of Mount Kisco issued a Request for Proposals (RFPs) wherein it seeks to undertake, fund and or approve the design renovations and expansions for the existing buildings at the subject properties, which would be implemented through contract awards and bond issuances;

WHEREAS, the Village Board conducted a number of public meetings, both in a regular meeting format and in work sessions, it was able to have input form the pubic and consider alternatives;

WHEREAS, the Board of Trustees has had an opportunity to weigh the various facts, circumstances and considerations associated with proposal, and has also had an opportunity to confer with its various professionals;

WHEREAS, in connection with such project the Village Board, as lead agency, has reviewed and fully considered the proposed action and Part I of the Environmental Assessment Form (EAF) and has completed Part II of the EAF, addressing the potential impacts of the project;

WHEREAS, the Board of Trustees has determined that depending upon the final architectural plans (amount of square footage), the proposal is either: a) Type II activity [minor expansion, replacement, rehabilitation pursuant to 6 NYCRR617.5(c)(2),(3) or (9)] or b) is an unlisted action that does not exceed or trigger any thresholds for Type I activities;

NOW, THEREFORE, be it:

RESOLVED, that based on the impact assessments discussed in the attached SEQRA Negative Declaration – Notice of Determination of Non-Significance ("Negative Declaration") the Board of Trustees, as lead agency, hereby finds that the Action will not have a significant adverse impact on the environment and authorizes the filing of a Negative Declaration for the Action, and consequently no EIS will be prepared.

FURTHER RESOLVED, that the Mayor is hereby authorized to execute the determination of significance and any documents necessary and incidental thereto.

On the question:

Trustee Schleimer stated that she found it unusual that we are acting as the Lead Agency, generally the Planning Board acts as Lead Agency, this is the first time I've seen this Environmental Assessment Form. I feel unprepared to evaluate it, as to whether or not we should sign it.

Village Attorney Singleton replied that you can't move forward with your determination for funding without making a determination that you are moving forward with the project. So that is why you are making the determination now. My understanding is that the proposed renovations and/or additions are going to be to the existing sites, and that they are going to be on the existing surfaces and that they will not result in any significate increase in traffic, there will not be any construction on any contaminated sites, or next to a landfill, and that there is not going to be any significant adverse impacts to the environment as it's defined and set forth in this Environmental Assessment Form. Certainly, these are findings not for me to make, but these are findings for your Board to make in going through the Environmental Assessment Form. As to Trustee Schleimer' s concern about the Planning Board, I believe it's the Village Board's position, although it hasn't been discussed, that you are going to exempt this project from normal Planning and Zoning reviews as was done with the Mount Kisco Library.

Trustee Grunthal stated these are buildings that we own and that we are improving existing buildings. The Fire Department wants them improved and we want to put it to the residents in a referendum to see whether they want to spend the money and have them improved. So I don't have any problem adopting these findings, because from an environmental point of view, I can only see this as an improvement not a detriment.

Village Attorney Singleton replied that he had gone through the Short Environmental Assessment Form and had completed and researched the form to the best of his ability. But ultimately it is the Village Board's determination, not his, he simply provided the Board with a filled out form.

Deputy Mayor Markus stated that he agreed with Trustee Grunthal, we want to move forward with this, the Fire Department requires it. I don't believe that we have any problems with environmental issues here. We are doing it in the same fashion we did with the Library and I for one would like to move forward on this. We can certainly continue the review of all of the different plans as we move forward and if the Bond Referendum is approved. But again, these are existing sites and these improvements are only going to help the environment. I'm very comfortable moving forward with this.

Trustee Farber stated that this has been extremely well reviewed and researched. We know exactly what we need and time is of the essence because it has to be on the ballot in November and I feel very comfortable that we have done our due diligence.

Motion Adopted	
Trustee Farber	Aye
Trustee Grunthal	Aye
Deputy Mayor Markus	Aye
Trustee Schleimer	NAY

STATE OF NEW YORK)
COUNTY OF WESTCHESTER ss.
VILLAGE OF MOUNT KISCO

I hereby certify that I have compared the foregoing Resolution with the original on file in my office, and that the same is a correct transcript therefrom and of the whole of the said original Resolution, which was duly adopted by the Board of Trustees of the Village of Mount Kisco, on September 18, 2007.

In WITNESS WHEREOF, I have hereunto set my hand and affixed the Corporate Seal of said Village of Mount Kisco,

Eileen D. Buttner Village Clerk
Village of Mount Kisco.

Appendix E

Signatory Requirement
Contractor Certification Statement
Long Term Contact Information

Signatory Requirements:

Pursuant to NYSDEC SPDES General Permit for Stormwater Discharges from Construction Activity (GP-0-15-002), signatory requirements for all NOIs, NOTs, SWPPPs, MS4 SWPPP Acceptance forms, reports, certifications or information required by the aforementioned permit are as follows:

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 above 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 1) above;
   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.

Contractor or Subcontractor Certification Statement

"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."

Contractor Name: _____

Address: _____

_____

Telephone number: _____

Contractor Representative:

Name: _____ Title: _____

Signature: _____ Date: _____

Trained Contractor (if different from above):

Name: _____ Title: _____

Signature: _____ Date: _____

SWPPP Responsibilities

Elements of SWPPP above contractor is responsible for implementing:

_____

_____

_____

_____

Contractor or Subcontractor Certification Statement

"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."

Contractor Name: _____

Address: _____

_____

Telephone number: _____

Contractor Representative:

Name: _____ Title: _____

Signature: _____ Date: _____

Trained Contractor (if different from above):

Name: _____ Title: _____

Signature: _____ Date: _____

SWPPP Responsibilities

Elements of SWPPP above contractor is responsible for implementing:

_____

_____

_____

_____

Contractor or Subcontractor Certification Statement

"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."

Contractor Name: _____

Address: _____

_____

Telephone number: _____

Contractor Representative:

Name: _____ Title: _____

Signature: _____ Date: _____

Trained Contractor (if different from above):

Name: _____ Title: _____

Signature: _____ Date: _____

SWPPP Responsibilities

Elements of SWPPP above contractor is responsible for implementing:

_____

_____

_____

_____

architects + engineers
2 Executive Boulevard, Ste 401
Suffern, NY 10901 | tel 845.357.7238

Mutual Fire Station – SWPPP
99 Main Street
Village of Mount Kisco, NY 10549
New Croton Reservoir Drainage Basin

Contact Information for Long Term Maintenance of Stormwater Practices:

Village of Mount Kisco

104 Main Street
Mount Kisco, NY 10549

Hours: M-F 8:30AM - 4:30PM

PH: (914) 241-0500 FAX: (914) 241-9018

webmaster@mountkiscony.gov

Appendix F

Pre and Post Development Drainage Report

Watershed Model Schematic

Legend

Hyd.	Origin	Description
1	SCS Runoff	WS #1

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	0.875	-------	-------	-------	2.120	-------	-------	4.267	WS #1

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.875	2	730	3,573	------	------	------	WS #1

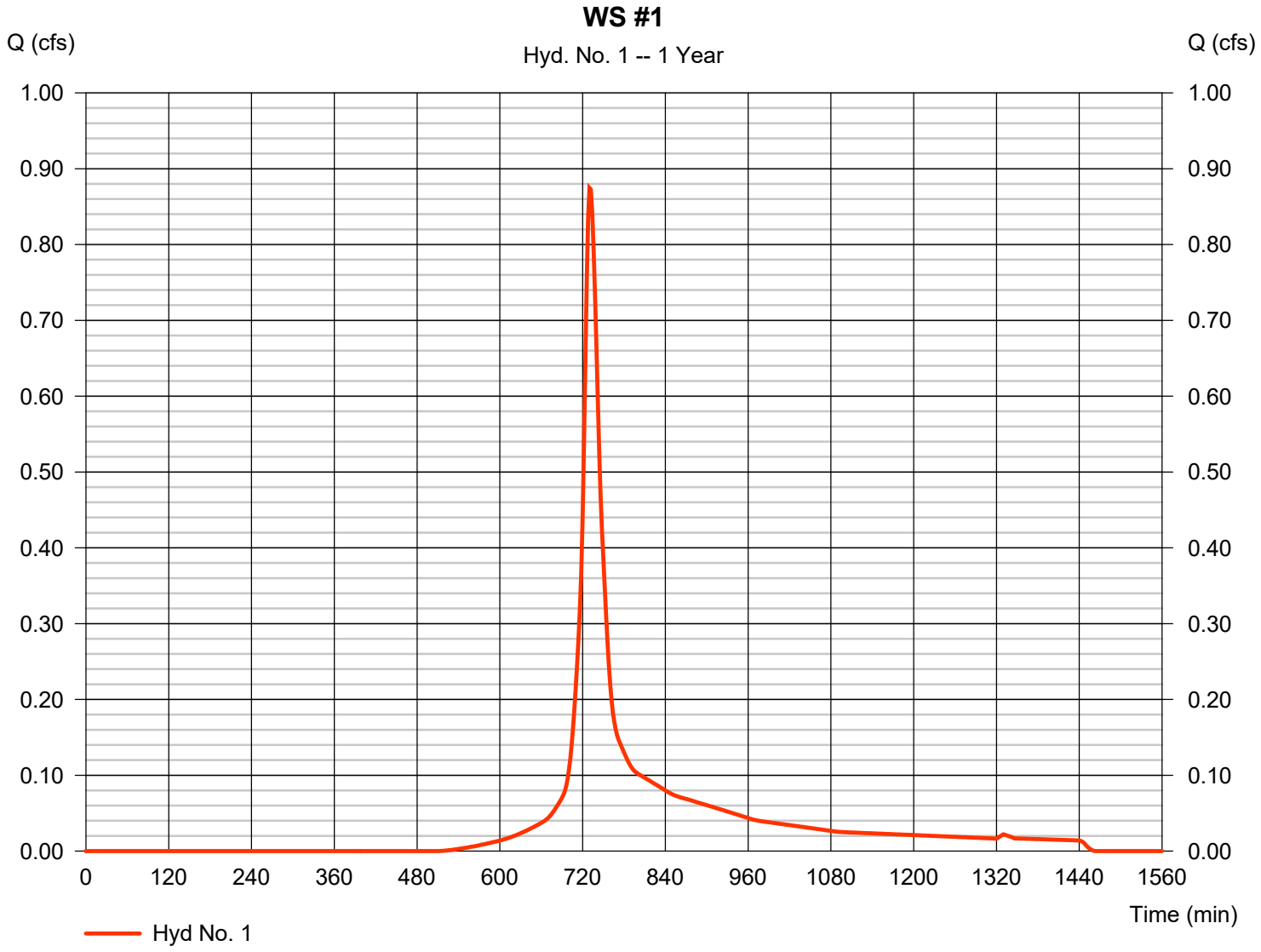
Hydrograph Report

Hyd. No. 1

WS #1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.875 cfs
Storm frequency	= 1 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 3,573 cuft
Drainage area	= 0.710 ac	Curve number	= 85*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.30 min
Total precip.	= 2.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.079 x 89) + (0.393 x 77) + (0.235 x 98)] / 0.710



TR55 Tc Worksheet

Hyd. No. 1

WS #1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.800		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.25		0.00		0.00		
Land slope (%)	= 21.00		0.00		0.00		
Travel Time (min)	**= 14.48**	**+**	**0.00**	**+**	**0.00**	**=**	**14.48**
Shallow Concentrated Flow							
Flow length (ft)	= 171.00		25.00		0.00		
Watercourse slope (%)	= 40.00		12.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=10.20		7.04		0.00		
Travel Time (min)	**= 0.28**	**+**	**0.06**	**+**	**0.00**	**=**	**0.34**
Channel Flow							
X sectional flow area (sqft)	= 0.20		0.79		0.00		
Wetted perimeter (ft)	= 1.57		3.14		0.00		
Channel slope (%)	= 4.40		2.30		0.00		
Manning's n-value	= 0.025		0.015		0.015		
Velocity (ft/s)	=3.10		5.95		0.00		
Flow length (ft)	({0})44.0		70.0		0.0		
Travel Time (min)	**= 0.24**	**+**	**0.20**	**+**	**0.00**	**=**	**0.43**

Total Travel Time, Tc ..... 15.30 min

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.120	2	730	8,696	------	------	------	WS #1

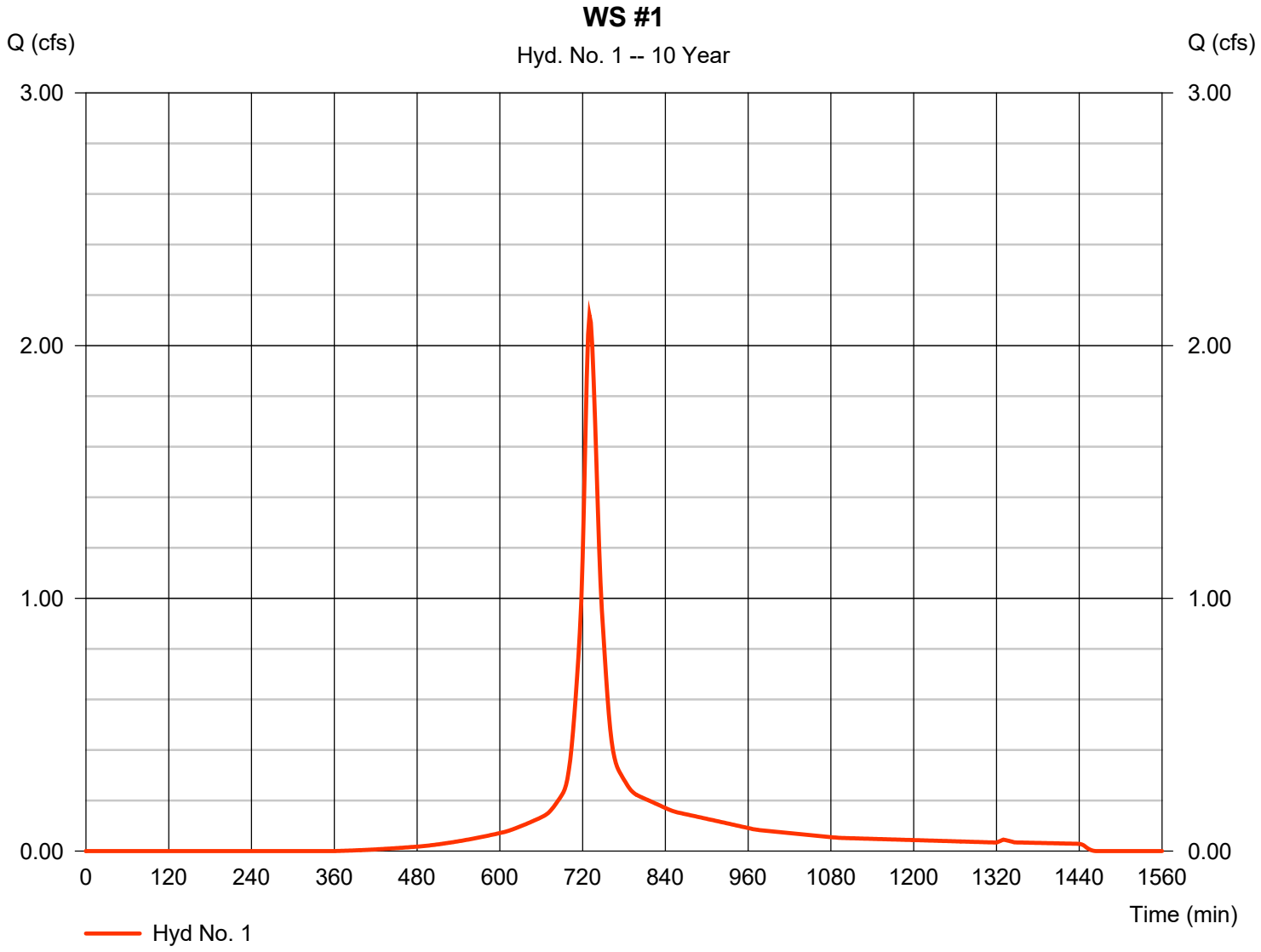
Hydrograph Report

Hyd. No. 1

WS #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.120 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	8,696 cuft
Drainage area	=	0.710 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	15.30 min
Total precip.	=	5.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.079 x 89) + (0.393 x 77) + (0.235 x 98)] / 0.710



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.267	2	730	18,046	------	------	------	WS #1

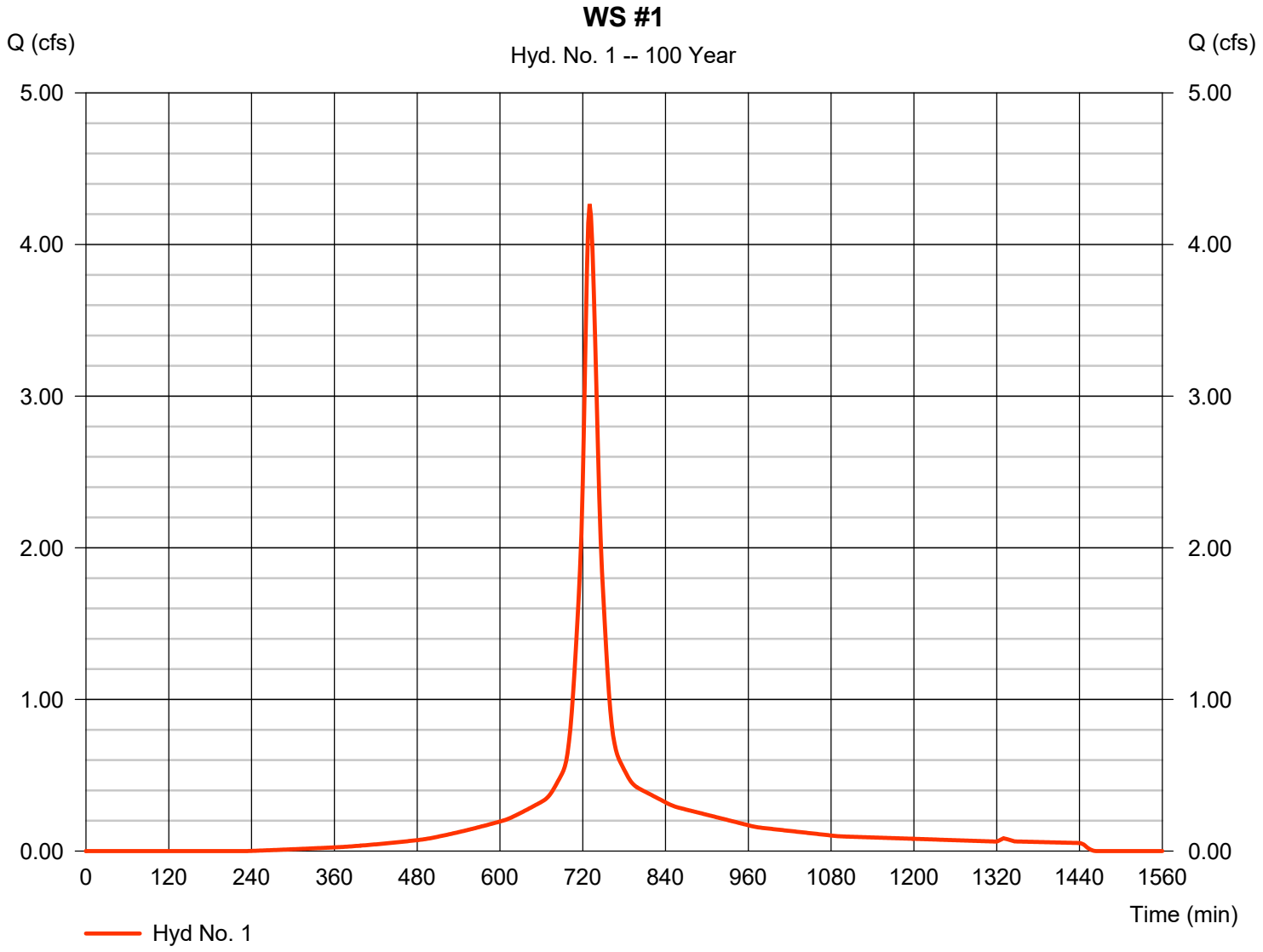
Hydrograph Report

Hyd. No. 1

WS #1

Hydrograph type	= SCS Runoff	Peak discharge	= 4.267 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 18,046 cuft
Drainage area	= 0.710 ac	Curve number	= 85*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.30 min
Total precip.	= 9.00 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.079 x 89) + (0.393 x 77) + (0.235 x 98)] / 0.710



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

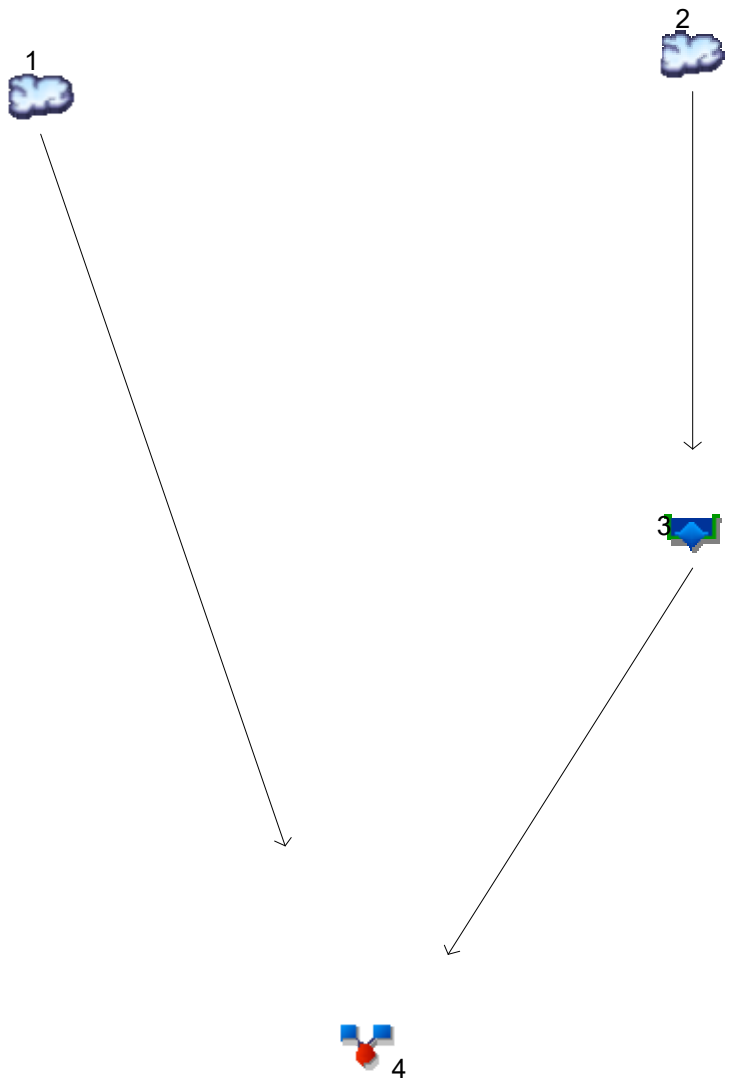
Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

X:\MKIV (Village of Mount Kisco)\MKIV1803 (Independent Fire Station)\01-Reports\SWPPP\Hydraflow\MKIV precip.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.80	3.25	0.00	3.30	5.10	5.77	6.80	9.00
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	2.75	0.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	5.25	6.00	0.00

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	WS #1
2	SCS Runoff	WS#2
3	Reservoir	WS#2 to SC-310
4	Combine	To Study Point #1

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	0.078	-------	-------	-------	0.144	-------	-------	0.256	WS #1
2	SCS Runoff	------	0.838	-------	-------	-------	2.030	-------	-------	4.087	WS#2
3	Reservoir	2	0.726	-------	-------	-------	1.904	-------	-------	3.954	WS#2 to SC-310
4	Combine	1, 3	0.761	-------	-------	-------	1.981	-------	-------	4.091	To Study Point #1

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.078	2	724	262	------	------	------	WS #1
2	SCS Runoff	0.838	2	730	3,422	------	------	------	WS#2
3	Reservoir	0.726	2	732	1,135	2	283.30	260	WS#2 to SC-310
4	Combine	0.761	2	732	1,397	1, 3	------	------	To Study Point #1

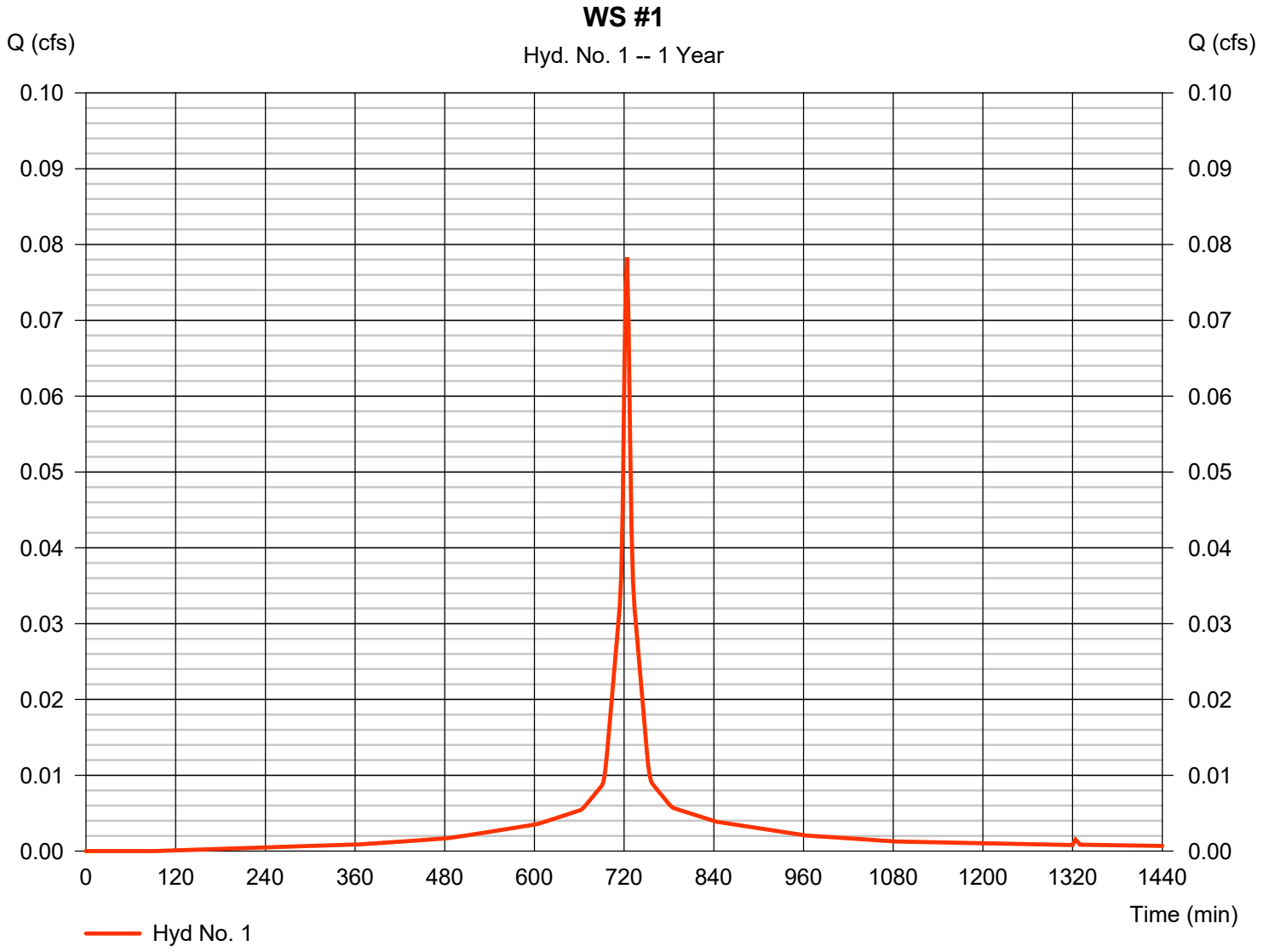
Hydrograph Report

Hyd. No. 1

WS #1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.078 cfs
Storm frequency	= 1 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 262 cuft
Drainage area	= 0.030 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 2.80 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.028 x 98)] / 0.030



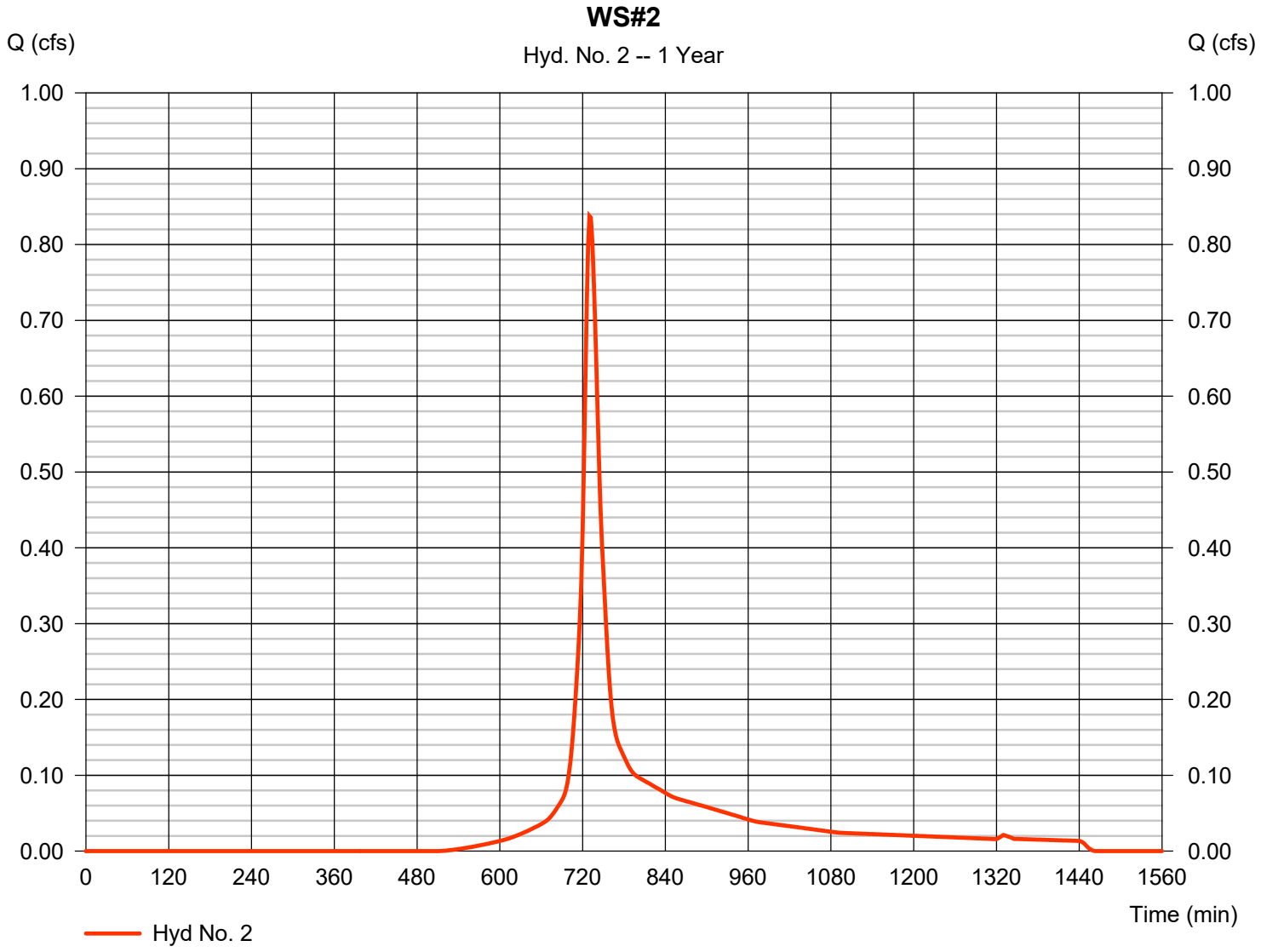
Hydrograph Report

Hyd. No. 2

WS#2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.838 cfs
Storm frequency	=	1 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	3,422 cuft
Drainage area	=	0.680 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	15.40 min
Total precip.	=	2.80 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.050 x 80) + (0.382 x 77) + (0.247 x 98)] / 0.680



TR55 Tc Worksheet

Hyd. No. 2

WS#2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.800		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.25		0.00		0.00		
Land slope (%)	= 21.00		0.00		0.00		
Travel Time (min)	**= 14.48**	**+**	**0.00**	**+**	**0.00**	**=**	**14.48**
Shallow Concentrated Flow							
Flow length (ft)	= 150.00		45.00		0.00		
Watercourse slope (%)	= 40.00		22.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=10.20		9.53		0.00		
Travel Time (min)	**= 0.24**	**+**	**0.08**	**+**	**0.00**	**=**	**0.32**
Channel Flow							
X sectional flow area (sqft)	= 1.22		1.77		0.79		
Wetted perimeter (ft)	= 3.92		4.71		3.14		
Channel slope (%)	= 3.50		0.50		1.20		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=8.49						
			3.65				
					4.30		
Flow length (ft)	({0})46.0		54.0		62.0		
Travel Time (min)	**= 0.09**	**+**	**0.25**	**+**	**0.24**	**=**	**0.58**

Total Travel Time, Tc ..... 15.40 min

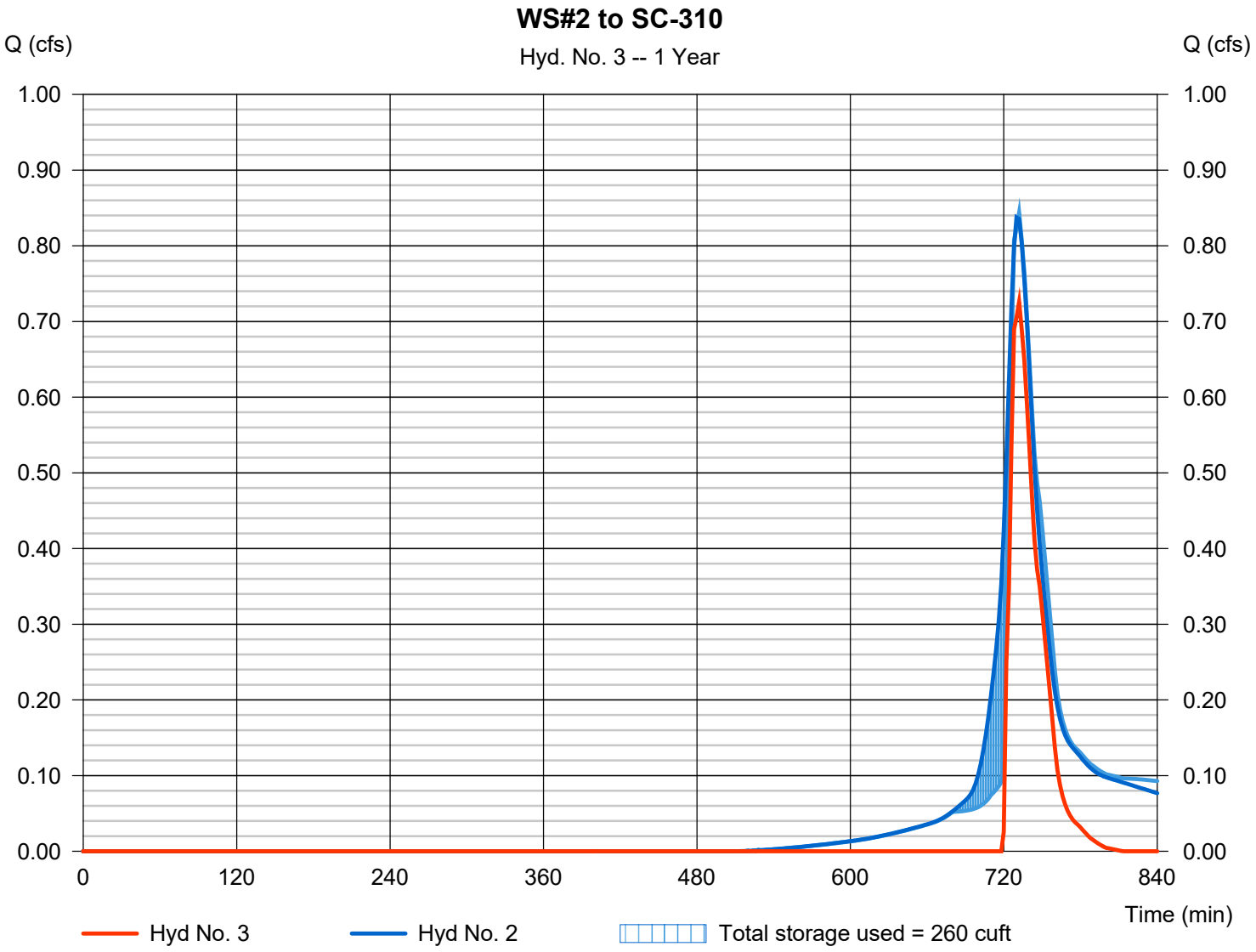
Hydrograph Report

Hyd. No. 3

WS#2 to SC-310

Hydrograph type	= Reservoir	Peak discharge	= 0.726 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 1,135 cuft
Inflow hyd. No.	= 2 - WS#2	Max. Elevation	= 283.30 ft
Reservoir name	= SC-310 Chambers	Max. Storage	= 260 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond No. 1 - SC-310 Chambers

Pond Data

UG Chambers -Invert elev. = 281.50 ft, Rise x Span = 1.15 x 2.30 ft, Barrel Len = 7.12 ft, No. Barrels = 6, Slope = 0.00%, Headers = No
Encasement -Invert elev. = 280.50 ft, Width = 4.33 ft, Height = 3.33 ft, Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	280.50	n/a	0	0
0.33	280.83	n/a	25	25
0.67	281.17	n/a	25	49
1.00	281.50	n/a	25	74
1.33	281.83	n/a	44	118
1.66	282.17	n/a	42	160
2.00	282.50	n/a	38	198
2.33	282.83	n/a	28	226
2.66	283.16	n/a	25	250
3.00	283.50	n/a	25	275
3.33	283.83	n/a	25	300

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	3.00	0.00	0.00
Span (in)	= 12.00	3.00	0.00	0.00
No. Barrels	= 1	2	0	0
Invert El. (ft)	= 281.40	282.40	0.00	0.00
Length (ft)	= 5.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .011	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 2.00	0.00	0.00	0.00
Crest El. (ft)	= 283.17	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 12.000 (by Wet area)
TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	280.50	0.00	0.00	---	---	0.00	---	---	---	0.000	---	0.000
0.03	2	280.53	0.00	0.00	---	---	0.00	---	---	---	0.052	---	0.052
0.07	5	280.57	0.00	0.00	---	---	0.00	---	---	---	0.053	---	0.053
0.10	7	280.60	0.00	0.00	---	---	0.00	---	---	---	0.054	---	0.054
0.13	10	280.63	0.00	0.00	---	---	0.00	---	---	---	0.055	---	0.055
0.17	12	280.67	0.00	0.00	---	---	0.00	---	---	---	0.055	---	0.055
0.20	15	280.70	0.00	0.00	---	---	0.00	---	---	---	0.056	---	0.056
0.23	17	280.73	0.00	0.00	---	---	0.00	---	---	---	0.057	---	0.057
0.27	20	280.77	0.00	0.00	---	---	0.00	---	---	---	0.058	---	0.058
0.30	22	280.80	0.00	0.00	---	---	0.00	---	---	---	0.058	---	0.058
0.33	25	280.83	0.00	0.00	---	---	0.00	---	---	---	0.059	---	0.059
0.37	27	280.87	0.00	0.00	---	---	0.00	---	---	---	0.060	---	0.060
0.40	30	280.90	0.00	0.00	---	---	0.00	---	---	---	0.061	---	0.061
0.43	32	280.93	0.00	0.00	---	---	0.00	---	---	---	0.062	---	0.062
0.47	35	280.97	0.00	0.00	---	---	0.00	---	---	---	0.062	---	0.062
0.50	37	281.00	0.00	0.00	---	---	0.00	---	---	---	0.063	---	0.063
0.53	39	281.03	0.00	0.00	---	---	0.00	---	---	---	0.064	---	0.064
0.57	42	281.07	0.00	0.00	---	---	0.00	---	---	---	0.065	---	0.065
0.60	44	281.10	0.00	0.00	---	---	0.00	---	---	---	0.066	---	0.066
0.63	47	281.13	0.00	0.00	---	---	0.00	---	---	---	0.066	---	0.066
0.67	49	281.17	0.00	0.00	---	---	0.00	---	---	---	0.067	---	0.067
0.70	52	281.20	0.00	0.00	---	---	0.00	---	---	---	0.068	---	0.068
0.73	54	281.23	0.00	0.00	---	---	0.00	---	---	---	0.069	---	0.069
0.77	57	281.27	0.00	0.00	---	---	0.00	---	---	---	0.070	---	0.070
0.80	59	281.30	0.00	0.00	---	---	0.00	---	---	---	0.070	---	0.070
0.83	62	281.33	0.00	0.00	---	---	0.00	---	---	---	0.071	---	0.071
0.87	64	281.37	0.00	0.00	---	---	0.00	---	---	---	0.072	---	0.072
0.90	67	281.40	0.00	0.00	---	---	0.00	---	---	---	0.073	---	0.073
0.93	69	281.43	0.00	0.00	---	---	0.00	---	---	---	0.074	---	0.074
0.97	71	281.47	0.00	0.00	---	---	0.00	---	---	---	0.074	---	0.074
1.00	74	281.50	0.00	0.00	---	---	0.00	---	---	---	0.075	---	0.075
1.03	78	281.53	0.00	0.00	---	---	0.00	---	---	---	0.076	---	0.076

Continues on next page...

SC-310 Chambers

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
1.07	83	281.57	0.00	0.00	---	---	0.00	---	---	---	0.077	---	0.077
1.10	87	281.60	0.00	0.00	---	---	0.00	---	---	---	0.077	---	0.077
1.13	92	281.63	0.00	0.00	---	---	0.00	---	---	---	0.078	---	0.078
1.17	96	281.67	0.00	0.00	---	---	0.00	---	---	---	0.079	---	0.079
1.20	100	281.70	0.00	0.00	---	---	0.00	---	---	---	0.080	---	0.080
1.23	105	281.73	0.00	0.00	---	---	0.00	---	---	---	0.081	---	0.081
1.27	109	281.77	0.00	0.00	---	---	0.00	---	---	---	0.081	---	0.081
1.30	113	281.80	0.00	0.00	---	---	0.00	---	---	---	0.082	---	0.082
1.33	118	281.83	0.00	0.00	---	---	0.00	---	---	---	0.083	---	0.083
1.37	122	281.87	0.00	0.00	---	---	0.00	---	---	---	0.084	---	0.084
1.40	126	281.90	0.00	0.00	---	---	0.00	---	---	---	0.085	---	0.085
1.43	131	281.93	0.00	0.00	---	---	0.00	---	---	---	0.085	---	0.085
1.47	135	281.97	0.00	0.00	---	---	0.00	---	---	---	0.086	---	0.086
1.50	139	282.00	0.00	0.00	---	---	0.00	---	---	---	0.087	---	0.087
1.53	143	282.03	0.00	0.00	---	---	0.00	---	---	---	0.088	---	0.088
1.57	147	282.07	0.00	0.00	---	---	0.00	---	---	---	0.089	---	0.089
1.60	152	282.10	0.00	0.00	---	---	0.00	---	---	---	0.089	---	0.089
1.63	156	282.13	0.00	0.00	---	---	0.00	---	---	---	0.090	---	0.090
1.66	160	282.17	0.00	0.00	---	---	0.00	---	---	---	0.091	---	0.091
1.70	164	282.20	0.00	0.00	---	---	0.00	---	---	---	0.092	---	0.092
1.73	168	282.23	0.00	0.00	---	---	0.00	---	---	---	0.092	---	0.092
1.76	172	282.26	0.00	0.00	---	---	0.00	---	---	---	0.093	---	0.093
1.80	175	282.30	0.00	0.00	---	---	0.00	---	---	---	0.094	---	0.094
1.83	179	282.33	0.00	0.00	---	---	0.00	---	---	---	0.095	---	0.095
1.86	183	282.36	0.00	0.00	---	---	0.00	---	---	---	0.096	---	0.096
1.90	187	282.40	0.00	0.00	---	---	0.00	---	---	---	0.096	---	0.096
1.93	191	282.43	0.00 ic	0.00 ic	---	---	0.00	---	---	---	0.097	---	0.102
1.96	194	282.46	0.02 ic	0.02 ic	---	---	0.00	---	---	---	0.098	---	0.115
2.00	198	282.50	0.04 ic	0.04 ic	---	---	0.00	---	---	---	0.099	---	0.138
2.03	201	282.53	0.07 ic	0.07 ic	---	---	0.00	---	---	---	0.100	---	0.165
2.06	204	282.56	0.10 oc	0.10 ic	---	---	0.00	---	---	---	0.100	---	0.196
2.10	206	282.60	0.13 oc	0.13 ic	---	---	0.00	---	---	---	0.101	---	0.228
2.13	209	282.63	0.16 oc	0.16 ic	---	---	0.00	---	---	---	0.102	---	0.257
2.16	212	282.66	0.18 oc	0.18 ic	---	---	0.00	---	---	---	0.103	---	0.279
2.20	215	282.70	0.20 oc	0.20 ic	---	---	0.00	---	---	---	0.104	---	0.300
2.23	217	282.73	0.22 oc	0.21 ic	---	---	0.00	---	---	---	0.104	---	0.319
2.26	220	282.76	0.24 oc	0.23 ic	---	---	0.00	---	---	---	0.105	---	0.336
2.30	223	282.80	0.25 oc	0.25 ic	---	---	0.00	---	---	---	0.106	---	0.353
2.33	226	282.83	0.27 oc	0.26 ic	---	---	0.00	---	---	---	0.107	---	0.368
2.36	228	282.86	0.28 oc	0.28 ic	---	---	0.00	---	---	---	0.107	---	0.383
2.40	231	282.90	0.30 oc	0.29 ic	---	---	0.00	---	---	---	0.108	---	0.397
2.43	233	282.93	0.31 oc	0.30 ic	---	---	0.00	---	---	---	0.109	---	0.410
2.46	236	282.96	0.32 oc	0.31 ic	---	---	0.00	---	---	---	0.110	---	0.423
2.50	238	283.00	0.33 oc	0.32 ic	---	---	0.00	---	---	---	0.111	---	0.436
2.53	241	283.03	0.35 oc	0.34 ic	---	---	0.00	---	---	---	0.111	---	0.448
2.56	243	283.06	0.36 oc	0.35 ic	---	---	0.00	---	---	---	0.112	---	0.459
2.60	245	283.10	0.37 oc	0.36 ic	---	---	0.00	---	---	---	0.113	---	0.471
2.63	248	283.13	0.38 oc	0.37 ic	---	---	0.00	---	---	---	0.114	---	0.482
2.66	250	283.16	0.39 oc	0.38 ic	---	---	0.00	---	---	---	0.115	---	0.492
2.70	253	283.20	0.42 oc	0.39 ic	---	---	0.03	---	---	---	0.115	---	0.533
2.73	255	283.23	0.50 oc	0.40 ic	---	---	0.10	---	---	---	0.116	---	0.613
2.76	258	283.26	0.60 oc	0.41 ic	---	---	0.19	---	---	---	0.117	---	0.715
2.80	260	283.30	0.72 oc	0.42 ic	---	---	0.30	---	---	---	0.118	---	0.835
2.83	263	283.33	0.85 oc	0.42 ic	---	---	0.43	---	---	---	0.119	---	0.971
2.86	265	283.36	1.01 oc	0.43 ic	---	---	0.57	---	---	---	0.119	---	1.120
2.90	268	283.40	1.16 oc	0.44 ic	---	---	0.72	---	---	---	0.120	---	1.282
2.93	270	283.43	1.34 oc	0.45 ic	---	---	0.88	---	---	---	0.121	---	1.455
2.96	273	283.46	1.52 oc	0.46 ic	---	---	1.06	---	---	---	0.122	---	1.639
3.00	275	283.50	1.71 oc	0.47 ic	---	---	1.25	---	---	---	0.123	---	1.834
3.03	278	283.53	1.91 oc	0.47 ic	---	---	1.44	---	---	---	0.123	---	2.037
3.06	280	283.56	2.12 oc	0.48 ic	---	---	1.64	---	---	---	0.124	---	2.248
3.10	282	283.60	2.34 oc	0.48 ic	---	---	1.86	---	---	---	0.125	---	2.461
3.13	285	283.63	2.56 oc	0.48 ic	---	---	2.08	---	---	---	0.126	---	2.681
3.16	287	283.66	2.78 oc	0.47 ic	---	---	2.31	---	---	---	0.126	---	2.907
3.20	290	283.70	3.01 oc	0.47 ic	---	---	2.55	---	---	---	0.127	---	3.141
3.23	292	283.73	3.25 oc	0.46 ic	---	---	2.79	---	---	---	0.128	---	3.380
3.26	295	283.76	3.50 oc	0.45 ic	---	---	3.04	---	---	---	0.129	---	3.625
3.30	297	283.80	3.75 oc	0.44 ic	---	---	3.30	---	---	---	0.130	---	3.876
3.33	300	283.83	4.00 ic	0.43 ic	---	---	3.57	---	---	---	0.130	---	4.127

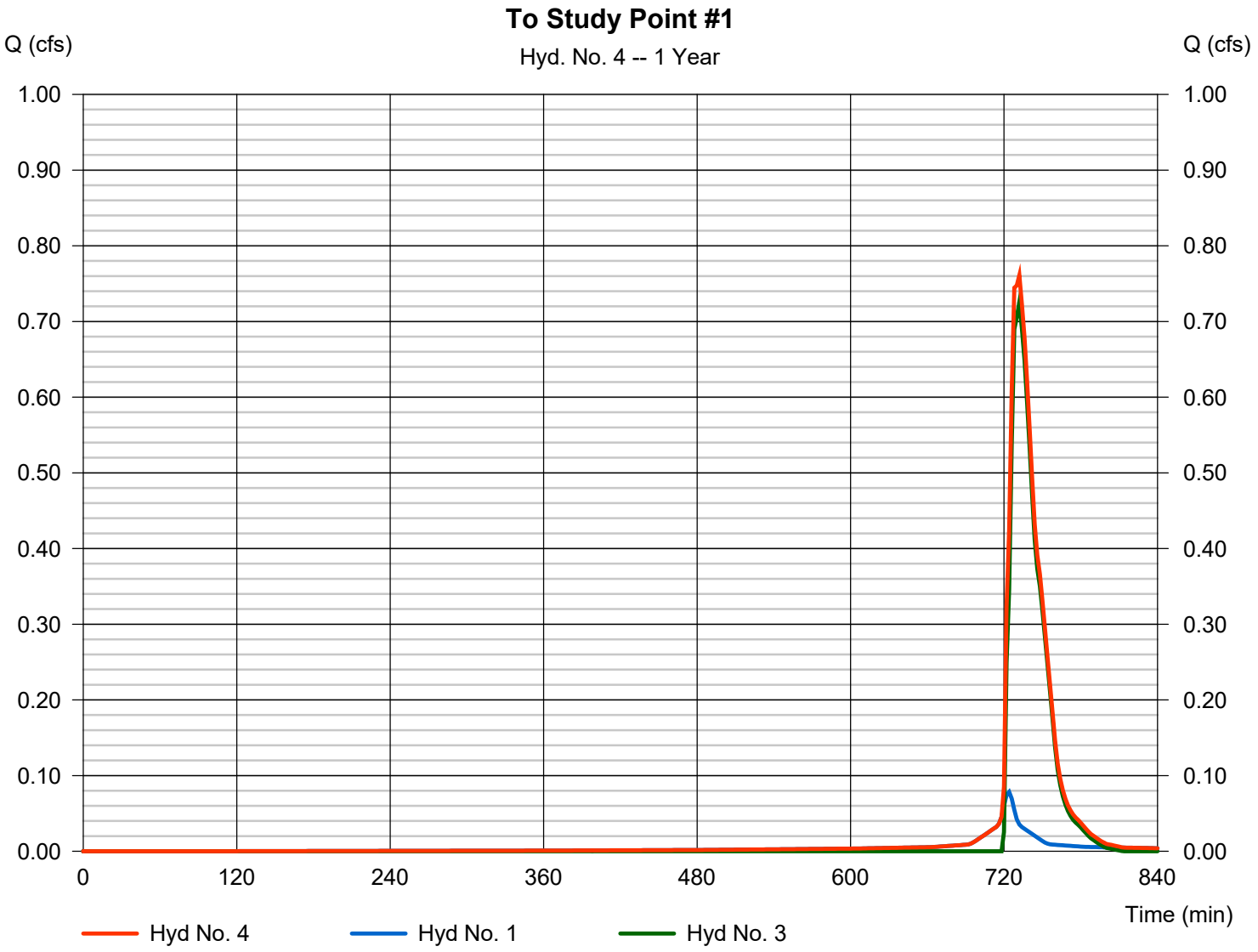
...End

Hydrograph Report

Hyd. No. 4

To Study Point #1

Hydrograph type	= Combine	Peak discharge	= 0.761 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 1,397 cuft
Inflow hyds.	= 1, 3	Contrib. drain. area	= 0.030 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.144	2	724	496	------	------	------	WS #1
2	SCS Runoff	2.030	2	730	8,329	------	------	------	WS#2
3	Reservoir	1.904	2	730	4,395	2	283.53	277	WS#2 to SC-310
4	Combine	1.981	2	730	4,891	1, 3	------	------	To Study Point #1

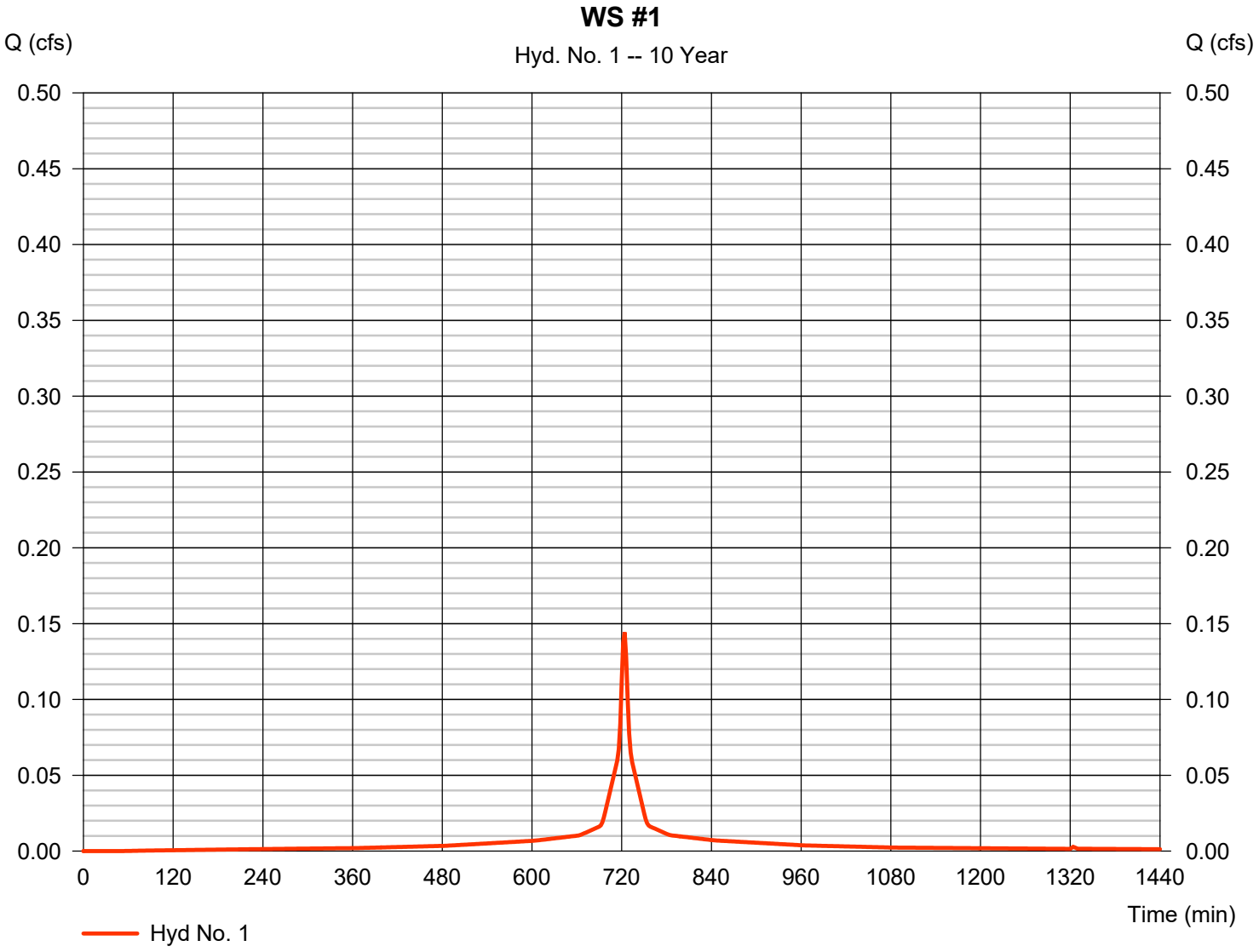
Hydrograph Report

Hyd. No. 1

WS #1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.144 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 496 cuft
Drainage area	= 0.030 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 6.00 min
Total precip.	= 5.10 in	Distribution	= Type III
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.028 x 98)] / 0.030



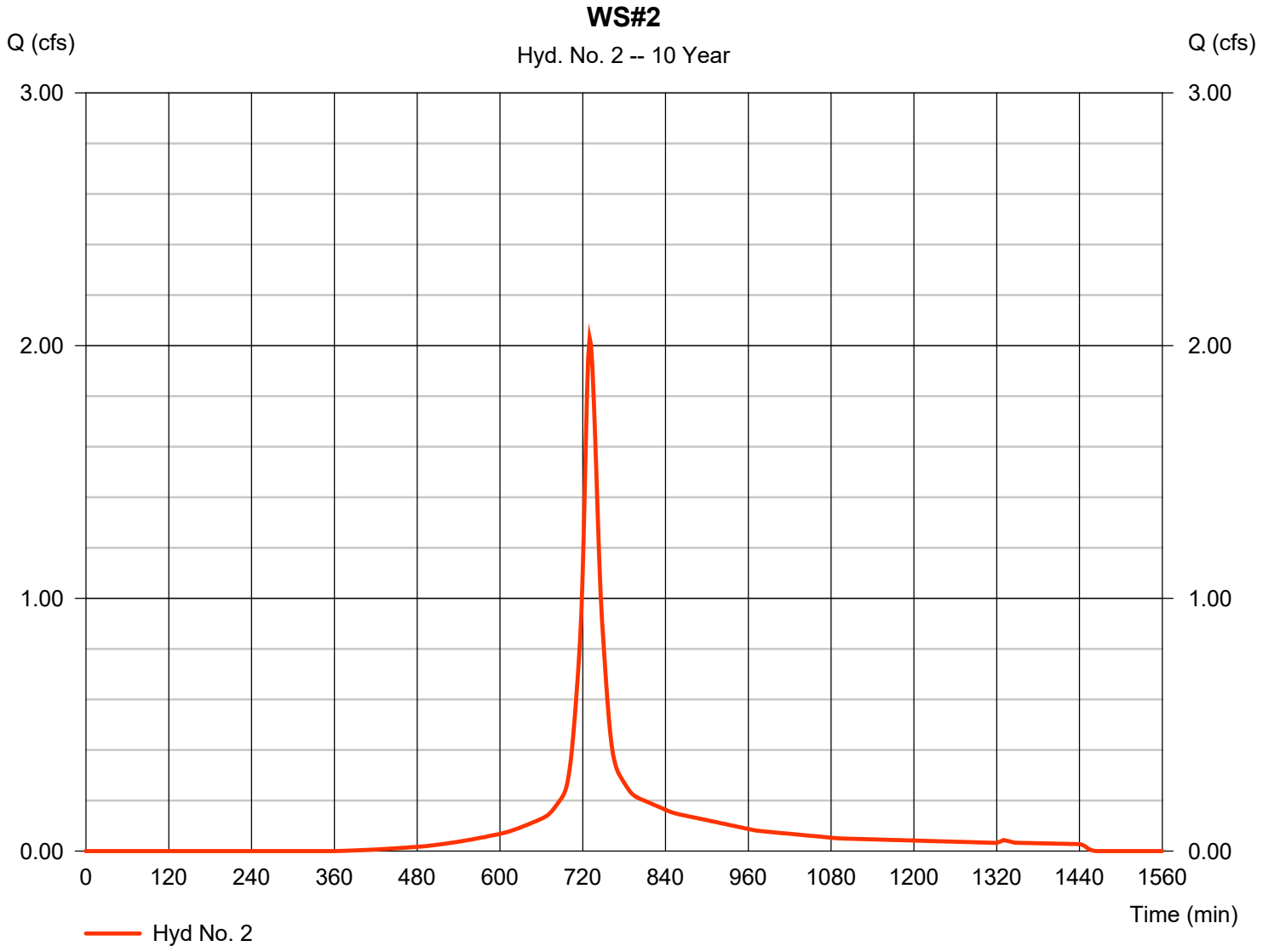
Hydrograph Report

Hyd. No. 2

WS#2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.030 cfs
Storm frequency	=	10 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	8,329 cuft
Drainage area	=	0.680 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	15.40 min
Total precip.	=	5.10 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.050 x 80) + (0.382 x 77) + (0.247 x 98)] / 0.680



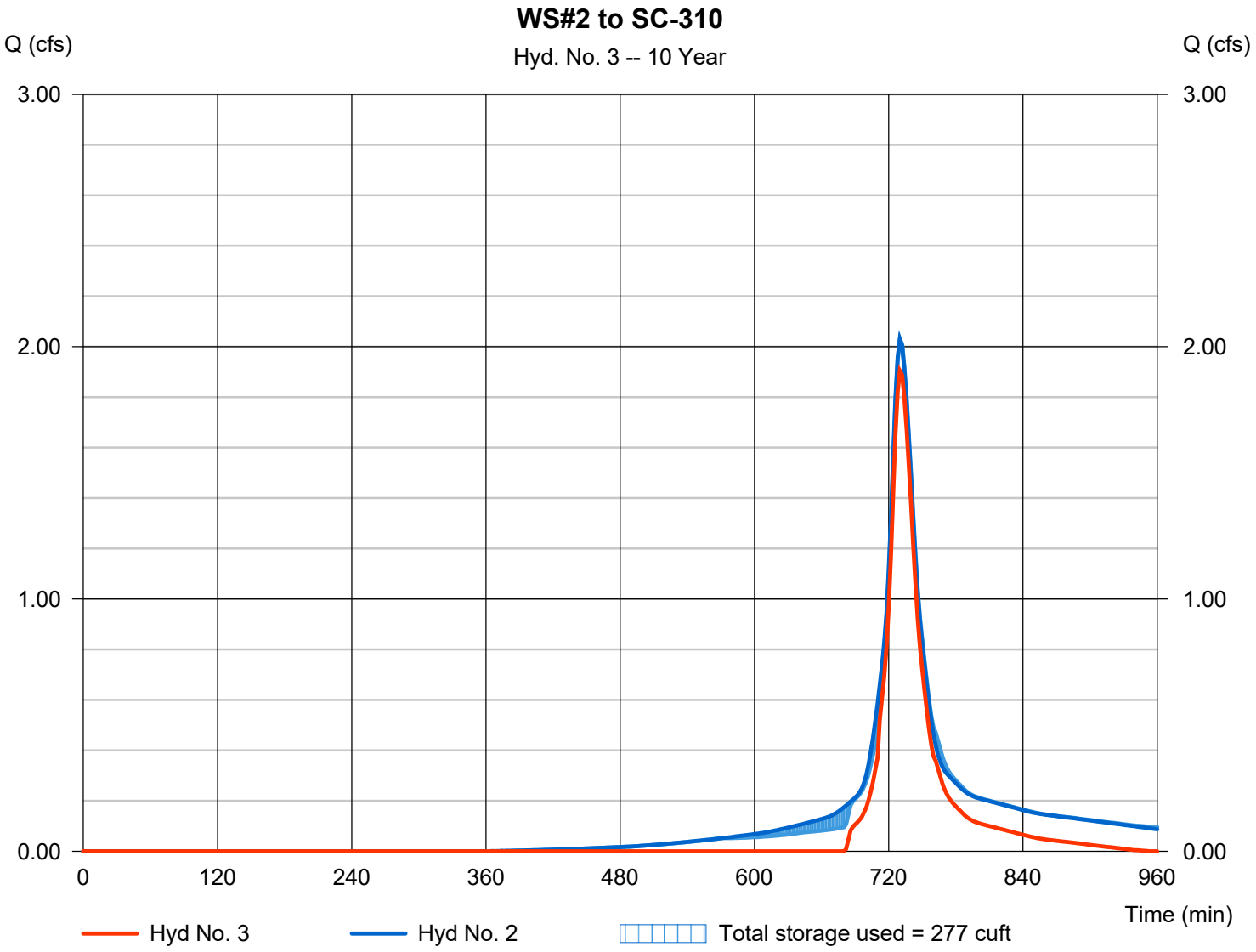
Hydrograph Report

Hyd. No. 3

WS#2 to SC-310

Hydrograph type	= Reservoir	Peak discharge	= 1.904 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 4,395 cuft
Inflow hyd. No.	= 2 - WS#2	Max. Elevation	= 283.53 ft
Reservoir name	= SC-310 Chambers	Max. Storage	= 277 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

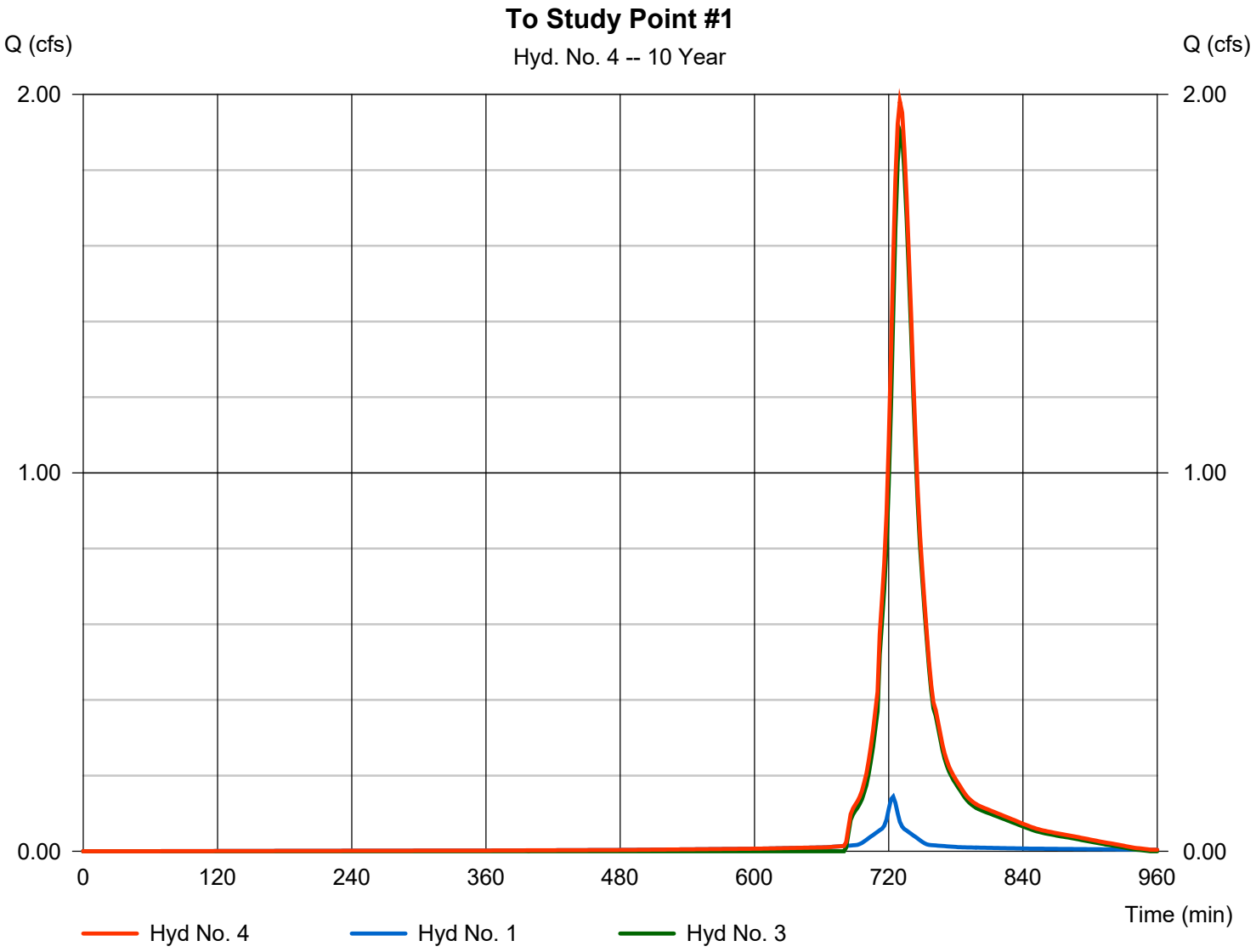


Hydrograph Report

Hyd. No. 4

To Study Point #1

Hydrograph type	= Combine	Peak discharge	= 1.981 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 4,891 cuft
Inflow hyds.	= 1, 3	Contrib. drain. area	= 0.030 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.256	2	724	894	------	------	------	WS #1
2	SCS Runoff	4.087	2	730	17,284	------	------	------	WS#2
3	Reservoir	3.954	2	730	11,516	2	283.82	299	WS#2 to SC-310
4	Combine	4.091	2	730	12,410	1, 3	------	------	To Study Point #1

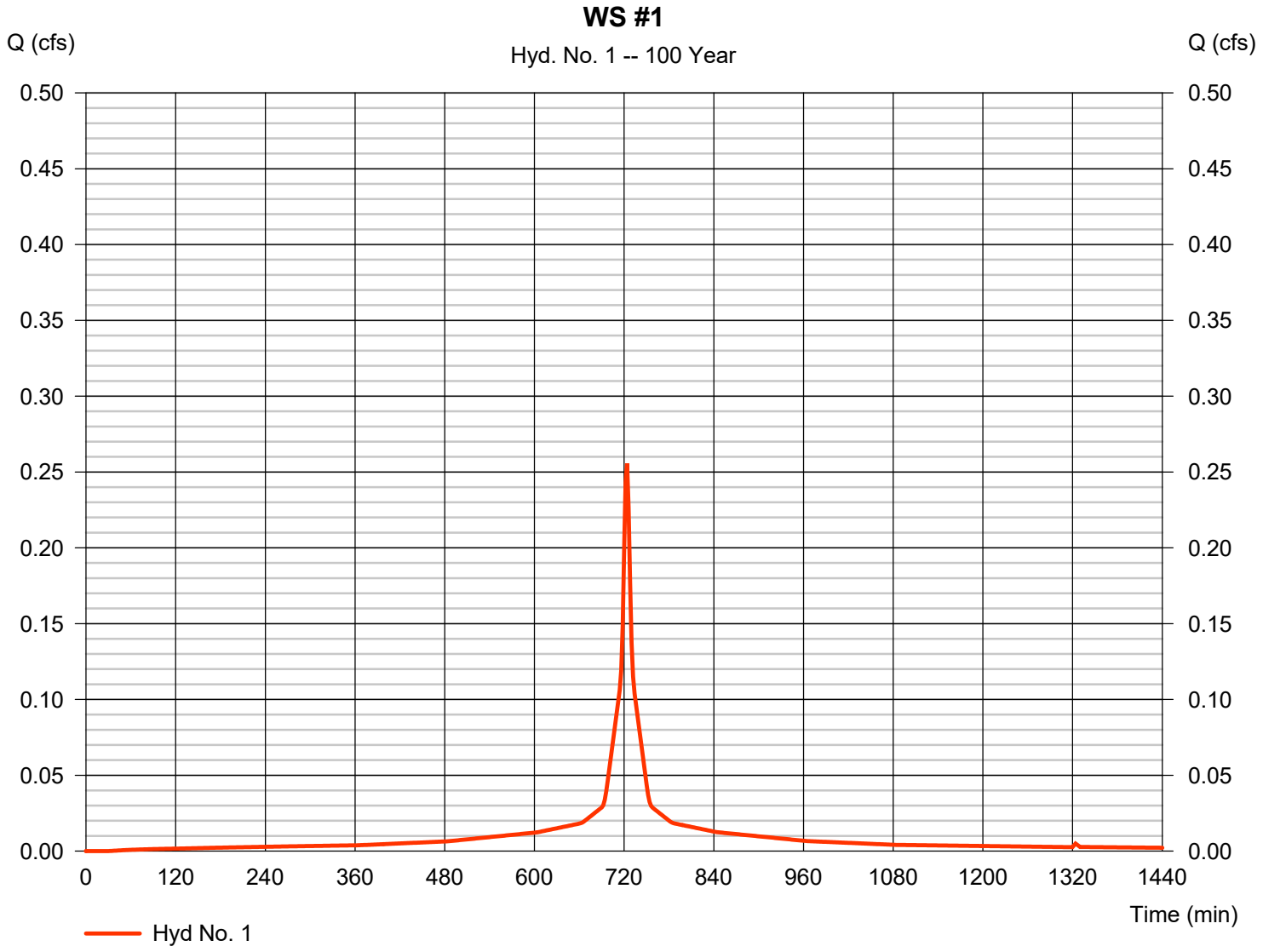
Hydrograph Report

Hyd. No. 1

WS #1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.256 cfs
Storm frequency	=	100 yrs	Time to peak	=	724 min
Time interval	=	2 min	Hyd. volume	=	894 cuft
Drainage area	=	0.030 ac	Curve number	=	98*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	9.00 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.028 x 98)] / 0.030



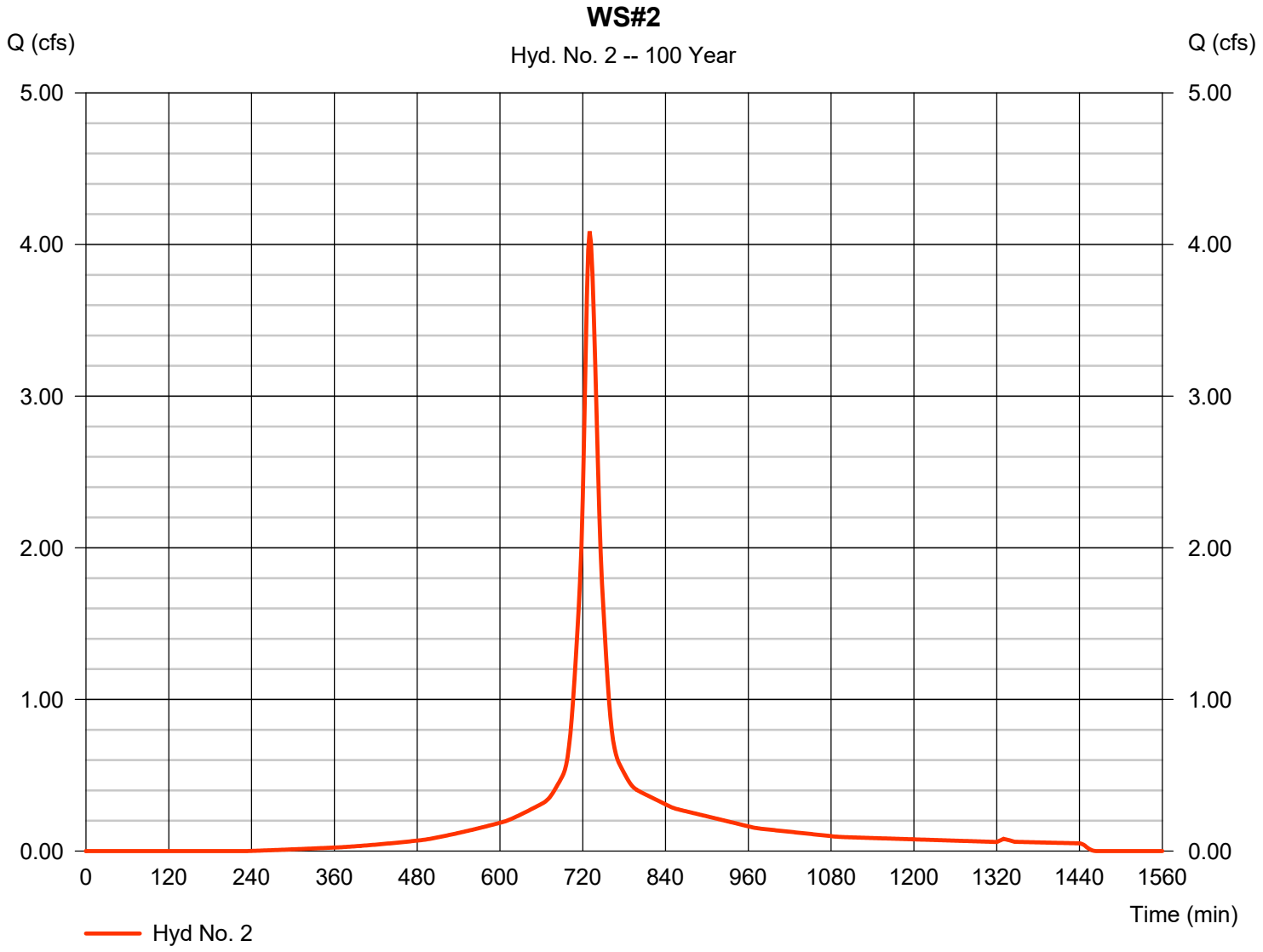
Hydrograph Report

Hyd. No. 2

WS#2

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.087 cfs
Storm frequency	=	100 yrs	Time to peak	=	730 min
Time interval	=	2 min	Hyd. volume	=	17,284 cuft
Drainage area	=	0.680 ac	Curve number	=	85*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	15.40 min
Total precip.	=	9.00 in	Distribution	=	Type III
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.050 x 80) + (0.382 x 77) + (0.247 x 98)] / 0.680



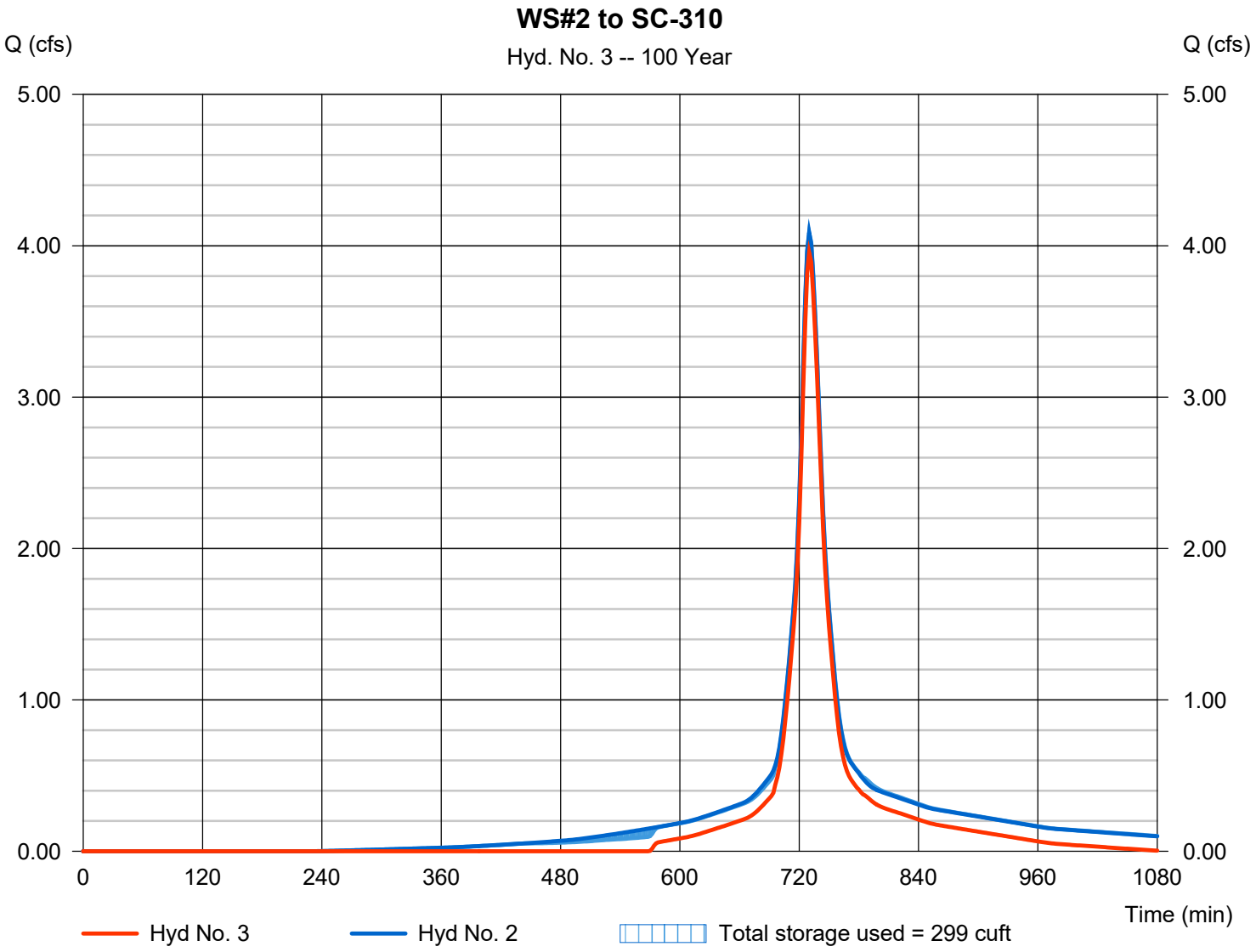
Hydrograph Report

Hyd. No. 3

WS#2 to SC-310

Hydrograph type	= Reservoir	Peak discharge	= 3.954 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 11,516 cuft
Inflow hyd. No.	= 2 - WS#2	Max. Elevation	= 283.82 ft
Reservoir name	= SC-310 Chambers	Max. Storage	= 299 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

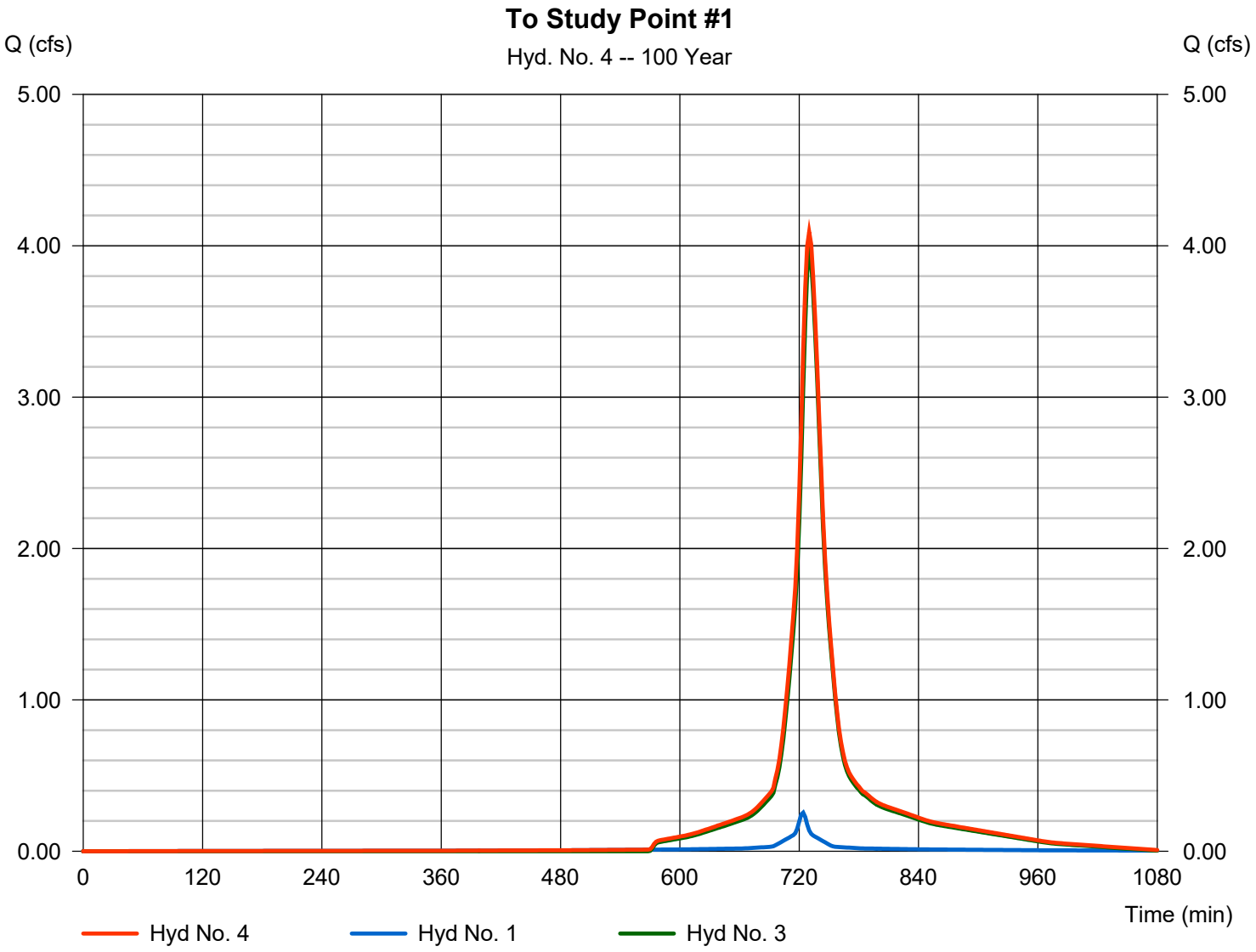


Hydrograph Report

Hyd. No. 4

To Study Point #1

Hydrograph type	= Combine	Peak discharge	= 4.091 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 12,410 cuft
Inflow hyds.	= 1, 3	Contrib. drain. area	= 0.030 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

X:\MKIV (Village of Mount Kisco)\MKIV1803 (Independent Fire Station)\01-Reports\SWPPP\Hydraflow\MKIV precip.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.80	3.25	0.00	3.30	5.10	5.77	6.80	9.00
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	2.75	0.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	2.80	0.00	5.25	6.00	0.00

Appendix G

WQv and RRv Calculations
Coliform Calculations
Design Storm Figures per NYS Design Manual

Mutual Fire Station

MKIV1802

WQv and RRv_{min}

H2M architects + engineers
2 Executive Boulevard, Ste 401
Suffern, NY 10901

WQv (New Development Area):		
P - 90% Rainfall Event Number	2.80	in
I - Percent Impervious Cover	100	%
Rv- Runoff Coefficient	0.95	
A - Contributing Area	0.04	acres
WQv	**0.009**	**ac-ft**
WQv	**386**	**ft^3**
RRv_{min} :		
S - HSG Reduction Factor	0.20	(HSG D)
Aic - Area of New Impervious Cover	0.04	acres
Rv- Runoff Coefficient (I = 100%)	0.95	
RRv_{min}	**0.002**	**ac-ft**
RRv_{min}	**77**	**ft^3**

Equations Used:

$$RRv_{min} = \frac{P_{1yr} * \bar{R}_v * Aic * S}{12}$$

$$WQv = \frac{P * R_v * A}{12}$$

Annual Pollutant Loading Calculations for Fecal Coliform
MKIV1802 Mutual Fire Station

architects + engineers
2 Executive Boulevard, Ste 401
Suffern, NY 10901

Existing Conditions WS#1

Land Use/ Ground Cover	Area (ac)	Area (ha)	Rate FC (#/ha/year)	Annual Loads (#/ha/year)
Pavement/ Impervious	0.235	0.0951	1.80E+08	1.71E+07
Grass/Pervious	0.472	0.1910	1.60E+10	3.06E+09
			TOTAL EXISTING	**3.07E+09**

Proposed Conditions WS#1 (Untreated)

Land Use/ Ground Cover	Area (ac)	Area (ha)	Rate FC (#/ha/year)	Annual Loads (#/ha/year)
Pavement/ Impervious	0.028	0.0113	1.80E+08	2.04E+06
Grass/Pervious	0.000	0.0000	1.60E+10	0.00E+00
			Total	**2.04E+06**

Proposed Conditions WS#1B (Treated By Infiltration Chambers)

Land Use/ Ground Cover	Area (ac)	Area (ha)	Rate FC (#/ha/year)	Annual Loads (#/ha/year)
Pavement/ Impervious	0.247	0.1000	1.80E+08	1.80E+07
Grass/Pervious	0.460	0.1862	1.60E+10	2.98E+09
			Sub-Total	**3.00E+09**
			Treatment from Infiltration Practices Per NYS Design Manual*:	70%
			Sub-Total After Treatment	**2.10E+09**
			TOTAL PROPOSED	**2.10E+09**
			Overall Reduction (%)	**31.68**

**Per Table 7.4 of NYS Design Manual: capable of >70% removal. Per Stormtech SC-310 Isolator row manual: capable of 80% removal. 70% used for more conservative estimate.*

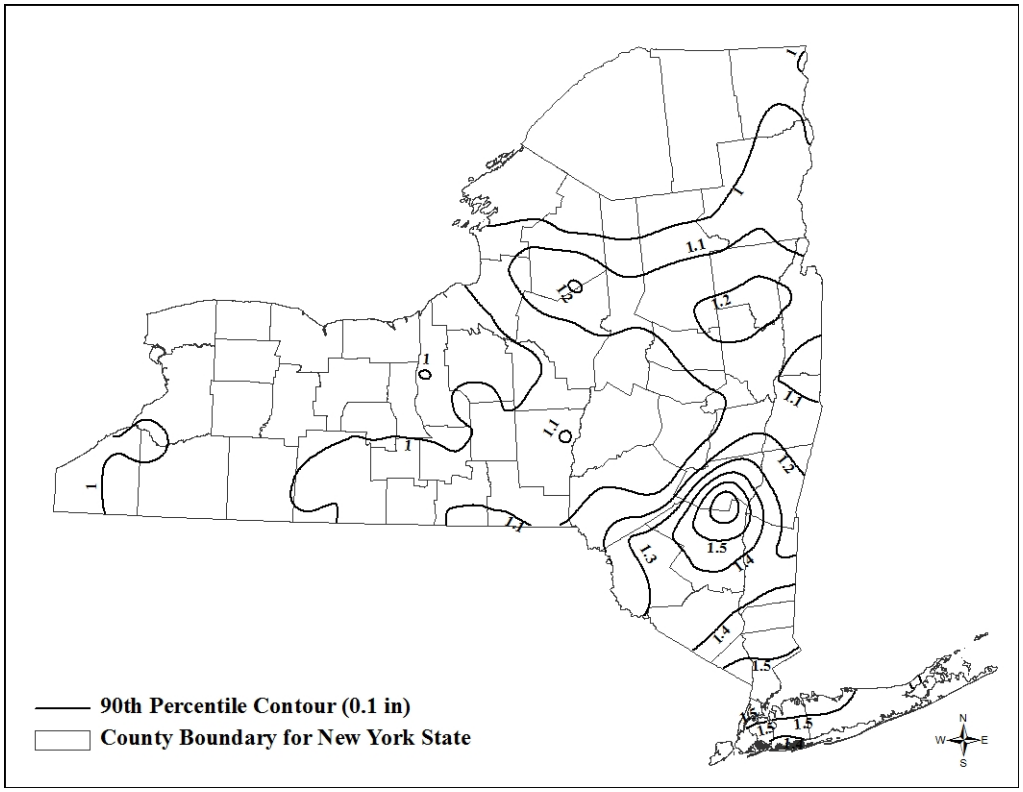
MKIV1801

Drainage Calculations for Proposed Drainage Improvements

architects + engineers
2 Executive Boulevard, Ste 401
Suffern, NY 10901

Identification		Invert		Run	Slope	Dia.	A	R						
Down	**Up**	**Down**	**Up**	**LF**	**FT/LF**	**IN**	**SF**	**FT**	**Mat'l**	**n**	**C_1**	**$S^{1/2}$**	**Q_{FULL}**	**V_{FULL}**
DMH#2	DMH#1	282.85	284.46	46	0.035	15	1.227	0.313	HDPE	0.010	83.61	0.1871	15.64	12.75
DMH#3	DMH#2	282.35	282.60	54	0.005	18	1.766	0.375	HDPE	0.010	136.04	0.0680	9.26	5.24
EXIST . DI#1	DMH#4	280.71	281.40	25	0.028	12	0.785	0.250	HDPE	0.010	46.08	0.1661	7.66	9.75

Figure 4.1: 90th Percentile Rainfall in New York State (NYSDEC, 2013)

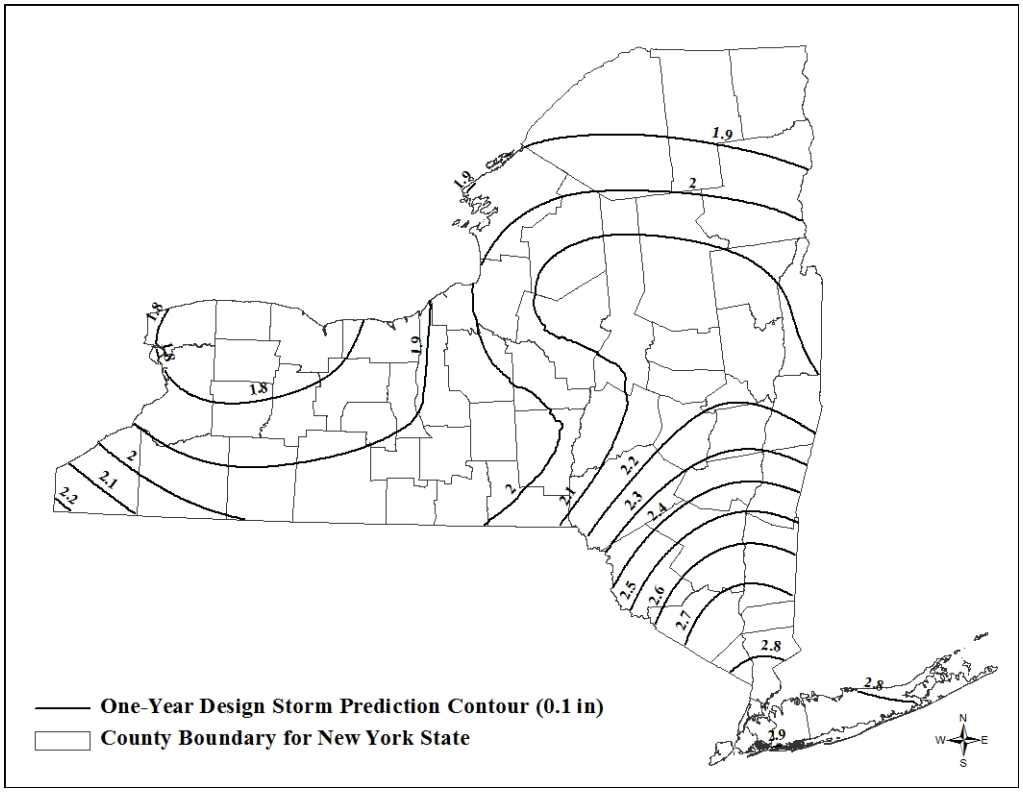


Basis of Design for Water Quality

As a basis for design, the following assumptions may be made:

Measuring Impervious Cover: the measured area of a site plan that does not have permanent vegetative or permeable cover shall be considered total impervious cover. Impervious cover is defined as all impermeable surfaces and includes: paved and gravel road surfaces, paved and gravel parking lots, paved driveways, building structures, paved sidewalks, and miscellaneous impermeable structures such as patios, pools, and sheds. Where site size makes direct measurement of impervious cover impractical, the land use/impervious cover relationships presented in Table 4.2 can be used to initially estimate impervious cover. In site specific planning impervious cover must be calculated based the specific proposed impervious cover.

Figure 4.2: One-Year Design Storm in New York State (NYSDEC, 2013)



Section 4.5 Overbank Flood Control Criteria (Q_p)

The primary purpose of the overbank flood control sizing criterion is to prevent an increase in the frequency and magnitude of out-of-bank flooding generated by urban development (i.e., flow events that exceed the bankfull capacity of the channel, and therefore must spill over into the floodplain).

Overbank control requires storage to attenuate the post development 10-year, 24-hour peak discharge rate (Q_p) to predevelopment rates.

The overbank flood control requirement (Q_p) does not apply in certain conditions, including:

- The site discharges directly tidal waters or fifth order (fifth downstream) or larger streams. Refer to Section 4.3 for instructions.
- A downstream analysis reveals that overbank control is not needed (see section 4.10).

Basis for Design of Overbank Flood Control

When addressing the overbank flooding design criteria, the following represent the minimum basis for design:

- TR-55 and TR-20 (or approved equivalent) will be used to determine peak discharge rates.

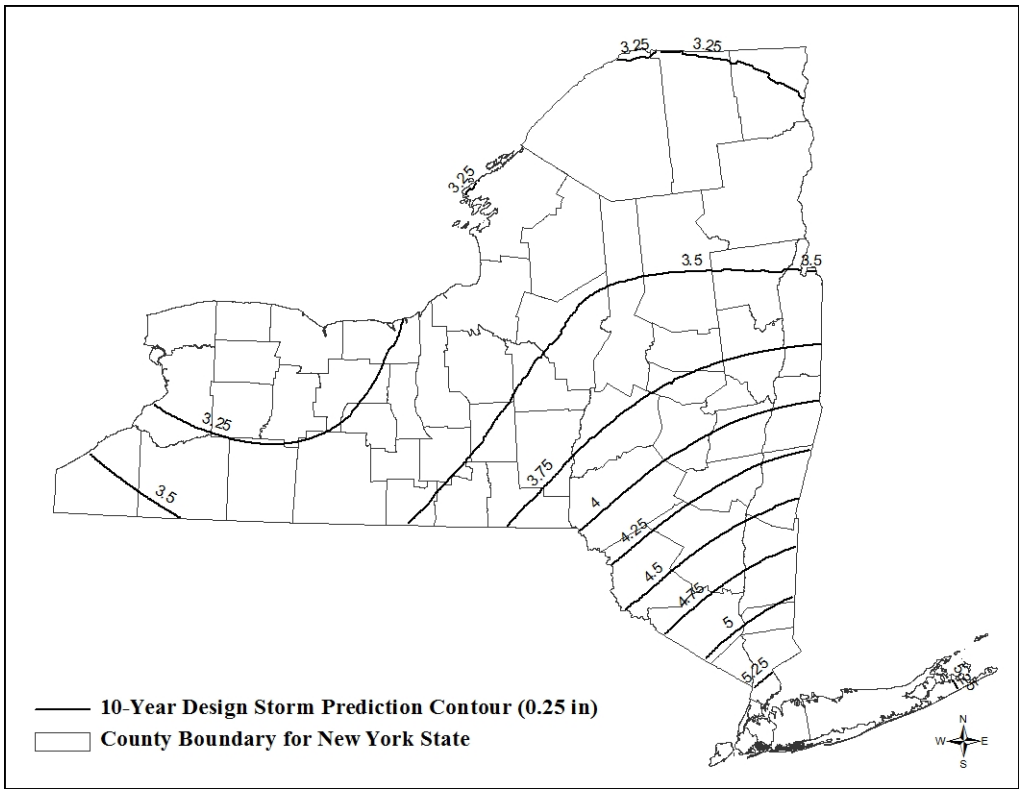
- When the predevelopment land use is agriculture, the curve number for the pre-developed condition shall be “taken as meadow”.

- Off-site areas should be modeled as "present condition" for the 10-year storm event.

- Figure 4.3 indicates the depth of rainfall (24 hour) associated with the 10-year storm event throughout the State of New York.

- The length of overland flow used in t_c calculations is limited to no more than 150 feet for predevelopment conditions and 100 feet for post development conditions. On areas of extremely flat terrain (<1% average slope), this maximum distance is extended to 250 feet for predevelopment conditions and 150 feet for post development conditions.

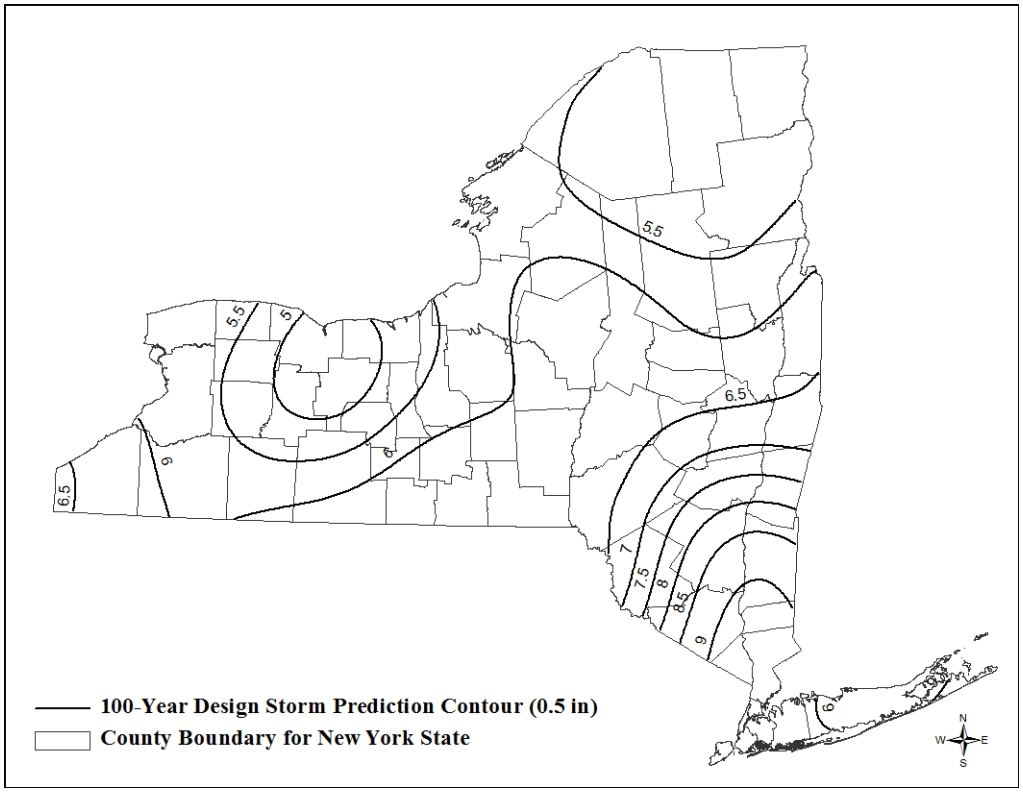
Figure 4.3: Ten-Year Design Storm in New York State (NYSDEC, 2013)



- When determining the storage required to reduce 100-year flood peaks, model off-site areas under current conditions.

- When determining storage required to safely pass the 100-year flood, model off-site areas under ultimate conditions.

Figure 4.4: One Hundred-Year Design Storm in New York State (NYSDEC, 2013)



Section 4.7 Alternative Method

New development causes changes to runoff volume, flow rates, timing of runoff and, most importantly, habitat destruction and degradation of the physical and chemical quality of the receiving waterbody. Traditionally, event based design storms are used for evaluation of hydrology and sizing of stormwater management practices. With an increasing need for assessment of the long term effects of development and maintenance of pre-development hydrology, the necessity of continuous simulation modeling as an effective tool for analysis and evaluation of flow-duration, downstream quality, quantity, biological, and hydro-habitat sustainability has been acknowledged.

Appendix H

StormTech Design and Maintenance Manuals

StormTech®
Detention • Retention • Water Quality
An ADS company

SC-310/SC-740/DC-780

StormTech Construction Guide

REQUIRED MATERIALS AND EQUIPMENT LIST

- Acceptable fill materials per Table 1
- Woven and non-woven geotextiles
- StormTech solid end caps and pre-cored end caps
- StormTech chambers
- StormTech manifolds and fittings

IMPORTANT NOTES:

A. This installation guide provides the minimum requirements for proper installation of chambers. Non-adherence to this guide may result in damage to chambers during installation. Replacement of damaged chambers during or after backfilling is costly and very time consuming. It is recommended that all installers are familiar with this guide, and that the contractor inspects the chambers for distortion, damage and joint integrity as work progresses.

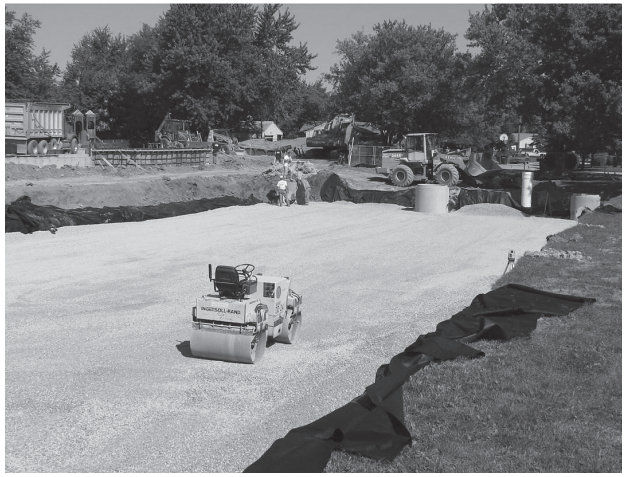
B. Use of a dozer to push embedment stone between the rows of chambers may cause damage to chambers and is not an acceptable backfill method. Any chambers damaged by using the "dump and push" method are not covered under the StormTech standard warranty.

C. Care should be taken in the handling of chambers and end caps. Avoid dropping, prying or excessive force on chambers during removal from pallet and initial placement.

Requirements for System Installation

Excavate bed and prepare subgrade per engineer's plans.

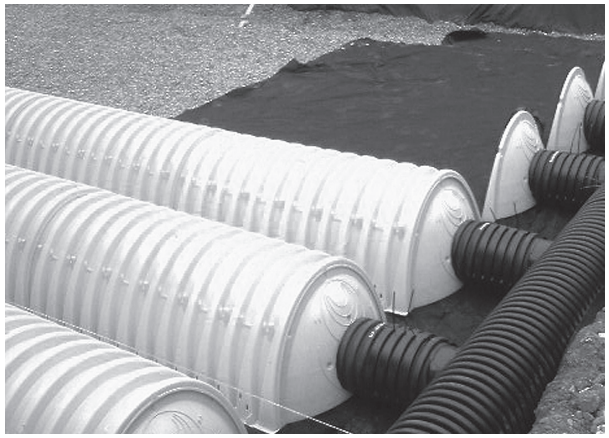
Place non-woven geotextile over prepared soils and up excavation walls. Install underdrains if required.



Place clean, crushed, angular stone foundation 6" (150 mm) min. Compact to achieve a flat surface.

Manifold, Scour Fabric and Chamber Assembly

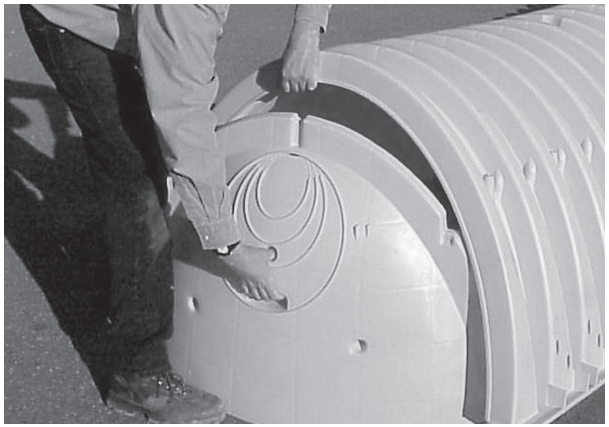
Install manifolds and lay out woven scour geo textile at inlet rows [min. 12.5 ft (3.8 m)] at each inlet end cap. Place a continuous piece (no seams, double layer) along entire length of Isolator® Row(s).



Align the first chamber and end cap of each row with inlet pipes. Contractor may choose to postpone stone placement around end chambers and leave ends of rows open for easy inspection of chambers during the backfill process.

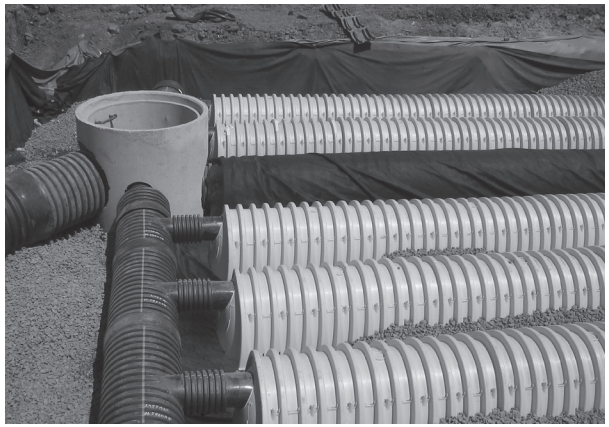
Continue installing chambers by overlapping chamber end corrugations. Chamber joints are labeled “Lower Joint – Overlap Here” and “Build this direction – Upper Joint” Be sure that the chamber placement does not exceed the reach of the construction equipment used to place the stone. Maintain minimum 6” (150 mm) spacing between rows

Attaching the End Caps



Lift the end of the chamber a few inches off the ground. With the curved face of the end cap facing outward, place the end cap into the chamber’s end corrugation.

Prefabricated End Caps



24” (600 mm) inlets are the maximum size that can fit into a SC-740/DC-780 end cap and must be prefabricated with a 24” (600 mm) pipe stub. SC-310 chambers with a 12” (300 mm) inlet pipe must use a prefabricated end cap with a 12” (300 mm) pipe stub.

Isolator Row

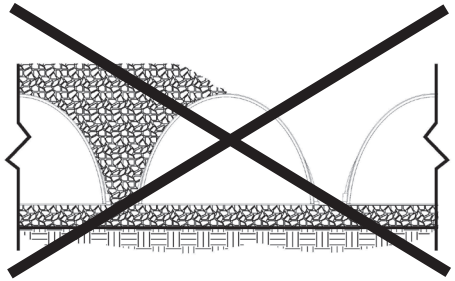
Place two continuous layers of ADS Woven fabric between the foundation stone and the isolator row chambers, making sure the fabric lays flat and extends the entire width of the chamber feet. Drape a strip of ADS non-woven geotextile over the row of chambers (not required over DC-780). This is the same type of non-woven geotextile used as a separation layer around the angular stone of the StormTech system.

Initial Anchoring of Chambers – Embedment Stone

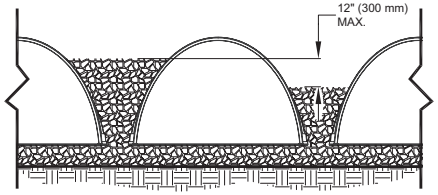
Initial embedment shall be spotted along the centerline of the chamber evenly anchoring the lower portion of the chamber. This is best accomplished with a stone conveyor or excavator reaching along the row.

No equipment shall be operated on the bed at this stage of the installation. Excavators must be located off the bed. Dump trucks shall not dump stone directly on to the bed. Dozers or loaders are not allowed on the bed at this time.

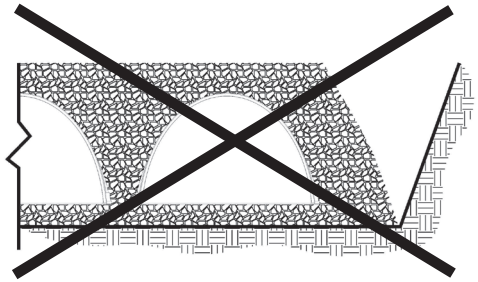
Backfill of Chambers – Embedment Stone



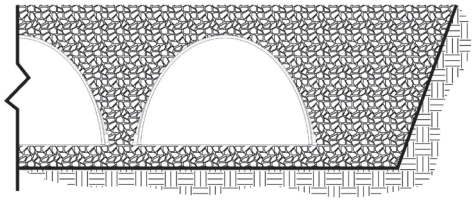
UNEVEN BACKFILL



EVEN BACKFILL



PERIMETER NOT BACKFILLED



PERIMETER FULLY BACKFILLED

Backfill chambers evenly. Stone column height should never differ by more than 12” (300 mm) between adjacent chamber rows or between chamber rows and perimeter.

Perimeter stone must be brought up evenly with chamber rows. Perimeter must be fully backfilled, with stone extended horizontally to the excavation wall.

Backfill - Embedment Stone & Cover Stone

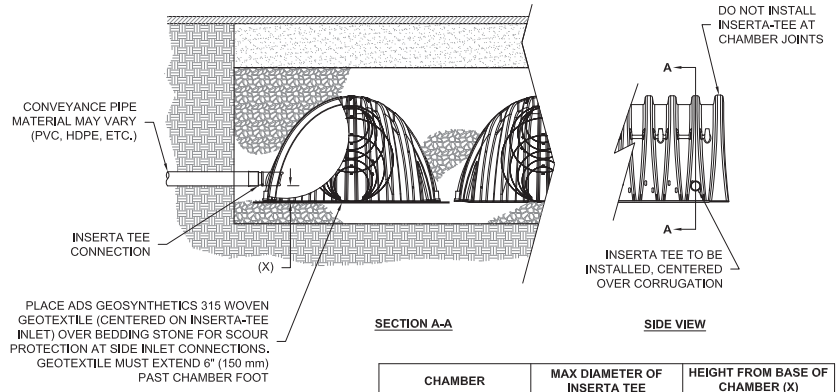
Continue evenly backfilling between rows and around perimeter until embedment stone reaches tops of chambers. Perimeter stone must extend horizontally to the excavation wall for both straight or sloped sidewalls. **Only after chambers have been backfilled to top of chamber and with a minimum 6" (150 mm) of cover stone on top of chambers can small dozers be used over the chambers for backfilling remaining cover stone.**

Small dozers and skid loaders may be used to finish grading stone backfill in accordance with ground pressure limits in Table 2. They must push material parallel to rows only. Never push perpendicular to rows. StormTech recommends that the contractor inspect chambers before placing final backfill. Any chambers damaged by construction shall be removed and replaced.

Final Backfill of Chambers – Fill Material

Install non-woven geotextile over stone. Geotextile must overlap 24" (600 mm) min. where edges meet. Compact each lift of backfill as specified in the site design engineer's drawings. Roller travel parallel with rows.

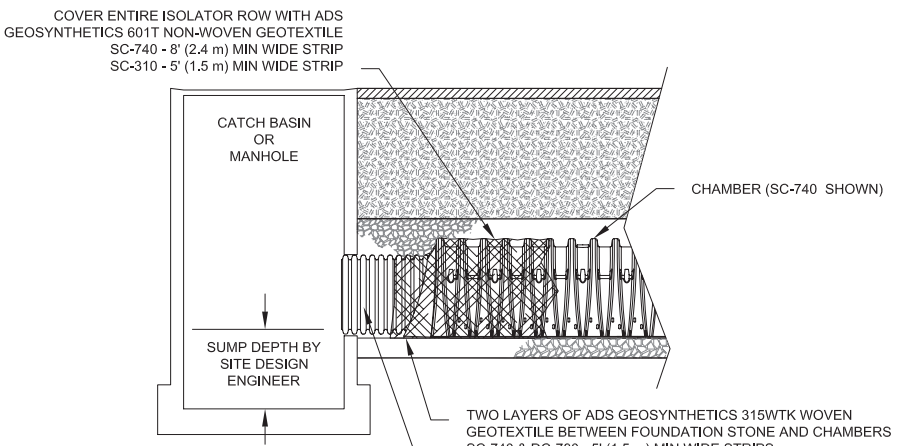
Inserta Tee Detail



CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
MC-3500	12" (300 mm)	6" (150 mm)
MC-4500	12" (300 mm)	8" (200 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.

StormTech Isolator Row Detail



NOTE: NON-WOVEN GEOTEXTILE OVER DC-780 ISOLATOR ROW CHAMBERS IS NOT REQUIRED.

Table 1- Acceptable Fill Materials

Material Location	Description	AASHTO M43 Designation[1]	Compaction/Density Requirement
(D) **Final Fill:** Fill Material for layer 'D' starts from the top of the 'C' layer to the bottom of flexible pavement or unpaved finished grade above. Note that the pavement subbase may be part of the 'D' layer.	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	N/A	Prepare per site design engineer's plans. Paved installations may have stringent material and preparation requirements.
(C) **Initial Fill:** Fill Material for layer 'C' starts from the top of the embedment stone ('B' layer) to 18" (450 mm) above the top of the chamber. Note that pavement subbase may be part of the 'C' layer.	Granular well-graded soil/ aggregate mixtures, <35% fines or processed aggregate. Most pavement subbase materials can be used in lieu of this layer.	AASHTO M45 A-1, A-2-4, A-3 or AASHTO M431 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	Begin compaction after min. 12" (300 mm) of material over the chambers is reached. Compact additional layers in 6" (150 mm) max. lifts to a min. 95% Proctor density for well-graded material and 95% relative density for processed aggregate materials. Roller gross vehicle weight not to exceed 12,000 lbs (53 kN). Dynamic force not to exceed 20,000 lbs (89 kN)
(B) **Embedment Stone:** Embedment Stone surrounding chambers from the foundation stone to the 'C' layer above.	Clean, crushed, angular stone	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	No compaction required.
(A) **Foundation Stone:** Foundation Stone below the chambers from the subgrade up to the foot (bottom) of the chamber.	Clean, crushed, angular stone,	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	Place and compact in 6" (150 mm) lifts using two full coverages with a vibratory compactor.[2, 3]

PLEASE NOTE:

1. ***The listed AASHTO designations are for gradations only. The stone must also be clean, crushed, angular. For example, a specification for #4 stone would state: "clean, crushed, angular no. 4 (AASHTO M43) stone".***
2. ***StormTech compaction requirements are met for 'A' location materials when placed and compacted in 6" (150 mm) (max) lifts using two full coverages with a vibratory compactor.***
3. ***Where infiltration surfaces may be comprised by compaction, for standard installations and standard design load conditions, a flat surface may be achieved by raking or dragging without compaction equipment. For special load designs, contact StormTech for compaction requirements.***

Figure 1- Inspection Port Detail

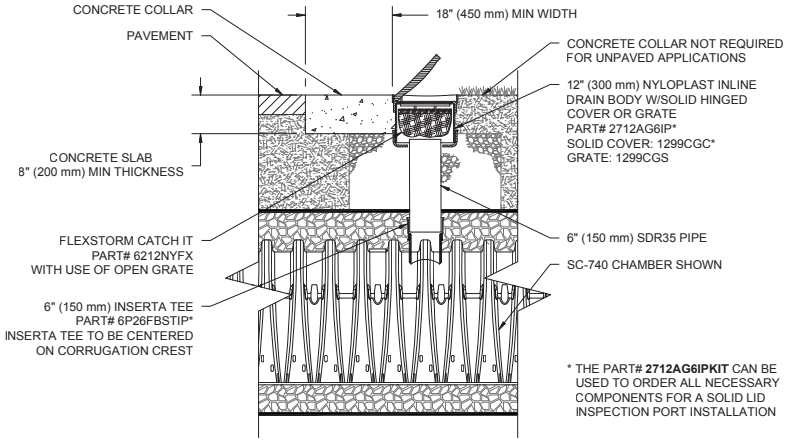
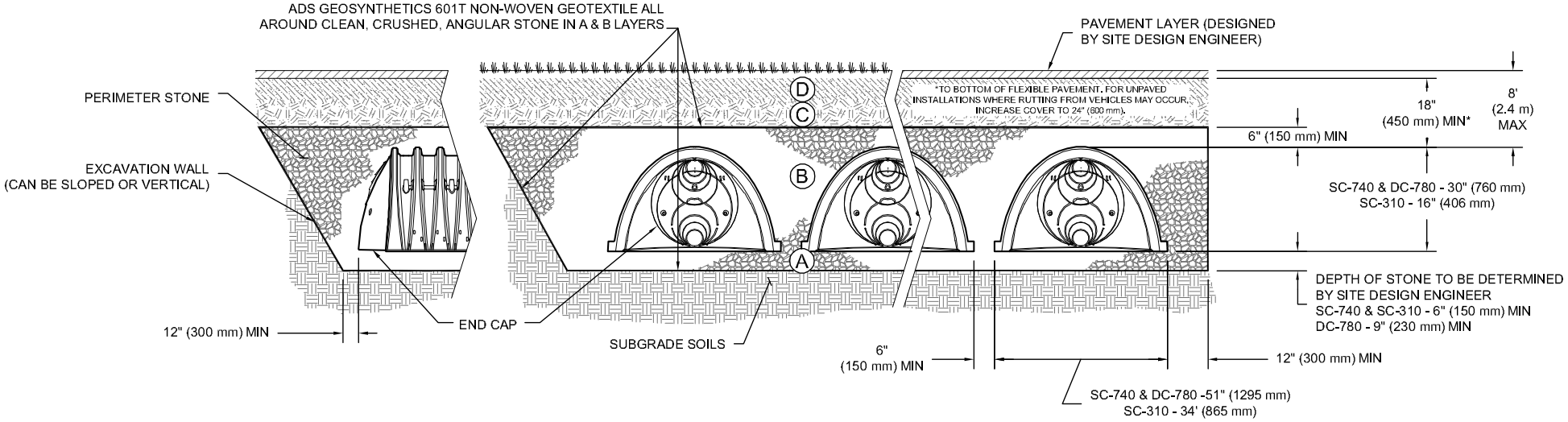


Figure 2 - Fill Material Locations



NOTES:

1. ***36" (900 mm) of stabilized cover materials over the chambers is required for full dump truck travel and dumping.***
2. ***During paving operations, dump truck axle loads on 18" (450 mm) of cover may be necessary. Precautions should be taken to avoid rutting of the road base layer, to ensure that compaction requirements have been met, and that a minimum of 18" (450 mm) of cover exists over the chambers. Contact StormTech for additional guidance on allowable axle loads during paving.***
3. ***Ground pressure for track dozers is the vehicle operating weight divided by total ground contact area for both tracks. Excavators will exert higher ground pressures based on loaded bucket weight and boom extension.***
4. ***Mini-excavators (< 8,000lbs/3,628 kg) can be used with at least 12" (300 mm) of stone over the chambers and are limited by the maximum ground pressures in Table 2 based on a full bucket at maximum boom extension.***
5. ***Storage of materials such as construction materials, equipment, spoils, etc. should not be located over the StormTech system. The use of equipment over the StormTech system not covered in Table 2 (ex. soil mixing equipment, cranes, etc) is limited. Please contact StormTech for more information.***
6. ***Allowable track loads based on vehicle travel only. Excavators shall not operate on chamber beds until the total backfill reaches 3 feet (900 mm) over the entire bed.***

Table 2 - Maximum Allowable Construction Vehicle Loads[5]

Material Location	Fill Depth over Chambers in. [mm]	Maximum Allowable Wheel Loads		Maximum Allowable Track Loads[6]		Maximum Allowable Roller Loads
		Max Axle Load for Trucks lbs [kN]	Max Wheel Load for Loaders lbs [kN]	Track Width in. [mm]	Max Ground Pressure psf [kPa]	Max Drum Weight or Dynamic Force lbs [kN]
Ⓓ **Final Fill Material**	36" [900] Compacted	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	3420 [164] 2350 [113] 1850 [89] 1510 [72] 1310 [63]	38,000 [169]
Ⓒ **Initial Fill Material**	24" [600] Compacted	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2480 [119] 1770 [85] 1430 [68] 1210 [58] 1070 [51]	20,000 [89]
	24" [600] Loose/Dumped	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2245 [107] 1625 [78] 1325 [63] 1135 [54] 1010 [48]	20,000 [89] Roller gross vehicle weight not to exceed 12,000 lbs. [53 kN]
	18" [450]	32,000 [142]	16,000 [71]	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	2010 [96] 1480 [71] 1220 [58] 1060 [51] 950 [45]	20,000 [89] Roller gross vehicle weight not to exceed 12,000 lbs. [53 kN]
Ⓑ **Embedment Stone**	12" [300]	16,000 [71]	NOT ALLOWED	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	1540 [74] 1190 [57] 1010 [48] 910 [43] 840 [40]	20,000 [89] Roller gross vehicle weight not to exceed 12,000 lbs. [53 kN]
	6" [150]	8,000 [35]	NOT ALLOWED	12" [305] 18" [457] 24" [610] 30" [762] 36" [914]	1070 [51] 900 [43] 800 [38] 760 [36] 720 [34]	NOT ALLOWED

Table 3 - Placement Methods and Descriptions

Material Location	Placement Methods/ Restrictions	Wheel Load Restrictions	Track Load Restrictions	Roller Load Restrictions
		See Table 2 for Maximum Construction Loads		
Ⓓ **Final Fill Material**	A variety of placement methods may be used. All construction loads must not exceed the maximum limits in Table 2.	36" (900 mm) minimum cover required for dump trucks to dump over chambers.	Dozers to push parallel to rows until 36" (900mm) compaced cover is reached.[4]	Roller travel parallel to rows only until 36" (900 mm) compacted cover is reached.
Ⓒ **Initial Fill Material**	Excavator positioned off bed recommended. Small excavator allowed over chambers. Small dozer allowed.	Asphalt can be dumped into paver when compacted pavement subbase reaches 18" (450 mm) above top of chambers.	Small LGP track dozers & skid loaders allowed to grade cover stone with at least 6" (150 mm) stone under tracks at all times. Equipment must push parallel to rows at all times.	Use dynamic force of roller only after compacted fill depth reaches 12" (300 mm) over chambers. Roller travel parallel to chamber rows only.
Ⓑ **Embedment Stone**	No equipment allowed on bare chambers. Use excavator or stone conveyor positioned off bed or on foundation stone to evenly fill around all chambers to at least the top of chambers.	No wheel loads allowed. Material must be placed outside the limits of the chamber bed.	No tracked equipment is allowed on chambers until a min. 6" (150 mm) cover stone is in place.	No rollers allowed.
Ⓐ **Foundation Stone**	No StormTech restrictions. Contractor responsible for any conditions or requirements by others relative to subgrade bearing capacity, dewatering or protection of subgrade.			

SC-310 / SC-740 / DC-780

StormTech®

Detention • Retention • Water Quality

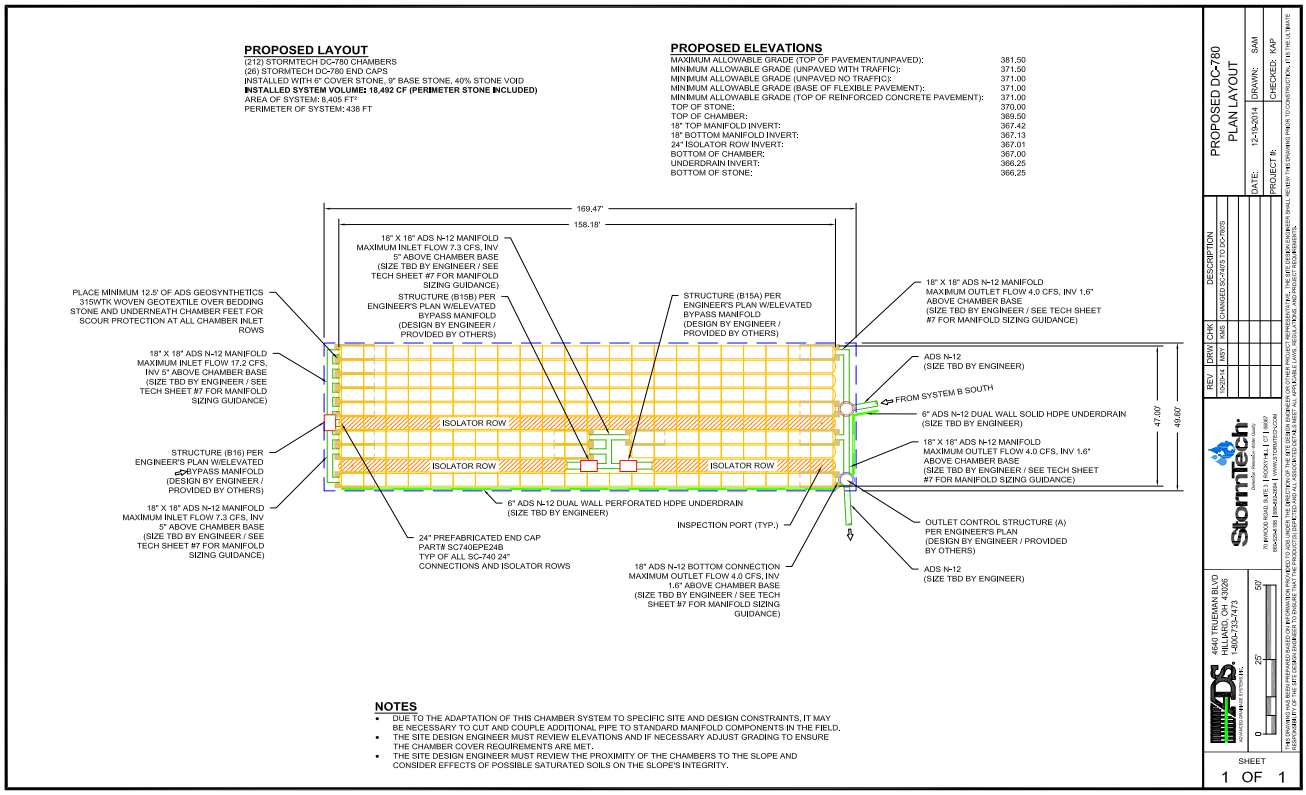
Design Manual

StormTech® Chamber Systems
for Stormwater Management

Table of Contents

* For MC-3500 and MC-4500 designs, please refer to the MC-3500/MC-4500 Design Manual

The StormTech Technical Services Department assists design professionals in specifying StormTech stormwater systems. This assistance includes the layout of chambers to meet the engineer's volume requirements and the connections to and from the chambers. The Technical Department can also assist converting and cost engineering projects currently specified with ponds, pipe, concrete and other manufactured stormwater detention/retention products. Please note that it is the responsibility of the design engineer to ensure that the chamber bed layout meets all design requirements and is in compliance with applicable laws and regulations governing this project.



This manual is exclusively intended to assist engineers in the design of subsurface stormwater systems using StormTech chambers.

1.1 INTRODUCTION

StormTech stormwater management systems allow stormwater professionals to create more profitable, environmentally sound developments. Compared with other subsurface systems, StormTech systems offer lower overall installed cost, superior design flexibility and enhanced performance. Applications include commercial, residential, agricultural and highway drainage.

StormTech has invested over $10 million and many years in the development of StormTech chambers. These innovative products exceed the rigorous requirements of the standards governing the design of thermoplastic structures.

1.2 THE GOLD STANDARD IN STORMWATER MANAGEMENT

The advanced designs of StormTech chambers were created by implementing an aggressive research, development, design and manufacturing protocol. StormTech chamber products establish the new gold standard in stormwater management through:

- Collaborations with experts in the field of buried plastic structures and polyolefin materials
- The development and utilization of new testing methods and proprietary test methods
- The use of thermoformed prototypes to verify engineering models, perform in-ground testing and install observation sites
- The investment in custom-designed, injection molding equipment
- The utilization of polypropylene and polyethylene as manufacturing materials
- The design of molded-in features not possible with traditional thermoformed chambers

Section 3.0 of this design manual, *Structural Capabilities*, provides a detailed description of the research, development and design process.

Many of StormTech's unique chamber features can benefit a site developer, stormwater system designer, and installer. Where applicable, StormTech Product Specifications are referenced throughout this design manual. If StormTech's unique product benefits are important to a stormwater system design, consider including the applicable StormTech Product Specifications on the site plans. This can prevent substitutions with inferior products. Refer to Section 14.0, *StormTech Product Specifications.*

1.3 PRODUCT QUALITY AND DESIGN TO INTERNATIONAL STANDARDS

StormTech chambers are designed to meet the full scope of design requirements of Section 12.12 of the AASHTO LRFD Bridge Design Specifications and produced to the requirements of the American Society of Testing Materials (ASTM) International specifications F2418 (polypropylene chambers) and F2922 (polyethylene chambers).

StormTech chambers provide the full AASHTO safety factors for live loads and permanent earth loads. The two ASTM standards mentioned previously are linked to the AASHTO LRFD Bridge Design Specifications Section 12.12 design standard. Both ASTM standards require that the safety factors included in the AASHTO guidance are achieved as a prerequisite to meeting either ASTM F2418 or ASTM F2922. StormTech chambers are also designed in accordance with ASTM F2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers" which provides specific guidance on how to design thermoplastic chambers in accordance with AASHTO Section 12.12. These standards provide both the assurance of product quality and safe structural design.

For non-proprietary specifications for public bids that ensure high product quality and safe design, consider including the specification in Section 15.0 Chamber Specifications for Contract Documents.

1.4 TECHNICAL SUPPORT FOR PLAN REVIEWS

StormTech's in-house technical support staff is available to review proposed plans that incorporate StormTech chamber systems. They are also available to assist with plan conversions from existing products to StormTech. Not all plan sheets are necessary for StormTech's review. Required sheets include plan view sheet(s) with design contours, cross sections of the stormwater system including catch basins and drainage details.

When specifying StormTech chambers it is recommended that the following items are included in project plans: StormTech chamber system General Notes, applicable StormTech chamber illustrations and StormTech chamber system Product Specifications. These items are available in various formats and can be obtained by contacting StormTech at **1-860-529-8188** or may be downloaded at **www.stormtech.com.**

StormTech's plan review is limited to the sole purpose of determining whether plans meet StormTech chamber systems' minimum requirements. **It is the ultimate responsibility of the design engineer to assure that the stormwater system's design is in full compliance with all applicable laws and regulations.** StormTech products must be designed and installed in accordance with StormTech's minimum requirements.

SEND PLANS TO:

StormTech, Plan Review, 70 Inwood Road, Suite 3, Rocky Hill, CT 06067 E-mail: info@stormtech.com. File size should not exceed 10 MB.

2.0 Product Information

2.1 PRODUCT APPLICATIONS

StormTech chamber systems may function as stormwater detention, retention, first-flush storage, or some combination of these. The StormTech chambers can be used for commercial, municipal, industrial, recreational, and residential applications especially for installations under parking lots and commercial roadways.

One of the key advantages of the StormTech chamber system is its design flexibility. Chambers may be configured into beds or trenches of various sizes or shapes. They can be centralized or decentralized, and fit on nearly all sites. Chamber lengths enhance the ability to develop on both existing and pre-developed projects. The systems can be designed easily and efficiently around utilities, natural or man-made structures and any other limiting boundaries.

2.2 CHAMBERS FOR STORMWATER DETENTION

Chamber systems have been used effectively for stormwater detention for over 15 years. A detention system temporarily holds water while it is released at a defined rate through an outlet. While some infiltration may occur in a detention system, it is often considered an environmental benefit and a storage safety factor. Over 70% of StormTech's installations are non-watertight detention systems. There are only a few uncommon situations where a detention system might need to limit infiltration: the subgrade soil's bearing capacity is significantly affected by saturation such as with expansive clays or karst soils, and; in sensitive aquifer areas where the depth to groundwater does not meet local guidelines. Adequate pretreatment could eliminate concerns for the latter case. A thermoplastic liner may be considered for both situations to limit infiltration.

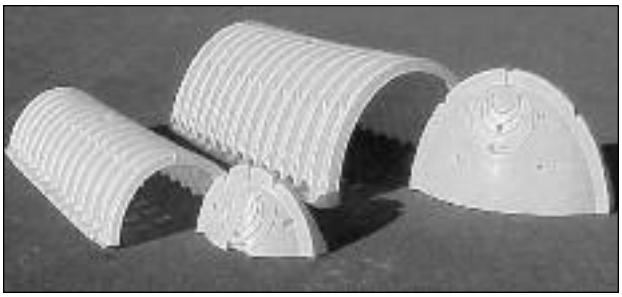
2.3 STONE POROSITY ASSUMPTION

A StormTech chamber system requires the application of clean, crushed, angular stone below, between and above the chambers. This stone serves as a structural component while allowing conveyance and storage of stormwater. Storage volume examples throughout this Design Manual are calculated with an assumption that the stone has an industry standard porosity of 40%. Actual stone porosity may vary. Contact StormTech for information on calculating stormwater volumes with varying stone porosity assumptions.

2.4 CHAMBER SELECTION

Primary considerations when selecting between the SC-310™, SC-740™ and DC-780™ chambers are the depth to restrictive layer, available area for subsurface storage, cover height and outfall restrictions.

The StormTech SC-310 chamber shown on page 4 is ideal for systems requiring low-rise and wide-span solutions. This low profile chamber allows the storage of large volumes, 1.3 ft^3/ft^2 (0.40 m^3/m^2) [minimum], at minimum depths.



The SC-310 and SC-740 chambers and end plates.

StormTech systems can be integrated into retrofit and new construction projects.

Like the Stormtech SC-310, the StormTech SC-310-3 found on page 6 allows for a design option for sites with both limited cover and limited space. With only 3" of spacing between the chambers, the SC-310-3 still provides 1.3 ft^3/ft^2 (0.40 m^3/m^2) [minimum] of storage.

The StormTech SC-740 chamber shown on page 8 optimizes storage volumes in relatively small footprints. By providing 2.2 ft^3/ft^2 (0.67 m^3/m^2) [minimum] of storage, the SC-740 chambers can minimize excavation, backfill and associated costs.

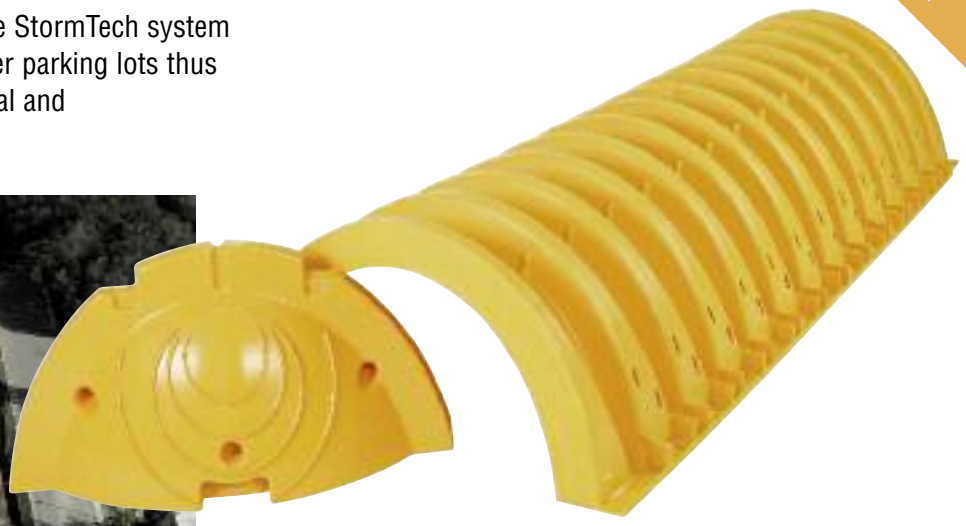
The DC-780 chamber shown on page 10 has been developed for those applications which exceed the maximum 8 ft (2.44 m) burial depth of the SC-740 and SC-310 chambers. The DC-780 is a modified version of the SC-740 allowing it to reach a maximum burial depth of 12 ft (3.66 m). The design of the DC-780 chamber, like other StormTech chambers, is designed and manufactured in accordance with the AASHTO LRFD Bridge Design Specifications as well as ASTM F 2418 and ASTM F 2787 ensuring structural adequacy for deeper systems.

The end corrugations of the DC-780 chamber have not been modified in order to allow connections to the SC-740 chamber. This will allow hybrid systems utilizing both chambers in one system design.

StormTech SC-310 Chamber

SC-310 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech SC-310 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	85.4" x 34.0" x 16.0" (2170 x 864 x 406 mm)
Chamber Storage	14.7 ft³ (0.42 m³)
Min. Installed Storage*	31.0 ft³ (0.88 m³)
Weight	37.0 lbs (16.8 kg)

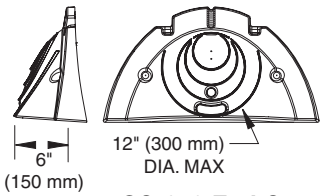
*Assumes 6" (150 mm) stone above, below and between chambers and 40% stone porosity.

Shipping

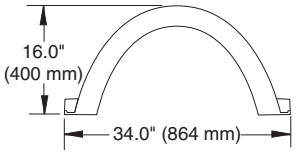
41 chambers/pallet

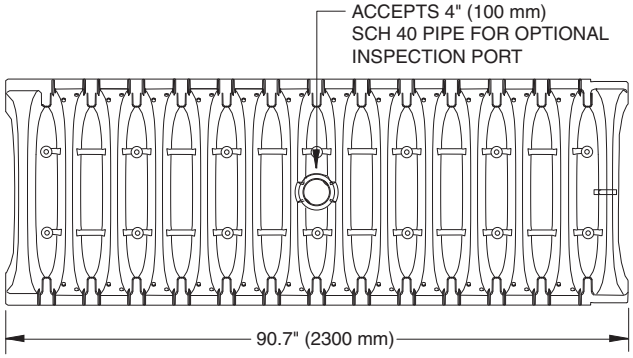
108 end caps/pallet

18 pallets/truck

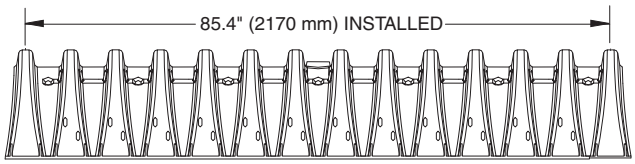


SC-310 End Cap





SC-310 Chamber



StormTech SC-310 Chamber

SC-310 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
28 (711)	14.70 (0.416)	31.00 (0.878)
27 (686)	14.70 (0.416)	30.21 (0.855)
26 (680)	Stone 14.70 (0.416)	29.42 (0.833)
25 (610)	Cover 14.70 (0.416)	28.63 (0.811)
24 (609)	14.70 (0.416)	27.84 (0.788)
23 (584)	14.70 (0.416)	27.05 (0.766)
22 (559)	14.70 (0.416)	26.26 (0.748)
21 (533)	14.64 (0.415)	25.43 (0.720)
20 (508)	14.49 (0.410)	24.54 (0.695)
19 (483)	14.22 (0.403)	23.58 (0.668)
18 (457)	13.68 (0.387)	22.47 (0.636)
17 (432)	12.99 (0.368)	21.25 (0.602)
16 (406)	12.17 (0.345)	19.97 (0.566)
15 (381)	11.25 (0.319)	18.62 (0.528)
14 (356)	10.23 (0.290)	17.22 (0.488)
13 (330)	9.15 (0.260)	15.78 (0.447)
12 (305)	7.99 (0.227)	14.29 (0.425)
11 (279)	6.78 (0.192)	12.77 (0.362)
10 (254)	5.51 (0.156)	11.22 (0.318)
9 (229)	4.19 (0.119)	9.64 (0.278)
8 (203)	2.83 (0.081)	8.03 (0.227)
7 (178)	1.43 (0.041)	6.40 (0.181)
6 (152)	0	4.74 (0.134)
5 (127)	0	3.95 (0.112)
4 (102)	0	3.16 (0.090)
3 (76)	Stone Foundation 0	2.37 (0.067)
2 (51)	0	1.58 (0.046)
1 (25)	0	0.79 (0.022)

Note: Add 0.79 cu. ft. (0.022 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (150)	12 (300)	18 (450)
StormTech SC-310	14.7 (0.4)	31.0 (0.9)	35.7 (1.0)	40.4 (1.1)

Note: Assumes 6" (150 mm) of stone above chambers, 6" (150 mm) row spacing and 40% stone porosity.

Amount of Stone Per Chamber

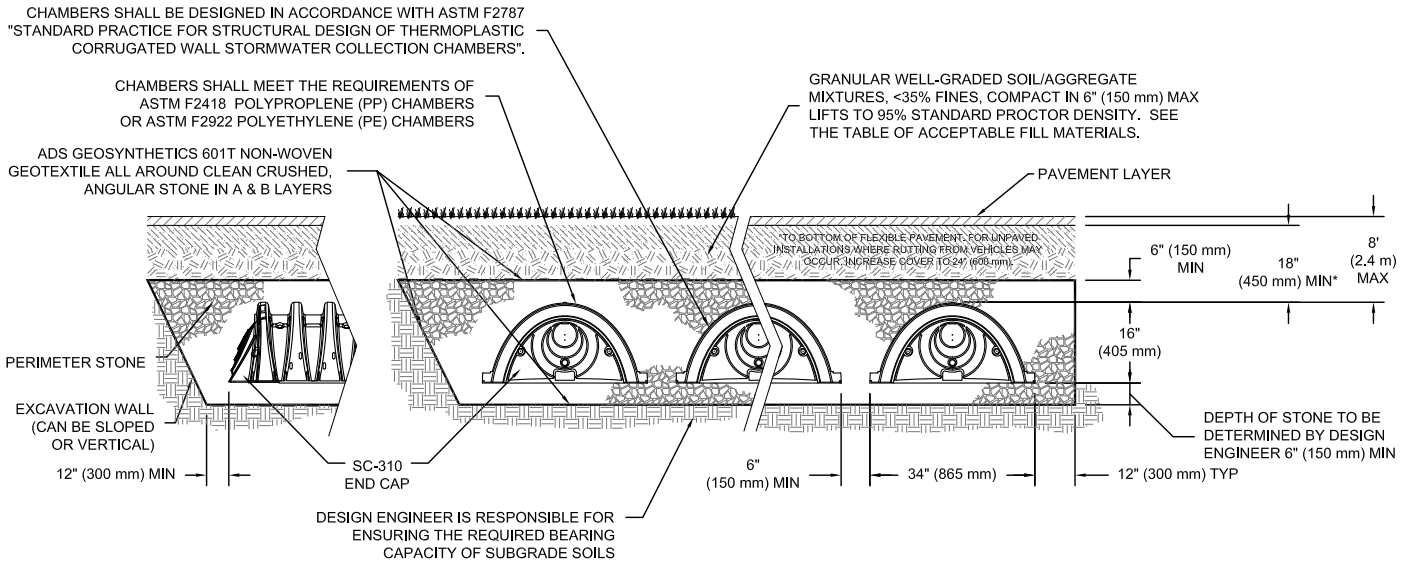
	Stone Foundation Depth		
ENGLISH TONS (yds³)	6"	12"	18"
StormTech SC-310	2.1 (1.5 yd³)	2.7 (1.9 yd³)	3.4 (2.4 yd³)
METRIC KILOGRAMS (m³)	**150 mm**	**300 mm**	**450 mm**
StormTech SC-310	1830 (1.1 m³)	2490 (1.5 m³)	2990 (1.8 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (150 mm)	12" (300 mm)	18" (450 mm)
StormTech SC-310	2.9 (2.2)	3.4 (2.6)	3.8 (2.9)

Note: Assumes 6" (150 mm) of row separation and 18" (450 mm) of cover. The volume of excavation will vary as the depth of the cover increases.



THE INSTALLED CHAMBER SYSTEM SHALL PROVIDE THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS SECTION 12.12 FOR EARTH AND LIVE LOADS, WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.

StormTech SC-310-3 Chamber

SC-310-3 Chamber

The proven strength and durability of the SC-310-3 Chamber allows for a design option for sites where limited cover, limited space, high water table and escalated aggregate cost are a factor. The SC-310-3 has a minimum cover requirement of 16" (400 mm) to bottom of pavement and reduces the spacing requirement between chambers by 50% to 3" (76 mm). This provides a reduced footprint overall and allows the designer to offer a traffic bearing application yet comply with water table separation regulations.

StormTech SC-310-3 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	85.4" x 34.0" x 16.0" (2170 x 864 x 406 mm)
Chamber Storage	14.7 ft³ (0.42 m³)
Min. Installed Storage*	29.3 ft³ (0.83 m³)
Weight	37.0 lbs (16.8 kg)

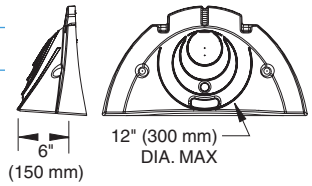
*Assumes 6" (150 mm) stone above and below chambers, 3" (76 mm) row spacing and 40% stone porosity.

Shipping

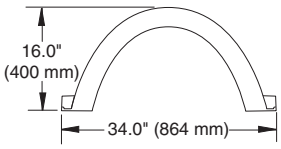
41 chambers/pallet

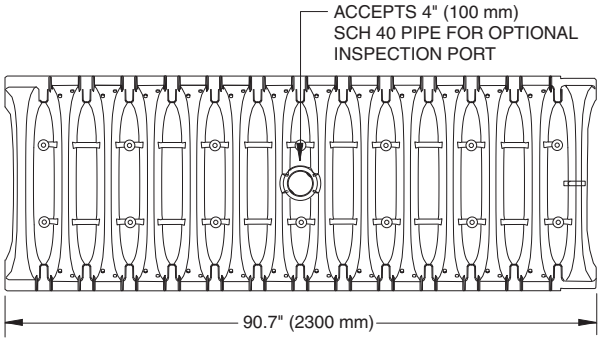
108 end caps/pallet

18 pallets/truck

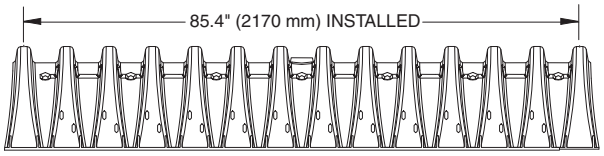


SC-310 End Cap

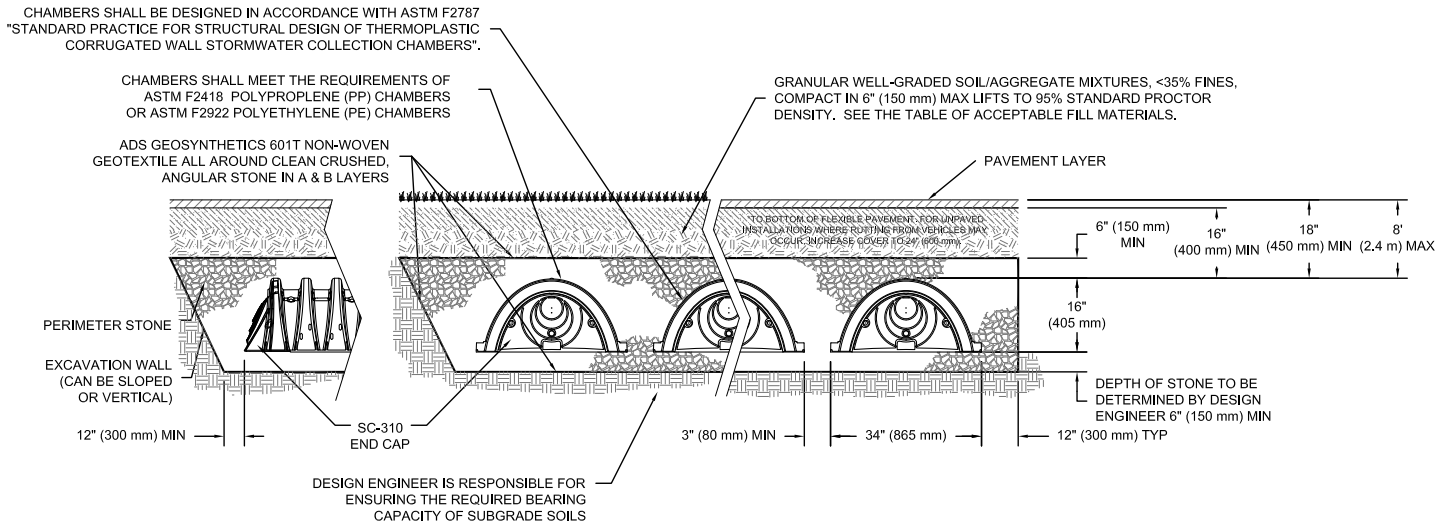




SC-310 Chamber



Typical Cross Section Detail



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StormTech SC-310-3 Chamber

SC-310-3 Cumulative Storage Volume Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
28 (711)	14.7 (0.416)	29.34 (0.831)
27 (686)	14.7 (0.416)	28.60 (0.810)
26 (660)	14.7 (0.416)	27.87 (0.789)
25 (635)	14.7 (0.416)	27.14 (0.769)
24 (610)	14.7 (0.416)	26.41 (0.748)
23 (584)	14.7 (0.416)	25.68 (0.727)
22 (559)	14.7 (0.416)	24.95 (0.707)
21 (533)	14.64 (0.415)	24.18 (0.685)
20 (508)	14.49 (0.410)	23.36 (0.661)
19 (483)	14.22 (0.403)	22.47 (0.636)
18 (457)	13.68 (0.387)	21.41 (0.606)
17 (432)	12.99 (0.368)	20.25 (0.573)
16 (406)	12.17 (0.345)	19.03 (0.539)
15 (381)	11.25 (0.319)	17.74 (0.502)
14 (356)	10.23 (0.290)	16.40 (0.464)
13 (330)	9.15 (0.260)	15.01 (0.425)
12 (305)	7.99 (0.226)	13.59 (0.385)
11 (279)	6.78 (0.192)	12.13 (0.343)
10 (254)	5.51 (0.156)	10.63 (0.301)
9 (229)	4.19 (0.119)	9.11 (0.258)
8 (203)	2.83 (0.080)	7.56 (0.214)
7 (178)	1.43 (0.040)	5.98 (0.169)
6 (152)	0	4.39 (0.124)
5 (127)	0	3.66 (0.104)
4 (102)	0	2.93 (0.083)
3 (76)	0	2.19 (0.062)
2 (51)	0	1.46 (0.041)
1 (25)	0	0.73 (0.021)

Stone Cover

Stone Foundation

Note: Add 0.73 ft³ (0.021 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Volume Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (150)	12 (300)	18 (450)
SC-310-3	14.7 (0.42)	29.3 (0.83)	33.7 (0.95)	38.1 (1.08)

Note: Assumes 6" (150 mm) of stone above chambers, 3" (76 mm) row spacing and 40% stone porosity.

Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (150)	12" (300)	18" (450)
SC-310-3	2.6 (2.0)	3.0 (2.3)	3.4 (2.6)

Note: Assumes 3" (76 mm) of row separation, 6" (150 mm) of stone above the chambers and 16" (400 mm) of cover. The volume of excavation will vary as depth of cover increases.

Amount of Stone Per Chamber

ENGLISH TONS (yd³)	Stone Foundation Depth		
	6"	12"	18"
SC-310-3	1.9 (1.4)	2.5 (1.8)	3.1 (2.2)
METRIC KILOGRAMS (m³)	**150 mm**	**300 mm**	**450 mm**
SC-310-3	1724 (1.0)	2268 (1.3)	2812 (1.7)

Note: Assumes 6" (150 mm) of stone above chambers and 3" (76 mm) row spacing.

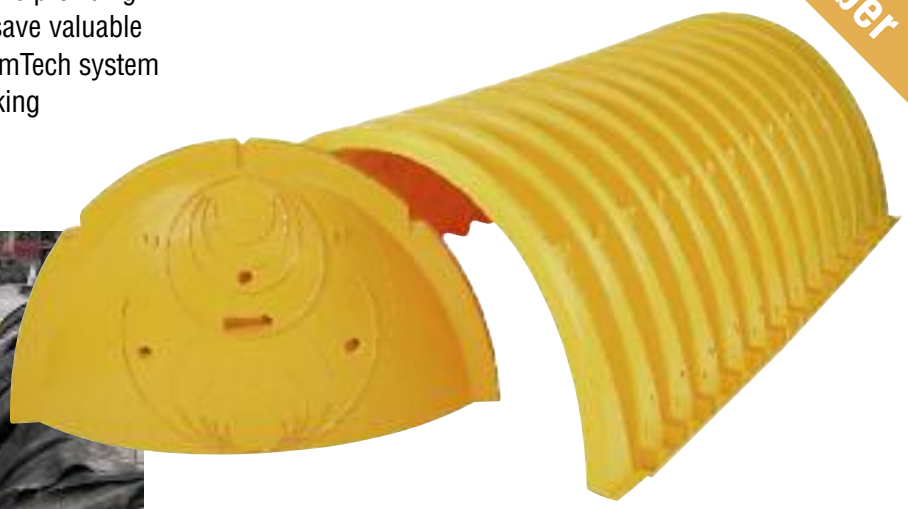
	Minimum Required Bearing Resistance for Service Loads ksf (kPa)										
Cover ft (m)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
1.5 (0.46)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2 (0.61)	6 152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2.5 (0.76)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)
3 (0.91)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)
3.5 (1.07)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)
4 (1.22)	6 152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)
4.5 (1.37)	6 152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)
5 (1.52)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)
5.5 (1.68)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)
6 (1.83)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)
6.5 (1.98)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)
7 (2.13)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)
7.5 (2.29)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)
8 (2.44)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the sub-grade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

StormTech SC-740 Chamber

SC-740 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.



StormTech SC-740 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	85.4" x 51.0" x 30.0" (2170 x 1295 x 762 mm)
Chamber Storage	45.9 ft³ (1.30 m³)
Min. Installed Storage*	74.9 ft³ (2.12 m³)
Weight	74.0 lbs (33.6 kg)

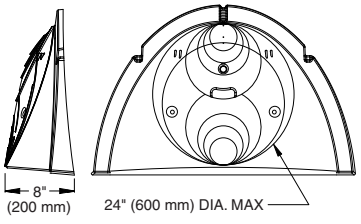
*Assumes 6" (150 mm) stone above, below and between chambers and 40% stone porosity.

Shipping

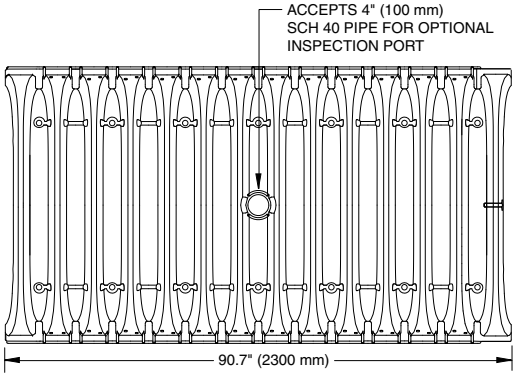
30 chambers/pallet

60 end caps/pallet

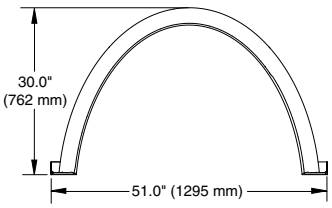
12 pallets/truck

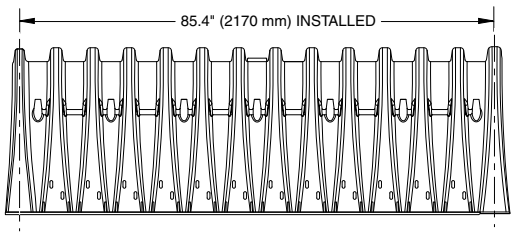


SC-740 End Cap



SC-740 Chamber





StormTech SC-740 Chamber

SC-740 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
42 (1067)	45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (948)	45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	41.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)

SC-740 Cumulative Storage Volumes Per Chamber (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	0	6.76 (0.191)
5 (127)	0	5.63 (0.160)
4 (102)	Stone Foundation 0	4.51 (0.125)
3 (76)	0	3.38 (0.095)
2 (51)	0	2.25 (0.064)
1 (25)	0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Stone Foundation Depth in. (mm)		
		6 (150)	12 (300)	18 (450)
StormTech SC-740	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Assumes 6" (150 mm) of stone above chambers, 6" (150 mm) row spacing and 40% porosity.

Amount of Stone Per Chamber

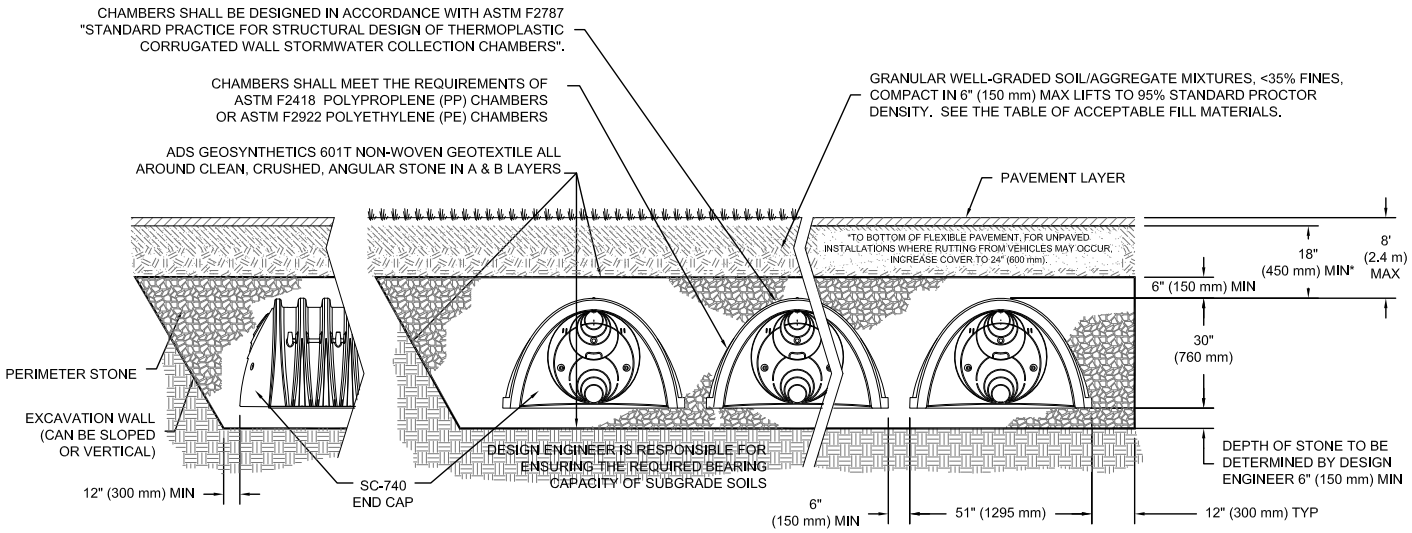
	Stone Foundation Depth		
ENGLISH TONS (yd³)	6"	12"	18"
StormTech SC-740	3.8 (2.8 yd³)	4.6 (3.3 yd³)	5.5 (3.9 yd³)
METRIC KILOGRAMS (m³)	**150 mm**	**300 mm**	**450 mm**
StormTech SC-740	3450 (2.1 m³)	4170 (2.5 m³)	4490 (3.0 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (150 mm)	12" (300 mm)	18" (450 mm)
StormTech SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Assumes 6" (150 mm) of row separation and 18" (450 mm) of cover. Volume of excavation will vary as depth of cover increases.



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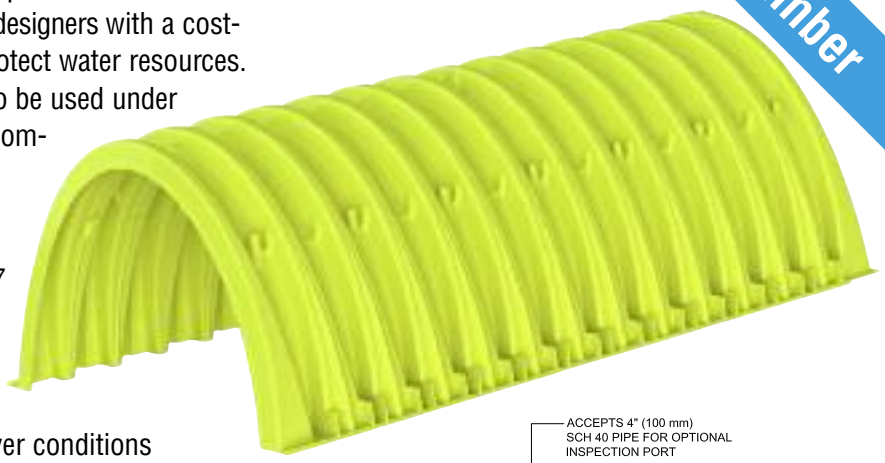
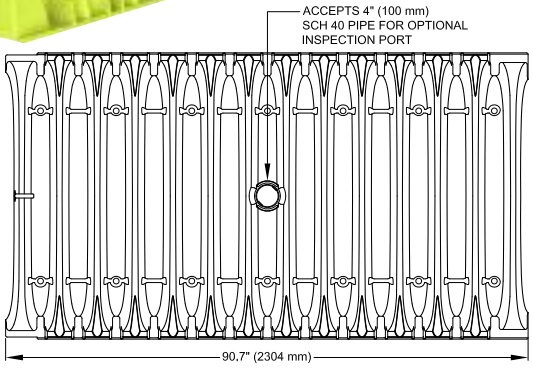
StormTech DC-780 Chamber

DC-780 Chamber

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots thus maximizing land usage for commercial and municipal applications.

- 12' Deep Cover applications.
- Designed in accordance with ASTM F 2787 and produced to meet the ASTM F 2418 product standard.
- AASHTO safety factors provided for AASHTO Design Truck (H20) and deep cover conditions





StormTech DC-780 Chamber (not to scale)

Nominal Chamber Specifications

Size (L x W x H)	85.4" x 51.0" x 30.0" (2169 x 1295 x 762 mm)
Chamber Storage	46.2 ft³ (1.3 m³)
Min. Installed Storage*	78.4 ft³ (2.2 m³)

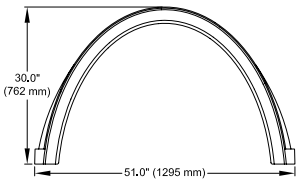
* Assumes 9" (230 mm) stone below, 6" (150 mm) stone above, 6" (150 mm) row spacing and 40% stone porosity.

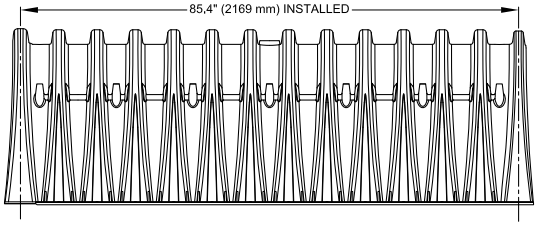
Shipping

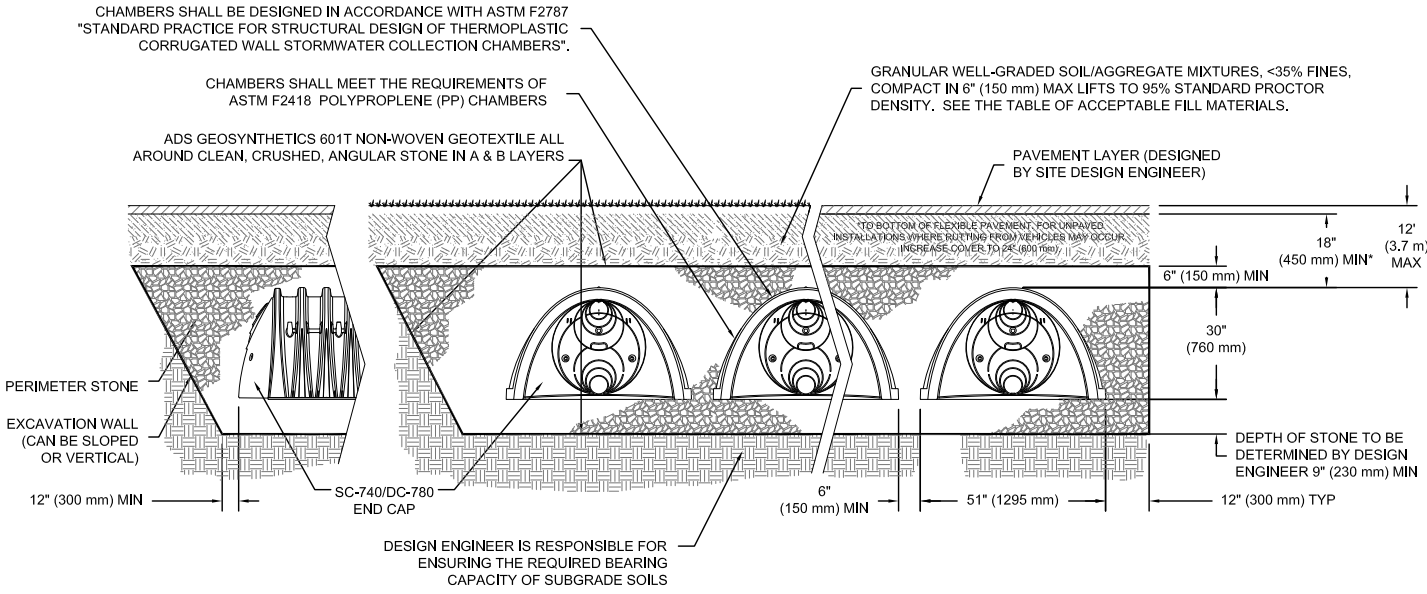
24 chambers/pallet

60 end caps/pallet

12 pallets/truck







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StormTech DC-780 Chamber

DC-780 Cumulative Storage Volumes Per Chamber

Assumes 40% Stone Porosity. Calculations are Based Upon a 9" (230 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
45 (1143)	46.27 (1.310)	78.47 (2.222)
44 (1118)	46.27 (1.310)	77.34 (2.190)
43 (1092)	Stone 46.27 (1.310)	76.21 (2.158)
42 (1067)	Cover 46.27 (1.310)	75.09 (2.126)
41 (1041)	46.27 (1.310)	73.96 (2.094)
40 (1016)	46.27 (1.310)	72.83 (2.062)
39 (991)	46.27 (1.310)	71.71 (2.030)
38 (965)	46.21 (1.309)	70.54 (1.998)
37 (940)	46.04 (1.304)	69.32 (1.963)
36 (914)	45.76 (1.296)	68.02 (1.926)
35 (889)	45.15 (1.278)	66.53 (1.884)
34 (864)	44.34 (1.255)	64.91 (1.838)
33 (838)	43.38 (1.228)	63.21 (1.790)
32 (813)	42.29 (1.198)	61.43 (1.740)
31 (787)	41.11 (1.164)	59.59 (1.688)
30 (762)	39.83 (1.128)	57.70 (1.634)
29 (737)	38.47 (1.089)	55.76 (1.579)
28 (711)	37.01 (1.048)	53.76 (1.522)
27 (686)	35.49 (1.005)	51.72 (1.464)
26 (660)	33.90 (0.960)	49.63 (1.405)
25 (635)	32.24 (0.913)	47.52 (1.346)
24 (610)	30.54 (0.865)	45.36 (1.285)
23 (584)	28.77 (0.815)	43.18 (1.223)
22 (559)	26.96 (0.763)	40.97 (1.160)
21 (533)	25.10 (0.711)	38.72 (1.096)
20 (508)	23.19 (0.657)	36.45 (1.032)
19 (483)	21.25 (0.602)	34.16 (0.967)
18 (457)	19.26 (0.545)	31.84 (0.902)
17 (432)	17.24 (0.488)	29.50 (0.835)
16 (406)	15.19 (0.430)	27.14 (0.769)
15 (381)	13.10 (0.371)	24.76 (0.701)
14 (356)	10.98 (0.311)	22.36 (0.633)
13 (330)	8.83 (0.250)	19.95 (0.565)
12 (305)	6.66 (0.189)	17.52 (0.496)
11 (279)	4.46 (0.126)	15.07 (0.427)

DC-780 Cumulative Storage Volumes Per Chamber (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
10 (254)	2.24 (0.064)	12.61 (0.357)
9 (229)	0	10.14 (0.287)
8 (203)	0	9.01 (0.255)
7 (178)	0	7.89 (0.223)
6 (152)	0	6.76 (0.191)
5 (127)	Stone Foundation 0	5.63 (0.160)
4 (102)	0	4.51 (0.128)
3 (76)	0	3.38 (0.096)
2 (51)	0	2.25 (0.064)
1 (25)	0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Volume- Stone Foundation Depth inches (millimeters)		
		9 (230)	12 (300)	18 (450)
StormTech DC-780	46.2 (1.3)	78.4 (2.2)	81.8 (2.3)	88.6 (2.5)

Note: Assumes 40% porosity for the stone, the bare chamber volume, 6" (150 mm) stone above, and 6" (150 mm) row spacing.

Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH TONS (YD³)	9"	12"	18"
StormTech DC-780	4.2 (3.0 yd³)	4.7 (3.3 yd³)	5.6 (3.9 yd³)
METRIC KILOGRAMS (M³)	**230 mm**	**300 mm**	**450 mm**
StormTech DC-780	3810 (2.3 m³)	4264 (2.5 m³)	5080 (3.0 m³)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	9" (230 mm)	12" (300 mm)	18" (450 mm)
StormTech DC-780	5.9 (4.5)	6.3 (4.8)	6.9 (5.3)

Note: Assumes 6" (150 mm) of separation between chamber rows and 18" (450 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

mm)

2.5 STORMTECH CHAMBERS

StormTech chamber systems have unique features to improve site optimization and reduce product waste. The SC-740, SC-310 and DC-780 chambers can be cut at the job site in approximately 6.5" (165 mm) increments to shorten a chamber's length. Designing and constructing chamber rows around site obstacles is easily accomplished by including specific cutting instructions or a well placed "cut to fit" note on the design plans. The last chamber of a row can be cut in any of its corrugation's valleys. An end cap placed into the trimmed corrugation's crest completes the row. The trimmed-off piece of a StormTech chamber may then be used to start the next row. See **Figure 4**.

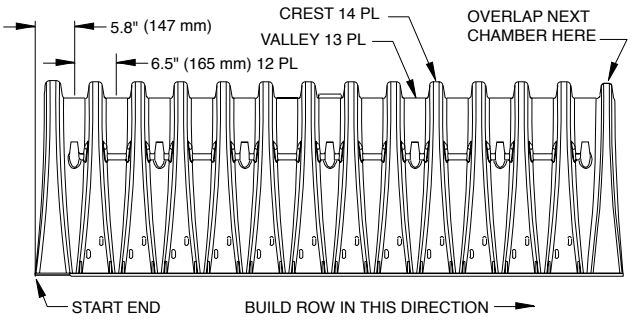
To assist the contractor, StormTech chambers are molded with simple assembly instructions and arrows that indicate the direction in which to build rows. Rows are formed by overlapping the next chamber's "Start End" corrugation with the previously laid chamber's end corrugation. Two people can safely and efficiently form rows of chambers without complicated connectors, special tools or heavy equipment.
Product Specifications: 2.2, 2.4, 2.5, 2.9 and 3.2

2.6 STORMTECH END CAPS

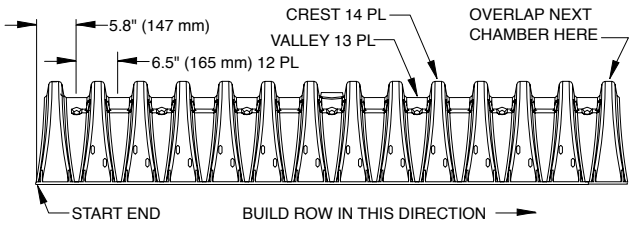
The StormTech end cap has features which make the chamber system simple to design, easy to build and more versatile than other products. StormTech end caps can be easily secured within any corrugation's crest. A molded-in handle makes attaching the end cap a one-person operation. Tools or fasteners are not required.

StormTech end caps are required at each end of a chamber row to prevent stone intrusion (two per row). The SC-740 and DC-780 end caps will accept up to a 24" (600 mm) HDPE inlet pipe. The SC-310 end cap will accept up to a 12" (300 mm) HDPE inlet pipe. See **Figure 5**.
Product Specifications: 3.1, 3.2, 3.3 and 3.4

Figure 4 – Distance Between Corrugations (not to scale)

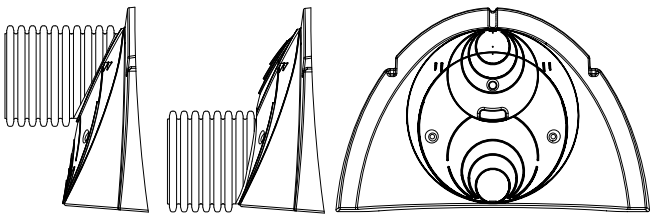


SC-740 chamber



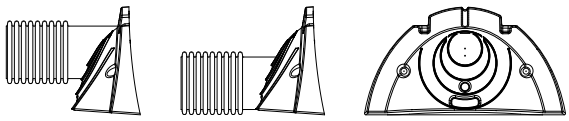
SC-310 chamber

Figure 5 – Chamber End Caps (not to scale)



SC-740/DC-780 CHAMBER FABRICATED END CAP (TOP AND BOTTOM FEED)
PIPES SIZES RANGE FROM 6" (150 mm) TO 24" (600 mm)
(INVERTS VARY WITH PIPE SIZE)

SC-740 / DC-780 end cap



SC-310 CHAMBER FABRICATED END CAP (TOP AND BOTTOM FEED)
PIPES SIZES RANGE FROM 6" (150 mm) TO 12" (300 mm)
(INVERTS VARY WITH PIPE SIZE)

SC-310 end cap

3.0 Structural Capabilities

3.1 STRUCTURAL DESIGN APPROACH

When installed per StormTech's minimum requirements, StormTech products are designed to exceed American Association of State Highway and Transportation Officials (AASHTO) LRFD recommended design factors for Earth loads and Vehicular live loads. AASHTO Vehicular live loads (previously HS-20) consist of two heavy axle configurations, that of a single 32 (142 kN) kip axle and that of tandem 25 (111 kN) kip axles. Factors for impact and multiple presences of vehicles ensure a conservative design where structural adequacy is assumed for a wide range of street legal vehicle weights and axle configurations.

Computer models of the chambers under shallow and deep conditions were developed. Utilizing design forces from computer models, chamber sections were evaluated using AASHTO procedures that consider thrust and moment, and check for local buckling capacity. The procedures also considered the time-dependent strength and stiffness properties of polypropylene and polyethylene. These procedures were developed in a research study conducted by the National Cooperative Highway Research Program (NCHRP) for AASHTO, and published as NCHRP Report 438 Recommended LRFD Specifications for Plastic Pipe and Culverts. *Product Specifications: 2.12.*

StormTech does not recommend installing StormTech products underneath buildings or parking garages. When specifying the StormTech products in close proximity to buildings, it is important to ensure that the StormTech products are not receiving any loads from these structures that may jeopardize the long term performance of the chambers.

3.2 FULL SCALE TESTING

After developing the StormTech chamber designs, the chambers were subjected to rigorous full-scale testing. The test programs verified the predicted safety factors of the designs by subjecting the chambers to more severe load conditions than anticipated during service life. Capacity under live loads and deep fill was investigated by conducting tests with a range of cover depths. Monitoring of long term deep fill installations has been done to validate the long term performance of the StormTech products.

3.3 INDEPENDENT EXPERT ANALYSIS

StormTech worked closely with the consulting firm Simpson Gumpertz & Heger Inc. (SGH) to develop and evaluate the SC-740, SC-310 and DC-780 chamber designs. SGH has world-renowned expertise in the design of buried drainage structures. The firm was the principal investigator for the NCHRP research program that developed the structural analysis and design methods adopted by AASHTO for thermoplastic culverts. SGH conducted design calculations and computer simulations of chamber performance under various installation and live load conditions. They worked with StormTech to design the full-scale test programs to verify the structural capacity of the chambers. SGH also observed all full-scale tests and inspected the chambers after completion of the tests. SGH continues to be StormTech's structural consultant.

3.4 INJECTION MOLDING

To comply with both the structural and design requirements of AASHTO's LRFD specifications and ASTM F 2787 as well as the product requirements of ASTM F 2418 or ASTM F2922, StormTech uses proprietary injection molding equipment to manufacture the chambers and end caps.

In addition to meeting structural goals, injection molding allows StormTech to design added features and advantages into StormTech's parts including:

- Precise control of wall thickness throughout parts
- Precise fit of joints and end caps
- Molded-in inspection port fitting
- Molded-in handles on end caps
- Molded-in pipe guides with blade starter slots
- Repeatability for Quality Control (See Section 3.6)

Product Specifications: 2.1, 3.1 and 3.3

3.5 POLYPROPYLENE AND POLYETHYLENE RESIN

StormTech chambers are injection molded from polypropylene and polyethylene. Polypropylene and polyethylene chambers are inherently resistant to chemicals typically found in stormwater run-off. StormTech chambers maintain a greater portion of their structural stiffness through higher installation and service temperatures.

StormTech polypropylene and polyethylene are virgin materials specially designed to achieve a high 75-year creep modulus that is necessary to provide a sound long-term structural design. Since the modulus remains high well beyond the 75-year value, StormTech chambers can exhibit a service life in excess of 75 years.

3.6 QUALITY CONTROL

StormTech chambers are manufactured under tight quality control programs. Materials are routinely tested in an environmentally controlled lab that is verified every six months via the external ASTM Proficiency Testing Program. The chamber material properties are measured and controlled with procedures following ISO 9001:2000 requirements.

Statistical Process Control (SPC) techniques are applied during manufacturing. Established upper and lower control limits are maintained on key manufacturing parameters to maintain consistent product.
Product Specifications: 2.13 and 3.6

4.0 Foundation for Chambers

4.1 FOUNDATION REQUIREMENTS

StormTech chamber systems and embedment stone may be installed in various native soil types. The sub-grade bearing capacity and chamber cover height determine the required depth of clean, crushed, angular stone for the chamber foundation. The chamber foundation is the clean, crushed, angular stone placed between the subgrade soils and the feet of the chamber.

As cover height increases (top of chamber to top of finished grade) the chambers foundation requirements increase. Foundation strength is the product of the sub-grade soils bearing capacity and the depth of clean, crushed, angular stone below the chamber foot. **Table 1** for the SC-740 and SC-310 and **Table 2** for the DC-780 specify the required minimum foundation depth for varying cover heights and subgrade bearing capacities.

4.2 WEAKER SOILS

For sub-grade soils with allowable bearing capacity less than 2000 pounds per square foot [(2.0 ksf) (96 kPa)], a geotechnical engineer should evaluate the specific conditions. These soils are often highly variable, may contain organic materials and could be more sensitive to moisture. A geotechnical engineer's recommendations may include increasing the stone foundation, improving the bearing capacity of the sub-grade soils through compaction, replacement, or other remedial measures including the use of geogrids. The use of a thermoplastic liner may also be considered for systems installed in subgrade soils that are highly affected by moisture. The project engineer is responsible for ensuring overall site settlement is within acceptable limits. A geotechnical engineer should always review installation of StormTech chambers on organic soils.

4.3 CHAMBER SPACING OPTION

StormTech always requires a minimum of 6" (150 mm) clear spacing between the feet of chambers rows for the SC-310, SC-740 and DC-780 chambers. However, increasing the spacing between chamber rows may allow the application of StormTech chambers with either less foundation stone or with weaker subgrade soils. This may be a good option where a vertical restriction on site prevents the use of a deeper foundation. Contact StormTech's Technical Service Department for more information on this option. In all cases, StormTech recommends consulting a geotechnical engineer for subgrade soils with a bearing capacity less than 2.0 ksf (96 kPa).

Table 1 – SC-310 and SC-740 Minimum Required Foundation Depth in inches (millimeters)

Cover Ht. ft. (m)	Minimum Required Bearing Resistance for Service Loads ksf (kPa)																							
	4.1 (196)	4.0 (192)	3.9 (187)	3.8 (182)	3.7 (177)	3.6 (172)	3.5 (168)	3.4 (163)	3.3 (158)	3.2 (153)	3.1 (148)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
1.5 (0.46)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)
2 (0.61)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)
2.5 (0.76)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)
3 (0.91)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)
3.5 (1.07)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
4 (1.22)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
4.5 (1.37)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
5 (1.52)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
5.5 (1.68)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)
6 (1.83)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)
6.5 (1.98)	6 (152)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	24 (610)
7 (2.13)	6 (152)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)
7.5 (2.29)	6 (152)	6 (152)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	27 (686)
8 (2.44)	6 (152)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

4.0 Foundation for Chambers/5.0 Cumulative Storage Volumes

Table 2 – DC-780 Minimum Required Foundation Depth in inches (millimeters)

Cover Ht. ft. (m)	Minimum Required Bearing Resistance for Service Loads ksf (kPa)																						
	4.1 (196)	4.0 (192)	3.9 (187)	3.8 (182)	3.7 (177)	3.6 (172)	3.5 (168)	3.4 (163)	3.3 (158)	3.2 (153)	3.1 (148)	3.0 (144)	2.9 (139)	2.8 (134)	2.7 (129)	2.6 (124)	2.5 (120)	2.4 (115)	2.3 (110)	2.2 (105)	2.1 (101)	2.0 (96)
8.5 (2.59)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	24 (610)	24 (610)	27 (686)	30 (762)
9.0 (2.74)	9 (229)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)	30 (762)
9.5 (2.90)	9 (229)	9 (229)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)	30 (762)	33 (838)
10.0 (3.05)	9 (229)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)	30 (762)	33 (838)	36 (915)
10.5 (3.20)	9 (229)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)	30 (762)	30 (762)	33 (838)	36 (915)
11.0 (3.35)	12 (305)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)	27 (686)	30 (762)	33 (838)	36 (915)	39 (991)
11.5 (3.50)	12 (305)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)	27 (686)	30 (762)	33 (838)	36 (915)	39 (991)	42 (1067)
12.0 (3.66)	12 (305)	12 (305)	12 (305)	15 (381)	15 (381)	15 (381)	15 (381)	18 (457)	18 (457)	18 (457)	21 (533)	21 (533)	21 (533)	24 (610)	24 (610)	27 (686)	30 (762)	30 (762)	33 (838)	36 (915)	39 (991)	42 (1067)

NOTE: The design engineer is solely responsible for assessing the bearing resistance (allowable bearing capacity) of the subgrade soils and determining the depth of foundation stone. Subgrade bearing resistance should be assessed with consideration for the range of soil moisture conditions expected under a stormwater system.

Tables 3, 4 and **5** provide cumulative storage volumes for the SC-310, SC-740 and DC-780 chamber systems. This information may be used to calculate a detention/retention system's stage storage volume. A spreadsheet is available at www.stormtech.com in which the number of chambers can be input for quick cumulative storage calculations. *Product Specifications: 1.1, 2.2, 2.3, 2.4, and 2.6*

Table 3 - SC-310 Cumulative Storage Volumes Per Chamber
Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
28 (711)	14.70 (0.416)	31.00 (0.878)
27 (686)	14.70 (0.416)	30.21 (0.855)
26 (680)	Stone 14.70 (0.416)	29.42 (0.833)
25 (610)	Cover 14.70 (0.416)	28.63 (0.811)
24 (609)	14.70 (0.416)	27.84 (0.788)
23 (584)	14.70 (0.416)	27.05 (0.766)
22 (559)	14.70 (0.416)	26.26 (0.748)
21 (533)	14.64 (0.415)	25.43 (0.720)
20 (508)	14.49 (0.410)	24.54 (0.695)
19 (483)	14.22 (0.403)	23.58 (0.668)
18 (457)	13.68 (0.387)	22.47 (0.636)
17 (432)	12.99 (0.368)	21.25 (0.602)

Table 3 - SC-310 Cumulative Storage Volumes (cont.)

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
16 (406)	12.17 (0.345)	19.97 (0.566)
15 (381)	11.25 (0.319)	18.62 (0.528)
14 (356)	10.23 (0.290)	17.22 (0.488)
13 (330)	9.15 (0.260)	15.78 (0.447)
12 (305)	7.99 (0.227)	14.29 (0.425)
11 (279)	6.78 (0.192)	12.77 (0.362)
10 (254)	5.51 (0.156)	11.22 (0.318)
9 (229)	4.19 (0.119)	9.64 (0.278)
8 (203)	2.83 (0.081)	8.03 (0.227)
7 (178)	1.43 (0.041)	6.40 (0.181)
6 (152)	0	4.74 (0.134)
5 (127)	0	3.95 (0.112)
4 (102)	Stone 0	3.16 (0.090)
3 (76)	Foundation 0	2.37 (0.067)
2 (51)	0	1.58 (0.046)
1 (25)	0	0.79 (0.022)

Note: Add 0.79 ft³ (0.022 m³) of storage for each additional inch (25 mm) of stone foundation.

5.0 Cumulative Storage Volumes

TABLE 4 – SC-740 Cumulative Storage Volumes Per Chamber
Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
42 (1067)	45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (948)	45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	41.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	0	6.76 (0.191)
5 (127)	0	5.63 (0.160)
4 (102)	Stone 0	4.51 (0.125)
3 (76)	Foundation 0	3.38 (0.095)
2 (51)	0	2.25 (0.064)
1 (25)	0	1.13 (0.032)

Note: Add 1.13 ft³ (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

Table 5 - DC-780 Cumulative Storage Volumes Per Chamber
Assumes 40% Stone Porosity. Calculations are Based Upon a 9" (230 mm) Stone Base Under the Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage Ft³ (m³)	Total System Cumulative Storage Ft³ (m³)
45 (1143)	46.27 (1.310)	78.47 (2.222)
44 (1118)	46.27 (1.310)	77.34 (2.190)
43 (1092)	Stone 46.27 (1.310)	76.21 (2.158)
42 (1067)	Cover 46.27 (1.310)	75.09 (2.126)
41 (1041)	46.27 (1.310)	73.96 (2.094)
40 (1016)	46.27 (1.310)	72.83 (2.062)
39 (991)	46.27 (1.310)	71.71 (2.030)
38 (965)	46.21 (1.309)	70.54 (1.998)
37 (940)	46.04 (1.304)	69.32 (1.963)
36 (914)	45.76 (1.296)	68.02 (1.926)
35 (889)	45.15 (1.278)	66.53 (1.884)
34 (864)	44.34 (1.255)	64.91 (1.838)
33 (838)	43.38 (1.228)	63.21 (1.790)
32 (813)	42.29 (1.198)	61.43 (1.740)
31 (787)	41.11 (1.164)	59.59 (1.688)
30 (762)	39.83 (1.128)	57.70 (1.634)
29 (737)	38.47 (1.089)	55.76 (1.579)
28 (711)	37.01 (1.048)	53.76 (1.522)
27 (686)	35.49 (1.005)	51.72 (1.464)
26 (660)	33.90 (0.960)	49.63 (1.405)
25 (635)	32.24 (0.913)	47.52 (1.346)
24 (610)	30.54 (0.865)	45.36 (1.285)
23 (584)	28.77 (0.815)	43.18 (1.223)
22 (559)	26.96 (0.763)	40.97 (1.160)
21 (533)	25.10 (0.711)	38.72 (1.096)
20 (508)	23.19 (0.657)	36.45 (1.032)
19 (483)	21.25 (0.602)	34.16 (0.967)
18 (457)	19.26 (0.545)	31.84 (0.902)
17 (432)	17.24 (0.488)	29.50 (0.835)
16 (406)	15.19 (0.430)	27.14 (0.769)
15 (381)	13.10 (0.371)	24.76 (0.701)
14 (356)	10.98 (0.311)	22.36 (0.633)
13 (330)	8.83 (0.250)	19.95 (0.565)
12 (305)	6.66 (0.189)	17.52 (0.496)
11 (279)	4.46 (0.126)	15.07 (0.427)
10 (254)	2.24 (0.064)	12.61 (0.357)
9 (229)	0	10.14 (0.287)
8 (203)	0	9.01 (0.255)
7 (178)	Stone 0	7.89 (0.223)
6 (152)	Foundation 0	6.76 (0.191)
5 (127)	0	5.63 (0.160)
4 (102)	0	4.51 (0.128)
3 (76)	0	3.38 (0.096)
2 (51)	0	2.25 (0.064)
1 (25)	0	1.13 (0.032)

Note: Add 1.13 cu. ft. (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

6.1 CHAMBER ROW SEPARATION

StormTech SC-740, SC-310 and DC-780 chambers must be specified with a minimum 6" (150 mm) space between the feet of adjacent parallel chamber rows. Increasing the space between rows is acceptable. This will increase the storage volume due to additional stone voids.

6.2 STONE SURROUNDING CHAMBERS

Refer to **Table 6** for acceptable stone materials. StormTech requires clean, crushed, angular stone below, between and above chambers as shown in **Figure 6**. Acceptable gradations are listed in **Table 6.** Subrounded and rounded stone are not acceptable.

6.3 GEOTEXTILE SEPARATION REQUIREMENT

A non-woven geotextile that meets AASHTO M288 Class 2 Separation requirements must be applied as a separation layer to prevent soil intrusion into the clean, crushed, angular stone as shown in **Figure 6**. The geotextile is required between the clean, crushed, angular stone and the subgrade soils, the excavation's sidewalls and the fill materials. The geotextile should completely envelope the clean, crushed, angular stone. Overlap adjacent geotextile rolls per AASHTO M288 separation guidelines. Contact StormTech for a list of acceptable geotextiles.

6.4 FILL ABOVE CHAMBERS

Refer to **Table 6** and **Figure 6** for acceptable fill material above the 6" (150 mm) of clean, crushed, angular stone. Minimum and maximum fill requirements for the SC-740, SC-310 and DC-780 chambers are shown in **Figure 6** below. StormTech requires a minimum of 24" (600 mm) of fill in non-paved installations where rutting from vehicles may occur. **Table 6** provides details on soil class and compaction requirements for suitable fill materials.

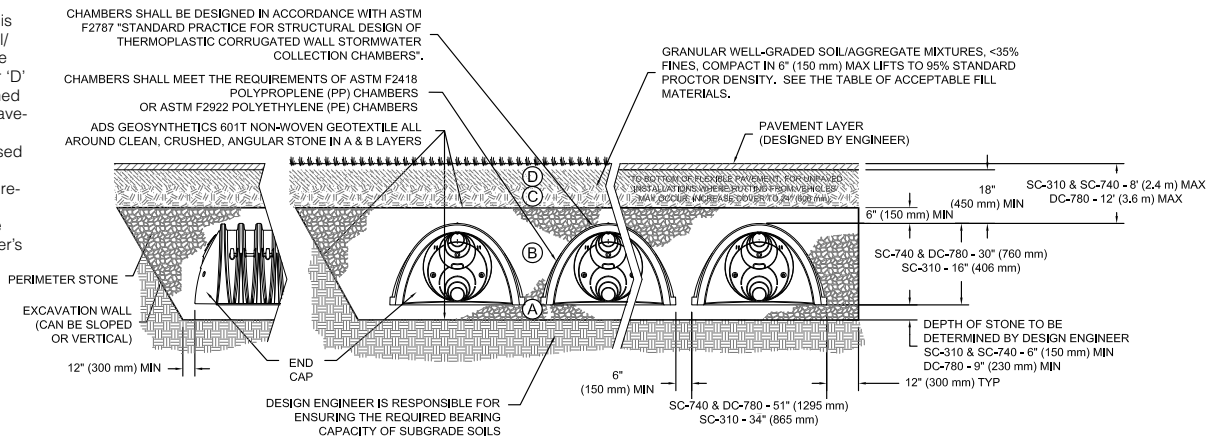
Table 6 – Acceptable Fill Materials

	MATERIAL LOCATION	DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 18" (450 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN).
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE. [2] [3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 6" (150 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.

Figure 6 – Fill Material Locations

Once layer 'C' is placed any soil/material can be placed in layer 'D' up to the finished grade. Most pavement subbase soils can be used to replace the materials requirements of layer 'C' or 'D' at the design engineer's discretion.



7.0 Inletting the Chambers

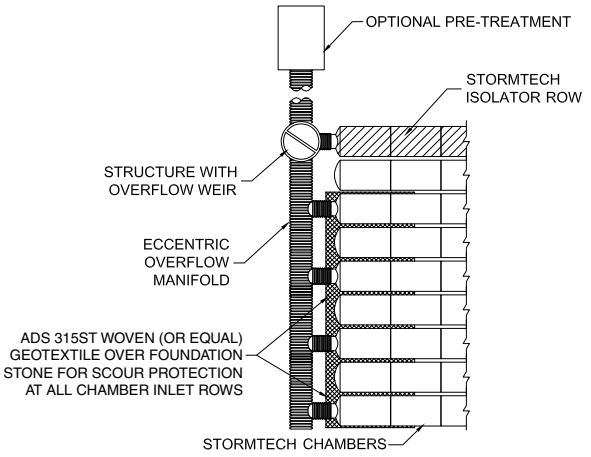
The design flexibility of a StormTech chamber system includes many inletting possibilities. Contact StormTech's Technical Service Department for guidance on designing an inlet system to meet specific site goals.

7.1 TREATMENT TRAIN

A properly designed inlet system can ensure good water quality, easy inspection and maintenance, and a long system service life. StormTech recommends a treatment train approach for inletting an underground stormwater management system under a typical commercial parking area. *Treatment train* is an industry term for a multi-tiered water quality network. As shown in **Figure 7**, a StormTech recommended inlet system can inexpensively have tiers of treatment upstream of the StormTech chambers:

Tier 1 – Pre-treatment (BMP)
Tier 2 - StormTech Isolator® Row
Tier 3 - Enhanced Treatment (BMP)

Figure 7 – Typical StormTech Treatment Train Inlet System



7.2 PRE-TREATMENT (BMP) – TREATMENT TIER 1

In some areas pre-treatment of the stormwater is required prior to entry into a stormwater system. By treating the stormwater prior to entry into the system, the service life of the system can be extended, pollutants such as hydrocarbons may be captured, and local regulations met. Pre-treatment options are often described as a Best Management Practice or simply a BMP.

Pre-treatment devices differ greatly in complexity, design and effectiveness. Depending on a site's characteristics and treatment goals, the simple, least expensive pre-treatment solutions can sometimes be just as effective as the complex systems. Options include a simple deep sumped manhole with a 90° bend on its outlet, baffle boxes, swirl concentrators, and devices that combine these processes. Some of the most effective pre-treatment options combine engineered site grading with vegetation such as bio-swales or grassy strips.

The type of pretreatment device specified as the first level of treatment up-stream of a StormTech chamber system can vary greatly throughout the country and from site-to-site. It is the responsibility of the design engineer to understand the water quality requirements and design a stormwater treatment system that will satisfy local regulators and follow applicable laws. A design engineer should apply their understanding of local weather conditions, site topography, local maintenance requirements, expected service life, etc…to select an appropriate stormwater pre-treatment system.

7.3 STORMTECH ISOLATOR ROW – TREATMENT TIER 2

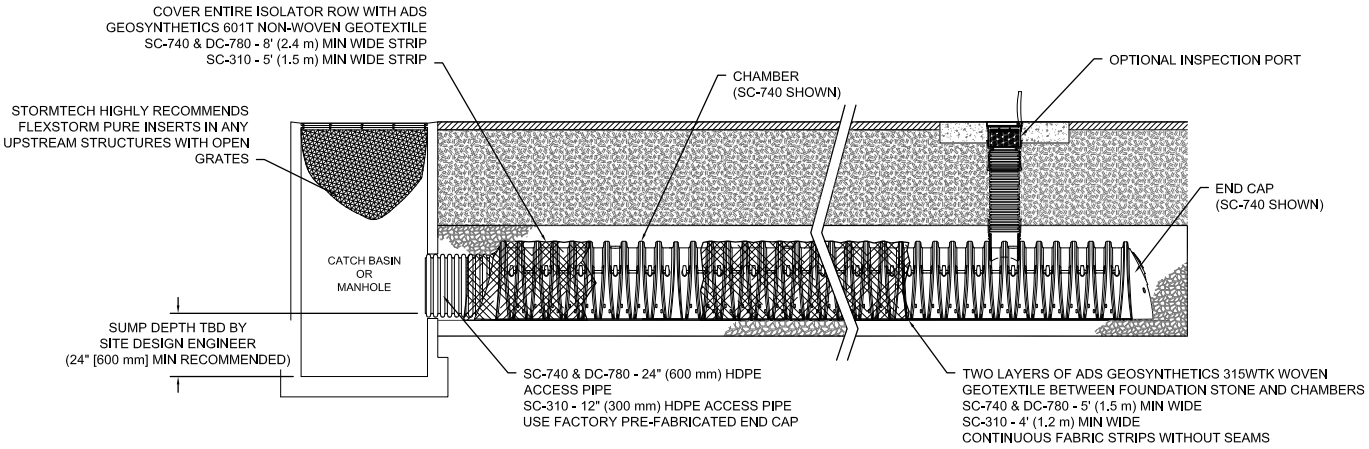
StormTech has a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance. The StormTech Isolator Row is a row of standard StormTech chambers surrounded with appropriate filter fabrics and connected to a manhole for easy access. This application basically creates a filter/detention basin that allows water to egress through the surrounding filter fabric while sediment is trapped within. It may be best to think of the Isolator Row as a first-flush treatment device. *First-Flush* is a term typically used to describe the first ½" to 1" (13-25 mm) of rainfall or runoff on a site. The majority of stormwater pollutants are carried in the sediments of the first-flush, therefore the Isolator Row is an effective component of a treatment train.

The StormTech Isolator Row should be designed with a manhole with an overflow weir at its upstream end. The diversion manhole is multi-purposed. It can provide access to the Isolator Row for both inspection and maintenance and acts as a diversion structure. The manhole is connected to the Isolator Row with a short length of 12" (300 mm) pipe for the SC-310 chamber and 24" (600 mm) pipe for the SC-740 and DC-780 chambers. These pipes are connected to the Isolator Row with a 12" (300 mm) fabricated end cap for the SC-310 chamber and a 24" (600 mm) fabricated end cap for the SC-740 and DC-780 chambers. The overflow weir typically has its crest set between the top of the chamber and its midpoint. This allows stormwater in excess of the Isolator Row's storage/conveyance capacity to bypass into the chamber system through the downstream manifold system.

Specifying and installing proper geotextiles is essential for efficient operation and to prevent damage to the system during the JetVac maintenance process. In a typical configuration, two strips of woven geotextile that meet AASHTO M288 Class 1 requirements are required between the chambers and the stone foundation. This strong filter fabric traps sediments and protects the stone base during maintenance. A strip of non-woven

7.0 Inletting the Chambers

Figure 8 – StormTech Isolator Row Detail



Note: Non-woven geotextile over DC-780 Isolator Row chambers is not required.

AASHTO M288 Class 2 geotextile is draped over the Isolator chamber row. This 6-8 oz. (217-278 g/m^2) non-woven filter fabric prevents sediments from migrating out of the chamber perforations while allowing modest amounts of water to flow out of the Isolator Row. **Figure 8** is a detail of the Isolator Row that shows proper application of the geotextiles. Contact StormTech for a table of acceptable geotextiles.

Inspection is easily accomplished through the upstream manhole or optional inspection ports. Maintenance of an Isolator Row is fast and easy using the JetVac process through the upstream manhole. Section 12.0 explains the inspection and maintenance process in more detail.

Isolator Rows can be sized to accommodate either a water quality volume or a water quality flow rate requirement. The use of filter fabric around the Isolator Row chambers allows stormwater to egress out of the row during and between storm events. The rate of egression for design is dependent upon the chamber model and sediment accumulation on the geotextile. Contact StormTech's Technical Services Department for more information on Isolator Row sizing.

7.4 ENHANCED TREATMENT (BMP) – TREATMENT TIER 3

As regulations have become more stringent, requiring higher levels of containment removal, water quality systems may be required to treat higher flow rates, greater volumes or to provide a higher level of filtration or other more sophisticated treatment process. StormTech systems can easily be configured with enhanced treatment techniques located either upstream or down stream of the retention or detention chamber system. Located upstream of an infiltration bed, between the pretreatment device and the Isolator Row, enhanced treatment provides a high level of contaminant removal which protects groundwater or better preserves the infiltration surface. Located downstream of detention, enhanced treatment provides a higher level of contaminant removal prior to discharge to a receiving body.

Enhanced treatment BMPs are normally applied where specific regulations and specific water quality product approvals are in place. StormTech works closely with providers of enhanced treatment technologies to meet local requirements.

7.5 TREATMENT TRAIN CONCLUSION

The treatment train is a highly effective water-quality approach that may not add significant cost to a StormTech system being installed under commercial parking areas. The StormTech Isolator Row adds a significant level of treatment, easy inspection and maintenance, while maintaining storage volume credit for the cost of a modest amount of geotextile. Finally where higher levels of treatment are required, StormTech can integrate other technologies into the treatment train to provide the most cost effective treatment approach. This treatment train concept provides three levels of treatment, inspection and maintenance upstream and downsstream of the StormTech detention/retention bed.

7.0 Inletting the Chambers

7.6 OTHER INLET OPTIONS

While the three-tiered treatment train approach is the recommended method of inletting StormTech chambers for typical under-commercial parking applications, there are other effective inlet methods that may be considered. For instance, Isolator Rows, while adding an inexpensive level of confidence, are not always necessary. A header system with fewer inlets can be designed to further minimize the cost of a StormTech system. There may be applications where stormwater pre-treatment may not be necessary at all and the system can be inlet directly from the source. Contact StormTech's Technical Service Department to discuss inlet options.

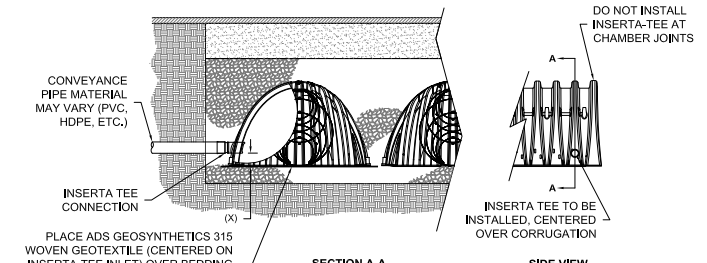
7.7 LATERAL FLOW RATES

The embedment stone surrounding the StormTech chambers allows the rapid conveyance of stormwater between chamber rows. Stormwater will rise and fall evenly within a bed of chambers. A single StormTech SC-740 chamber is able to release or accept stormwater at a rate of at least 0.5 cfs (14.2 l/s) through the surrounding stone.

7.8 INLETTING PERPENDICULAR TO A ROW OF CHAMBERS WITH INSERTA TEE

There is an easy, inexpensive method to perpendicularly inlet a row of chambers. Simply connect the inlet directly to the chamber with an Inserta Tee. **Figure 9** shows a typical detail along with the standard sizes offered for each chamber model.

Figure 9 – Inserta Tee Detail



CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS. CONTACT STORMTECH FOR MORE INFORMATION.

7.9 MAXIMUM INLET PIPE VELOCITIES TO PREVENT SCOURING OF THE STONE FOUNDATION

The primary function of the inlet manifold is to convey and distribute flows to a sufficient number of rows in the chamber bed such that there is ample conveyance capacity to pass the peak flows without creating an unacceptable backwater condition in upstream piping or scour the foundation stone under the chambers.

Manifolds are connected to the end caps either at the top or bottom of the end cap. High inlet flow rates from either connection location produce a shear scour potential of the foundation stone. Inlet flows from top inlets also produce impingement scour potential. Scour potential is reduced when standing water is present over the foundation stone. However, for safe design across the wide range of applications, StormTech assumes minimal standing water at the time the design flow occurs.

To minimize scour potential, StormTech recommends the installation of woven scour protection fabric at each inlet row. This enables a protected transition zone from the concentrated flow coming out of the inlet pipe to a uniform flow across the entire width of the chamber for both top and bottom connections. Allowable flow rates for design are dependent upon: the elevation of inlet pipe, foundation stone size and scour protection. An appropriate scour protection geotextile is installed from the end cap to at least 10.5' (3.2 m) for the SC-310, SC-740 and DC 780 chambers for both top and bottom feeding inlet pipes.

See StormTech's Tech Sheet #7 for guidance on manifold sizing. ADS's Technical Services department can also assist with sizing inlet manifolds for the StormTech chamber systems.

Table 7A – Standard distances from base of chamber to invert of inlet and outlet manifolds on StormTech end caps.

SC-310 ENDCAPS				
	PIPE DIA.	**INV. (IN)**	**INV. (FT)**	**INV. (MM)**
TOP	6" (150 mm)	5.8"	0.48	146
	8" (200 mm)	3.5"	0.29	88
	10" (250 mm)	1.4"	0.12	37
BOTTOM	6" (150 mm)	0.5"	0.04	12
	8" (200 mm)	0.6"	0.05	15
	10" (250 mm)	0.7"	0.06	18
	12" (300 mm)	0.9"	0.08	24

SC-740 / DC-780 ENDCAPS				
	PIPE DIA.	**INV. (IN)**	**INV. (FT)**	**INV. (MM)**
TOP	6" (150 mm)	18.5"	1.54	469
	8" (200 mm)	16.5"	1.38	421
	10" (250 mm)	14.5"	1.21	369
	12" (300 mm)	12.5"	1.04	317
	15" (375 mm)	9"	0.75	229
	18" (450 mm)	5"	0.42	128
BOTTOM	6" (150 mm)	0.5"	0.04	12
	8" (200 mm)	0.6"	0.05	15
	10" (250 mm)	0.7"	0.06	18
	12" (300 mm)	1.2"	0.10	30
	15" (375 mm)	1.3"	0.11	34
	18" (450 mm)	1.6"	0.13	40
	24" (600 mm)	0.1"	0.01	3

See StormTech's Tech Sheet #7 for manifold sizing guidance

8.0 OUTLETS FOR STORMTECH CHAMBER SYSTEMS

The majority of StormTech installations are detention systems and have some type of outlet structure. An outlet manifold is generally designed to ensure that peak flows can be conveyed to the outlet structure.

To drain the system completely, an underdrain system is located at or below the bottom of the foundation stone. Some beds may be designed with a pitched base to ensure complete drainage of the system. A grade of ½% is usually satisfactory.

An outlet pipe may be located at a higher invert within a bed. This allows a designed volume of water to infiltrate while excess volumes are outlet as necessary. This is an excellent method of recharging groundwater, replicating a site's pre-construction hydraulics.

Depending on the bed layout and inverts, outlet pipes should be placed in the embedment stone along the bed's perimeter as shown in **Figures 10** and **11**. Solid outlet pipes should also be used to penetrate the StormTech end caps at the designed outlet invert as shown in **Figure 12**. An Isolator Row should not be directly penetrated with an outlet pipe. For systems requiring higher outlet flow rates, a combination of connections may be utilized as shown in **Figure 13**.

In detention and retention applications the discharge of water from the stormwater management system is determined based on the hydrology of the area and the hydraulic design of the system. It is the design engineer's responsibility to design an outlet system that meets their hydraulic objectives while following local laws and regulations.

Table 7B – Maximum outlet flow rate capacities from StormTech manifolds.

OUTLET FLOW		
PIPE DIA.	**FLOW (CFS)**	**FLOW (L/S)**
6" (150 mm)	0.4	11.3
8" (200 mm)	0.7	19.8
10" (250 mm)	1.0	28.3
12" (300 mm)	2.0	56.6
15" (375 mm)	2.7	76.5
18" (450 mm)	4.0	113.3
24" (600 mm)	7.0	198.2
30" (750 mm)	11.0	311.5
36" (900 mm)	16.0	453.1
42" (1050 mm)	22.0	623.0
48" (1200 mm)	28.0	792.9

Figure 10 – Underdrain Parallel

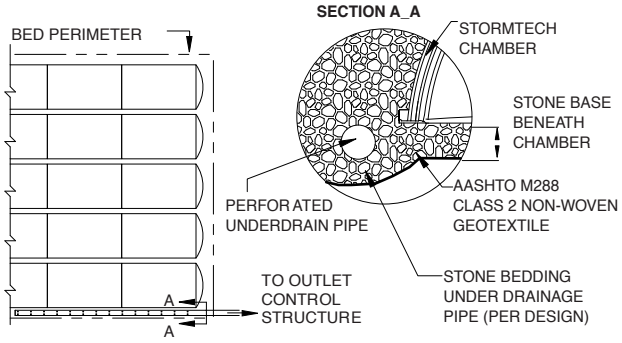


Figure 11 – Underdrain Perpendicular

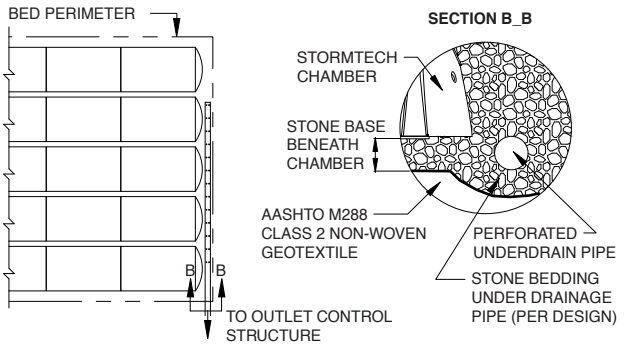


Figure 12 – Outlet Manifold

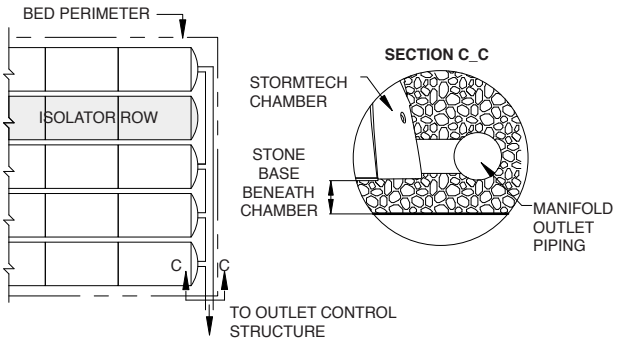
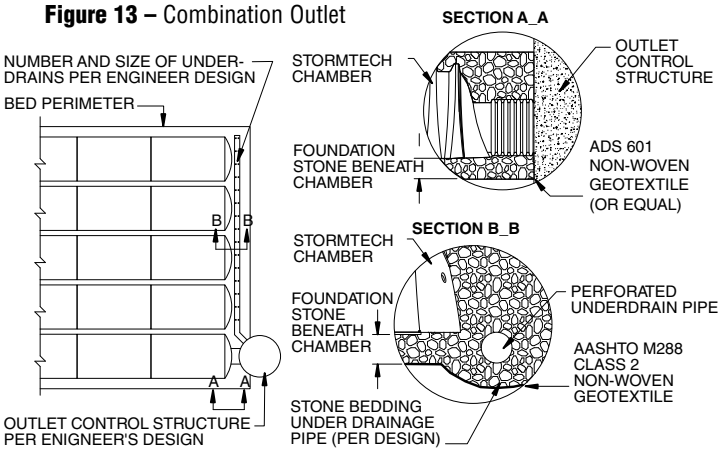


Figure 13 – Combination Outlet



9.1 EROSION CONTROL

Erosion and sediment control measures must be integrated into the plan to protect the stormwater system both during and after construction. These practices may have a direct impact on the system's infiltration performance and longevity. Vegetation, temporary sediment barriers (silt fences, hay bales, fabric-wrapped catch basin grates), and strategic stormwater runoff management may be used to control erosion and sedimentation. StormTech recommends the use of pipe plugs on the inlet pipe until the system is in service.

9.2 SITE IMPROVEMENT TECHNIQUES

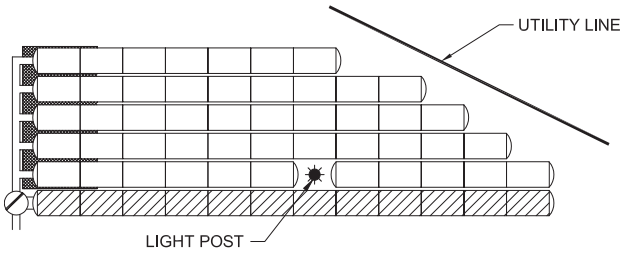
When site conditions are less than optimal, StormTech recognizes many methods for improving a site for construction. Some techniques include the removal and replacement of poor materials, the use of engineered subgrade materials, aggregates, chemical treatment, and mechanical treatments including the use of geosynthetics. StormTech recommends referring to AASHTO M 288 guidelines for the appropriate use of geotextiles.

StormTech also recognizes geogrid as a potential component of an engineered solution to improve site conditions or as a construction tool for the experienced contractor. StormTech chamber systems are compatible with the use of geosynthetics. The use of geosynthetics or any other site improvement method does not eliminate or modify any of StormTech's requirements. **It is the ultimate responsibility of the design engineer to ensure that site conditions are suitable for a StormTech chamber system.**

9.3 CONFORMING TO SITE CONSTRAINTS

StormTech chambers have the unique ability to conform to site constraints such as utility lines, light posts, large trees, etc. Rows of chambers can be ended short or interrupted by placing an end cap at the desired location, leaving the required number of chambers out of the row to get by the obstruction, then starting the row of chambers again with another end cap. See **Figure 14** for an example.

Figure 14 – Ability to Conform to Site Constraints



9.4 LINERS

StormTech chambers offer the distinct advantage and versatility that allow them to be designed as an open bottom detention or retention system. In fact, the vast majority of StormTech installations and designs are open bottom detention systems. Using an open bottom system enables treatment of the storm water through the underlying soils and provides a volume safety factor based on the infiltrative capacity of the underlying soils.

In some applications, however, open bottom detention systems may not be allowed. StormTech's Tech Sheet #2 provides guidance for the design and installation of thermoplastic liners for detention systems using StormTech chambers. The major points of the memo are:

- Infiltration of stormwater is generally a desirable stormwater management practice, often required by regulations. Lined systems should only be specified where unique site conditions preclude significant infiltration.
- Thermoplastic liners provide cost effective and viable means to contain stormwater in StormTech subsurface systems where infiltration is undesirable.
- PVC and LLDPE are the most cost effective, installed membrane materials.
- Enhanced puncture resistance from angular aggregate on the water side and from protrusions on the soil side can be achieved by placing a non-woven geotextile reinforcement on each side of the geomembrane. A sand underlayment in lieu of the geotextile reinforcement on the soil side may be considered when cost effective.
- StormTech does not design, fabricate, sell or install thermoplastic liners. StormTech recommends consulting with liner professionals for final design and installation advice.

Figure 15 – Chamber bed placed around light post.

For quick calculations, refer to the Site Calculator on StormTech's website at ***www.stormtech.com****.*

10.1 SYSTEM SIZING

The following steps provide the calculations necessary to size a system. If you need assistance determining the number of chambers per row or customizing the bed configuration to fit a specific site, call StormTech's Technical Services Department at **1-888-892-2694.**

1) Determine the amount of storage volume (V_S) required.

It is the design engineer's sole responsibility to determine the storage volume required by local codes.

TABLE 8 – Storage Volume Per Chamber ft³ (m³)

	Bare Chamber Storage	Chamber and Stone Foundation Depth in. (mm)		
	ft³ (m³)	6 (150)	12 (300)	18 (450)
StormTech SC-740	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)
StormTech SC-310	14.7 (0.4)	31.0 (0.9)	35.7 (1.0)	40.4 (1.1)
	ft³ (m³)	**9 (230)**	**12 (300)**	**18 (450)**
StormTech DC-780	46.2 (1.3)	78.4 (2.2)	81.8 (2.3)	88.6 (2.5)

Note: Assumes 40% porosity for the stone plus the chamber volume.

2) Determine the number of chambers (C) required.

To calculate the number of chambers needed for adequate storage, divide the storage volume (Vs) by the volume of the selected chamber, as follows:
C = Vs / Volume per Chamber

3) Determine the required bed size (S).

To find the size of the bed, multiply the number of chambers needed (C) by either:

StormTech SC-740 / DC-780
bed area per chamber = 33.8 ft² (3.1 m²)

StormTech SC-310
bed area per chamber = 23.7 ft² (2.2 m²)

S = (C x bed area per chamber) +
[1 foot (0.3 m) x bed perimeter in feet (meters)]

NOTE: It is necessary to add one foot (0.3 m) around the perimeter of the bed for end caps and working space.

4) Determine the amount of clean, crushed, angular stone (Vst) required.

TABLE 9 – Amount of Stone Per Chamber

	Stone Foundation Depth		
ENGLISH tons (yd³)	6"	12"	18"
StormTech SC-740	3.8 (2.8)	4.6 (3.3)	5.5 (3.9)
StormTech SC-310	2.1 (1.5)	2.7 (1.9)	3.4 (2.4)
METRIC kg (m³)	**150 mm**	**300 mm**	**450 mm**
StormTech SC-740	3450 (2.1)	4170 (2.5)	4490 (3.0)
StormTech SC-310	1830 (1.1)	2490 (1.5)	2990 (1.8)
ENGLISH tons (yd³)	**9"**	**12"**	**18"**
StormTech DC-780	4.2 (3.0)	4.7 (3.3)	5.6 (3.9)
METRIC kg (m³)	**230 mm**	**300 mm**	**450 mm**
StormTech DC-780	3810 (2.3)	4264 (2.5)	5080 (3.0)

Note: Assumes 6" (150 mm) of stone above, and between chambers.

To calculate the total amount of clean, crushed, angular stone required, multiply the number of chambers (C) by the selected weight of stone from **Table 9.**
NOTE: Clean, crushed, angular stone is also required around the perimeter of the system.

5) Determine the volume of excavation (Ex) required.
6) Determine the area of filter fabric (F) required.

TABLE 10 – Volume of Excavation Per Chamber yd³ (m³)

	Stone Foundation Depth		
	6" (150 mm)	12" (300 mm)	18" (450 mm)
StormTech SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)
StormTech SC-310	2.9 (2.2)	3.4 (2.6)	3.8 (2.9)
	9" (230 mm)	**12" (300 mm)**	**18" (457 mm)**
StormTech DC-780	5.9 (4.5)	6.3 (4.8)	6.9 (5.3)

Note: Assumes 6" (150 mm) of separation between chamber rows and 18" (450 mm) of cover. The volume of excavation will vary as the depth of the cover increases.

Each additional foot of cover will add a volume of excavation of 1.3 yds³ (1.0 m³) per SC-740 / DC-780 and 0.9 yds³ (0.7 m³) per SC-310 chamber.

The bottom and sides of the bed and the top of the embedment stone must be covered with ADS 601 (or equal) a non-woven geotextile (filter fabric). The area of the sidewalls must be calculated and a 2 foot (0.6 m) overlap must be included where two pieces of filter fabric are placed side-by-side or end-to-end. Geotextiles typically come in 15 foot (4.6 m) wide rolls.

7) Determine the number of end caps (E_C) required.

Each row of chambers requires two end caps.
E_C = number of rows x 2

11.0 Detail Drawings

Figure 16 – Inspection Port Detail

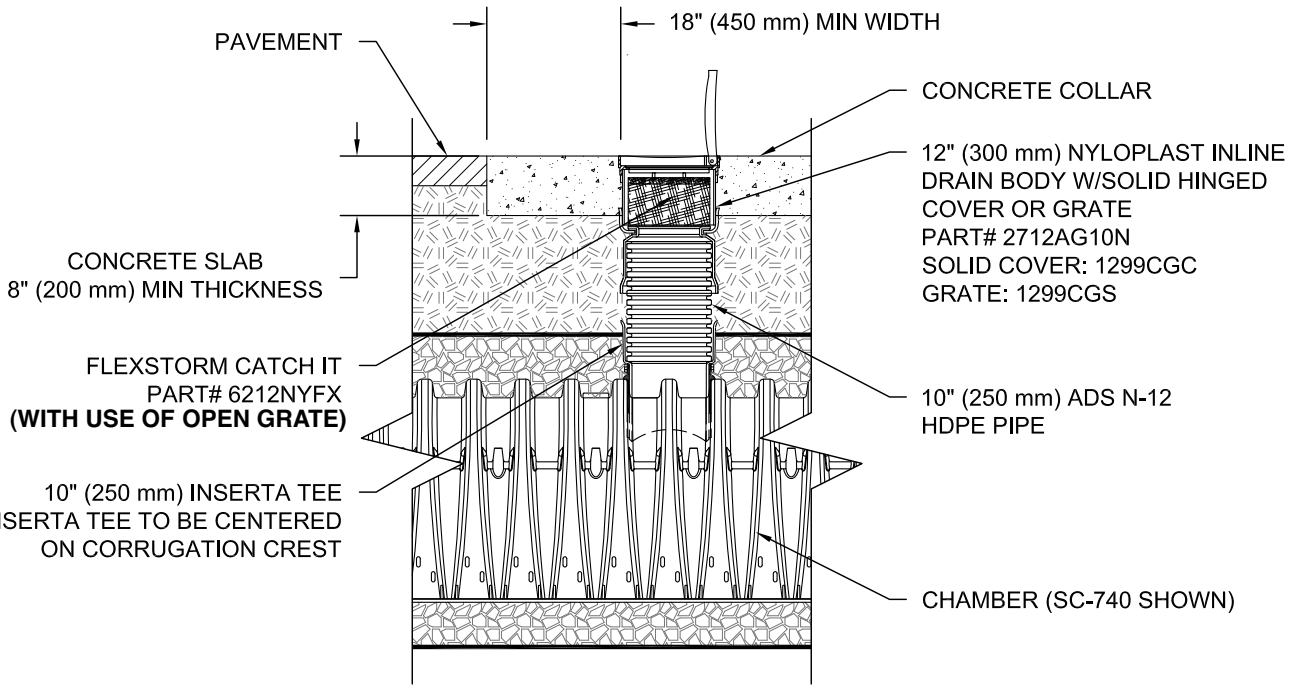
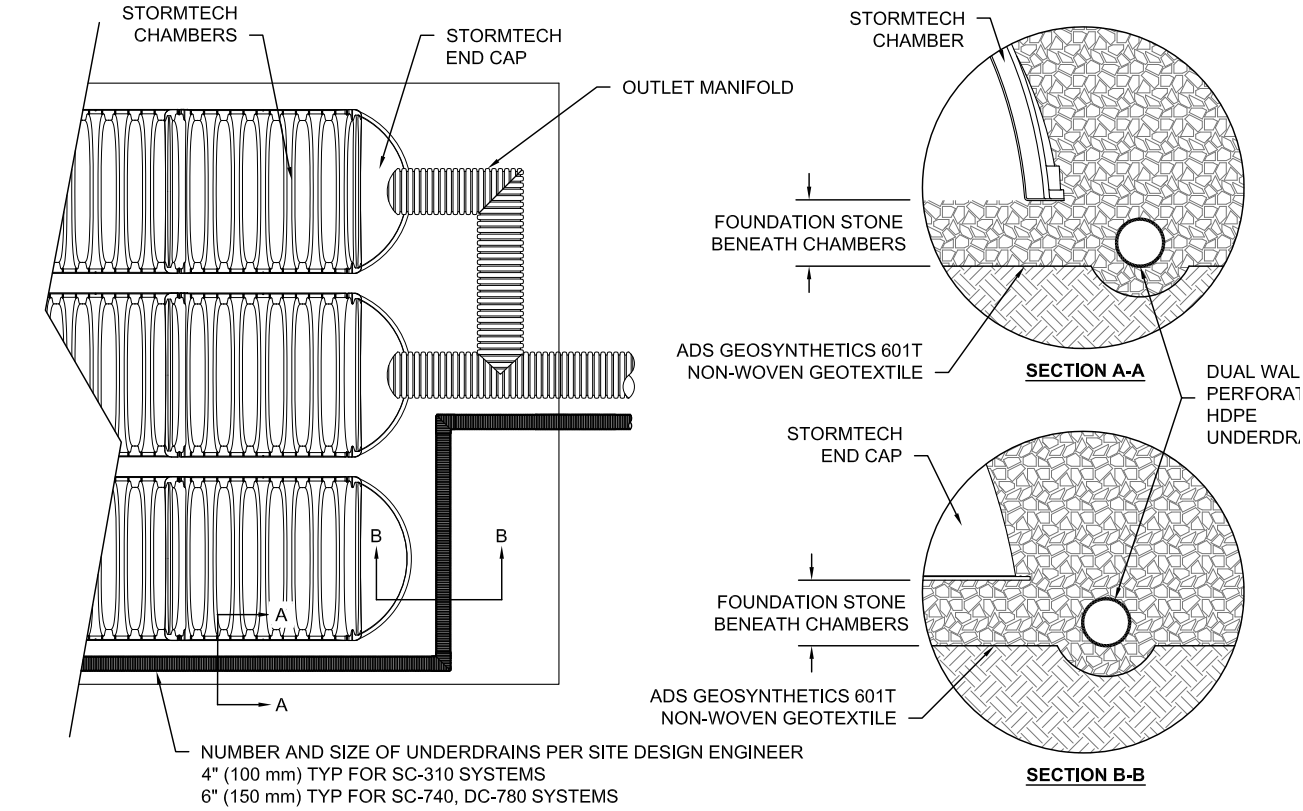


Figure 17 – Under Drain Detail



12.1 ISOLATOR ROW INSPECTION

Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3" (76 mm), cleanout is required.

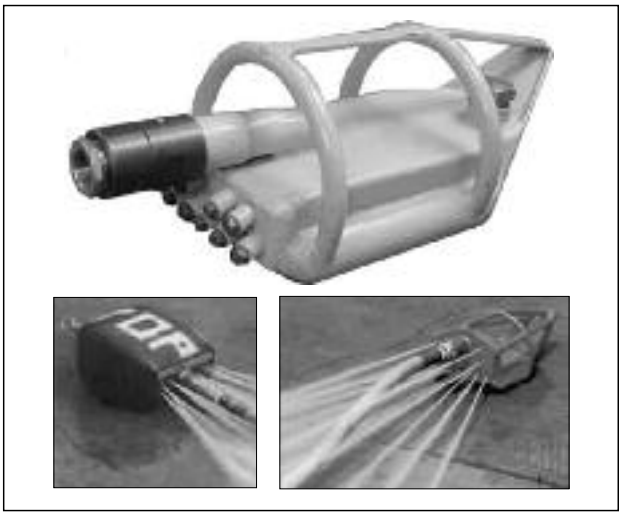
A StormTech Isolator Row should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

12.2 ISOLATOR ROW MAINTENANCE

JetVac maintenance is recommended if sediment has been collected to an average depth of 3" (76 mm) inside the Isolator Row. More frequent maintenance may be required to maintain minimum flow rates through the Isolator Row. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/ JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" (1143 mm) are best. The JetVac process shall only be performed on StormTech Rows that have AASHTO class 1 woven geotextile over the foundation stone (ADS 315ST or equal).

Looking down the Isolator Row.

A typical JetVac truck. (This is not a StormTech product.)



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

12.0 Inspection & Maintenance

STORMTECH ISOLATOR™ ROW - STEP-BY-STEP MAINTENANCE PROCEDURES

Step 1) Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment

iv. If sediment is at, or above, 3" (76 mm) depth proceed to Step 2. If not proceed to Step 3.

B) All Isolator Rows

i. Remove cover from manhole at upstream end of Isolator Row

ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Follow OSHA regulations for confined space entry if entering manhole

2. Mirrors on poles or cameras may be used to avoid a confined space entry

iii. If sediment is at or above the lower row of sidewall holes [approximately 3" (76 mm)] proceed to Step 2. If not proceed to Step 3.

Step 2) Clean out Isolator Row using the JetVac process

A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45" (1143 mm) or more is preferable

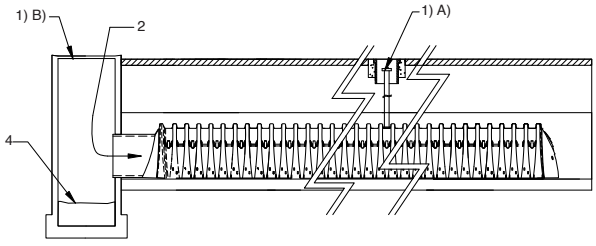
B) Apply multiple passes of JetVac until back-flush water is clean

C) Vacuum manhole sump as required during jetting

Step 3) Replace all caps, lids and covers

Step 4) Inspect and clean catch basins and manholes upstream of the StormTech system following local guidelines.

Figure 20 – StormTech Isolator Row (not to scale)



12.3 ECCENTRIC PIPE HEADER INSPECTION

Theses guidelines do not supercede a pipe manufacturer's recommended I&M procedures. Consult with the manufacturer of the pipe header system for specific I&M procedures. Inspection of the header system should be carried out quarterly. On sites which generate higher levels of sediment more frequent inspections may be necessary. Headers may be accessed through risers, access ports or manholes. Measurement of sediment may be taken with a stadia rod or similar device. Clean-out of sediment should occur when the sediment volume has reduced the storage area by 25% or the depth of sediment has reached approximately 25% of the diameter of the structure.

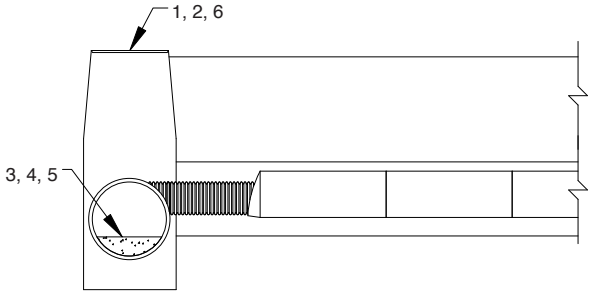
12.4 ECCENTRIC PIPE MANIFOLD MAINTENANCE

Cleanout of accumulated material should be accomplished by vacuum pumping the material from the header. Cleanout should be accomplished during dry weather. Care should be taken to avoid flushing sediments out through the outlet pipes and into the chamber rows.

Eccentric Header Step-by-Step Maintenance Procedures

1. Locate manholes connected to the manifold system
2. Remove grates or covers
3. Using a stadia rod, measure the depth of sediment
4. If sediment is at a depth of about 25% pipe volume or 25% pipe diameter proceed to step 5. If not proceed to step 6.
5. Vacuum pump the sediment. Do not flush sediment out inlet pipes.
6. Replace grates and covers
7. Record depth and date and schedule next inspection

Figure 21 – Eccentric Manifold Maintenance



Please contact StormTech's Technical Services Department at 888-892-2894 for a spreadsheet to estimate cleaning intervals.

13.0 General Notes

1. StormTech ("StormTech") requires installing contractors to use and understand StormTech's latest Installation Instructions prior to beginning system installation.
2. Our Technical Services Department offers installation consultations to installing contractors. Contact our Technical Service Representatives at least 30 days prior to system installation to arrange a pre-installation consultation. Our representatives can then answer questions or address comments on the StormTech chamber system and inform the Installing contractor of the minimum installation requirements before beginning the system's construction. Call **860-529-8188** to speak to a Technical Service Representative or visit **www.stormtech.com** to receive a copy of our Installation Instructions.
3. StormTech's requirements for systems with pavement design (asphalt, concrete pavers, etc.): Minimum cover for the SC-740, DC-780 and SC-310 chambers is 18" (457 mm) not including pavement; Maximum cover for the SC-740 and SC-310 chambers is 96" (2.4 m) including pavement design; Maximum cover for the DC-780 chamber is 12' (3.6 m) including pavement design. For installations that do not include pavement, where rutting from vehicles may occur, minimum required cover is 24" (610 mm), maximum cover is as stated above.
4. The contractor must report any discrepancies with the bearing capacity of the chamber foundation materials to the design engineer.
5. AASHTO M288 Class 2 non-woven geotextile (filter fabric) must be used as indicated in the project plans.
6. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of StormTech's Installation Instructions.
7. Backfilling over the chambers must follow requirements as indicated in the most current version of StormTech's Installation Instructions.
8. The contractor must refer to StormTech's Installation Instructions for a Table of Acceptable Vehicle Loads at various depths of cover. This information is also available at StormTech's website: **www.stormtech.com.** The contractor is responsible for preventing vehicles that exceed StormTech's requirements from traveling across or parking over the stormwater system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.
9. The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.
10. STORMTECH PRODUCT WARRANTY IS LIMITED. Contact StormTech for warranty information.

14.0 StormTech Product Specifications

1.0 GENERAL

1.1 StormTech chambers are designed to control stormwater runoff. As a subsurface retention system, StormTech chambers retain and allow effective infiltration of water into the soil. As a subsurface detention system, StormTech chambers detain and allow for the metered flow of water to an outfall.

2.0 CHAMBER PARAMETERS

2.1 The Chamber shall be injection molded of an impact modified polypropylene or polyethylene copolymer to maintain adequate stiffness through higher temperatures experienced during installation and service.

2.2 The nominal chamber dimensions of the StormTech SC-740 and DC-780 shall be 30.0" (762 mm) tall, 51.0" (1295 mm) wide and 90.7" (2304 mm) long. The nominal chamber dimensions of the StormTech SC-310 shall be 16.0" (406 mm) tall, 34.0" (864 mm) wide and 90.7" (2304 mm) long. The installed length of a joined chamber shall be 85.4" (2169 mm).

2.3 The chamber shall have a continuously curved section profile.

2.4 The chamber shall be open-bottomed.

2.5 The chamber shall incorporate an overlapping corrugation joint system to allow chamber rows of almost any length to be created. The overlapping corrugation joint system shall be effective while allowing a chamber to be trimmed to shorten its overall length.

2.6 The nominal storage volume of all StormTech chambers includes the volume of the clean, crushed, angular stone with an assumed 40% porosity. The nominal storage volume of a joined StormTech SC-740 chamber shall be 74.9 ft^3 (2.1 m^3) per chamber when installed per StormTech's typical details. This equates to a storage volume per unit area of bed of 2.2 ft^3/ft^2 (0.67 m^3/m^2). The nominal storage volume of a joined StormTech DC-780 chamber shall be 78.4 ft^3 (2.2 m^3) per chamber when installed per StormTech's typical details. This equates to a storage volume per unit area of bed of 2.3 ft^3/ft^2 (0.70 m^3/m^2). The nominal storage volume of a joined StormTech SC-310 chamber shall be 31.0 ft^3 (0.88 m^3) per chamber when installed per StormTech's typical details. This equates to a storage volume per unit area of bed of 1.3 ft^3/ft^2 (0.40 m^3/m^2).

2.7 The SC-740 and SC-310 chambers shall have forty-eight orifices penetrating the sidewalls to allow for lateral conveyance of water.

2.8 The chamber shall have two orifices near its top to allow for equalization of air pressure between its interior and exterior.

2.9 The chamber shall have both of its ends open to allow for unimpeded hydraulic flows and visual inspections down a row's entire length.

2.10 The chamber shall have 14 corrugations.

2.11 The chamber shall have a circular, indented, flat surface on the top of the chamber for an optional 4" (100 mm) diameter (maximum) inspection port.

2.12 The chamber shall be analyzed and designed using AASHTO methods for thermoplastic culverts contained in the LRFD Bridge Design Specifications, 2nd Edition, including Interim Specifications through 2001. Design live load shall be the AASHTO design truck. Design shall consider earth and live loads as appropriate for the minimum to maximum specified depth of fill.

2.13 The chamber shall be manufactured in an ISO 9001:2000 certified facility.

3.0 END CAP PARAMETERS

3.1 The end cap shall be designed to fit into any corrugation of a chamber, which allows: capping a chamber that has its length trimmed; segmenting rows into storage basins of various lengths.

3.2 The end cap shall have saw guides to allow easy cutting for various diameters of pipe that may be used to inlet the system.

3.3 The end cap shall have excess structural adequacies to allow cutting an orifice of any size at any invert elevation.

3.4 The primary face of an end cap shall be curved outward to resist horizontal loads generated near the edges of beds.

3.5 The end cap shall be manufactured in an ISO 9001:2000 certified facility.

15.0 Chamber Specifications for Contract Documents

STORMWATER CHAMBER SPECIFICATIONS:

1. Chambers shall be StormTech SC-740, SC-310 or approved equal.
2. Chambers shall conform to the requirements of ASTM F 2922, "Standard Specification for Polyethylene (PE) Corrugated Wall Stormwater Collection Chambers."
3. Chamber rows shall provide continuous, unobstructed internal space with no internal support panels.
4. The structural design of the chambers, the structural backfill and the installation requirements shall ensure that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met for: 1) long-duration dead loads and 2) short-duration live loads, based on the AASHTO Design Truck with consideration for impact and multiple vehicle presences.
5. Chambers shall conform to the requirements of ASTM F2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers."
6. Only chambers that are approved by the engineer will be allowed. The contractor shall submit (3 sets) of the following to the engineer for approval before delivering chambers to the project site:
   - A structural evaluation by a registered structural engineer that demonstrates that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met. The 50-year creep modulus data specified in ASTM F2922 must be used as part of the AASHTO structural evaluation to verify long-term performance.
7. Chambers shall be produced at an ISO 9001 certified manufacturing facility.
8. All design specifications for chambers shall be in accordance with the manufacturer's latest design manual.
9. The installation of chambers shall be in accordance with the manufacturer's latest installation instructions.

STORMWATER CHAMBER SPECIFICATIONS:

1. Chambers shall be StormTech DC-780 or approved equal.
2. Chambers shall conform to the requirements of ASTM F 2418, "Standard Specification for Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers."
3. Chamber rows shall provide continuous, unobstructed internal space with no internal support panels.
4. The structural design of the chambers, the structural backfill and the installation requirements shall ensure that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met for: 1) long-duration dead loads and 2) short-duration live loads, based on the AASHTO Design Truck with consideration for impact and multiple vehicle presences.
5. Chambers shall conform to the requirements of ASTM F2787, "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers."
6. Only chambers that are approved by the engineer will be allowed. The contractor shall submit (3 sets) of the following to the engineer for approval before delivering chambers to the project site:
   - A structural evaluation by a registered structural engineer that demonstrates that the load factors specified in the AASHTO LRFD Bridge Design Specifications, Section 12.12 are met. The 50-year creep modulus data specified in ASTM F2418 must be used as part of the AASHTO structural evaluation to verify long-term performance.
7. Chambers shall be produced at an ISO 9001 certified manufacturing facility.
8. All design specifications for chambers shall be in accordance with the manufacturer's latest design manual.
9. The installation of chambers shall be in accordance with the manufacturer's latest installation instructions.

A Family of Products and Services for the Stormwater Industry:

- MC-3500 and MC-4500 Chambers and End Caps
- SC-310 and SC-740 Chambers and End Caps
- DC-780 Chambers and End Caps
- Fabricated End Caps
- Fabricated Manifold Fittings
- Patented Isolator Row for Maintenance and Water Quality
- Chamber Separation Spacers
- In-House System Layout Assistance
- On-Site Educational Seminars
- Worldwide Technical Sales Group
- Centralized Product Applications Department
- Research and Development Team
- Technical Literature, O&M Manuals and Detailed CAD drawings all downloadable via our Web Site

StormTech provides state of the art products and services that meet or exceed industry performance standards and expectations. We offer designers, regulators, owners and contractors the highest quality products and services for stormwater management that "Saves Valuable Land and Protects Water Resources."

Please contact one of our inside project application professionals or Engineered Product Managers (EPMs) to discuss your particular application. A wide variety of technical support material is available in print, electronic media or from our website at www.stormtech.com. For any questions, please call StormTech at 888-892-2694.

StormTech®

Detention • Retention • Water Quality

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70 Inwood Road, Suite 3 | Rocky Hill | Connecticut | 06067
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Save Valuable Land and Protect Water Resources

Isolator® Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator® Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC-310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

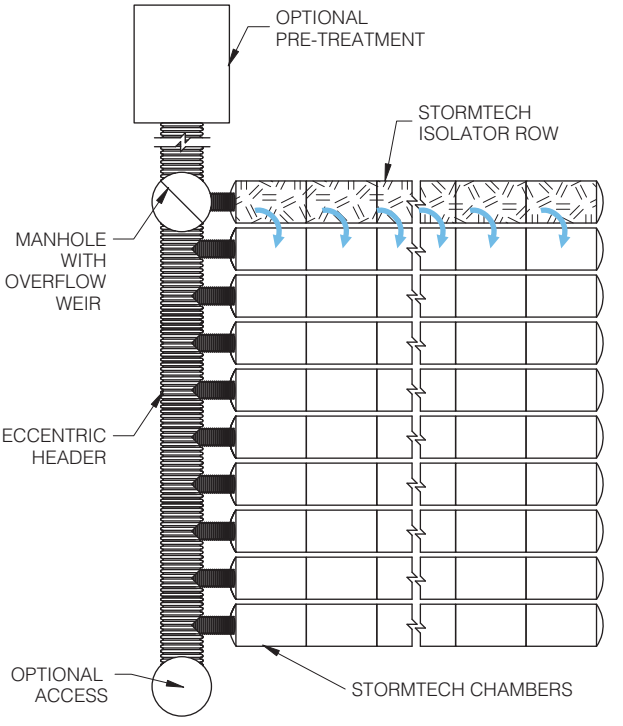
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

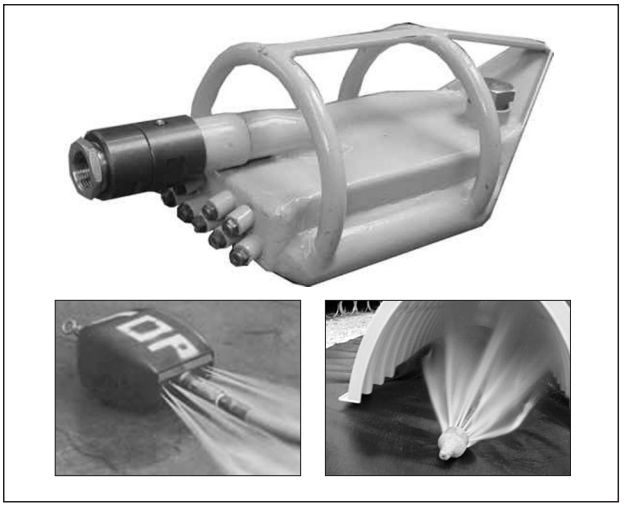
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

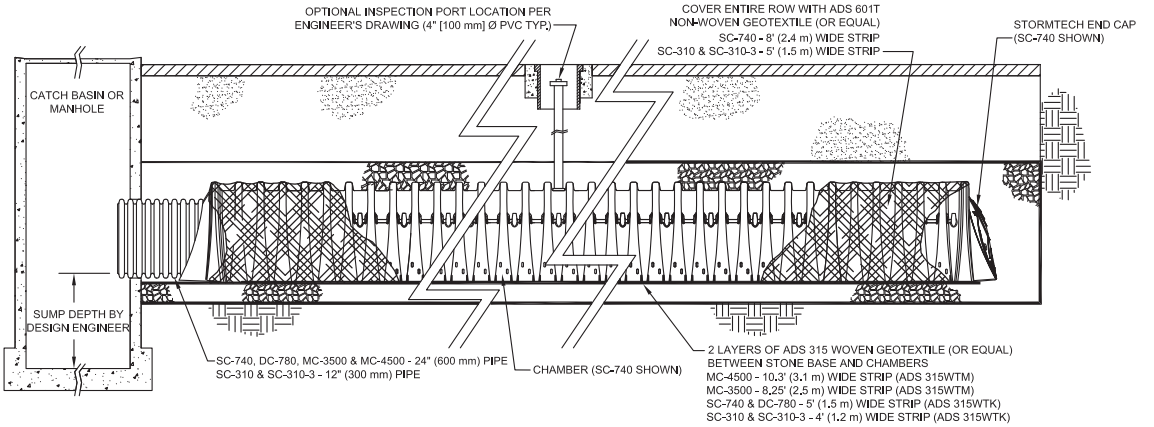
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)



NOTE: NON-WOVEN FABRIC IS ONLY REQUIRED OVER THE INLET PIPE CONNECTION INTO THE END CAP FOR DC-780, MC-3500 AND MC-4500 CHAMBER MODELS AND IS NOT REQUIRED OVER THE ENTIRE ISOLATOR ROW.

3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.

iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.

B) All Isolator Rows

i. Remove cover from manhole at upstream end of Isolator Row

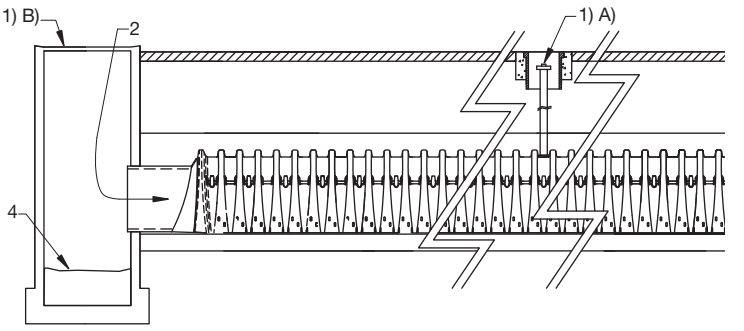
ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry

2. Follow OSHA regulations for confined space entry if entering manhole

iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process

A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable

B) Apply multiple passes of JetVac until backflush water is clean

C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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ADS GEOSYNTHETICS 0601T NONWOVEN GEOTEXTILE

Scope

This specification describes ADS Geosynthetics 6.0 oz (0601T) nonwoven geotextile.

Filter Fabric Requirements

ADS Geosynthetics 6.0 oz (0601T) is a needle-punched nonwoven geotextile made of 100% polypropylene staple fibers, which are formed into a random network for dimensional stability. ADS Geosynthetics 6.0 oz (0601T) resists ultraviolet deterioration, rotting, biological degradation, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. ADS Geosynthetics 6.0 oz (0601T) conforms to the physical property values listed below:

Filter Fabric Properties

PROPERTY	TEST METHOD	UNIT	M.A.R.V. (Minimum Average Roll Value)
Weight (Typical)	ASTM D 5261	oz/yd^2 (g/m^2)	6.0 (203)
Grab Tensile	ASTM D 4632	lbs (kN)	160 (0.711)
Grab Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs (kN)	60 (0.267)
CBR Puncture Resistance	ASTM D 6241	lbs (kN)	410 (1.82)
Permittivity*	ASTM D 4491	sec^{-1}	1.5
Water Flow*	ASTM D 4491	gpm/ft^2 ($l/min/m^2$)	110 (4480)
AOS*	ASTM D 4751	US Sieve (mm)	70 (0.212)
UV Resistance	ASTM D 4355	%/hrs	70/500

PACKAGING	
Roll Dimensions (W x L) – ft	12.5 x 360 / 15 x 300
Square Yards Per Roll	500
Estimated Roll Weight – lbs	195

* At the time of manufacturing. Handling may change these properties.

ADS GEOSYNTHETICS 315W WOVEN GEOTEXTILE

Scope

This specification describes ADS Geosynthetics 315W woven geotextile.

Filter Fabric Requirements

ADS Geosynthetics 315W is manufactured using high tenacity polypropylene yarns that are woven to form a dimensionally stable network, which allows the yarns to maintain their relative position. ADS Geosynthetics 315W resists ultraviolet deterioration, rotting and biological degradation and is inert to commonly encountered soil chemicals. ADS Geosynthetics 315W conforms to the physical property values listed below:

Filter Fabric Properties

PROPERTY	TEST METHOD	ENGLISH M.A.R.V. (Minimum Average Roll Value)	METRIC M.A.R.V. (Minimum Average Roll Value)
Tensile Strength (Grab)	ASTM D-4632	315 lbs	1400 N
Elongation	ASTM D-4632	15%	15%
CBR Puncture	ASTM D-6241	900 lbs	4005 N
Puncture	ASTM D-4833	150 lbs	667 N
Mullen Burst	ASTM D-3786	600 psi	4134 kPa
Trapezoidal Tear	ASTM D-4533	120 lbs	533 N
UV Resistance (at 500 hrs)	ASTM D-4355	70%	70%
Apparent Opening Size (AOS)*	ASTM D-4751	40 US Std. Sieve	0.425 mm
Permittivity	ASTM D-4491	.05 sec^{-1}	.05 sec^{-1}
Water Flow Rate	ASTM D-4491	4 gpm/ft^2	163 $l/min/m^2$
Roll Sizes		12.5' x 360' 15.0' x 300' 17.5' x 258'	3.81 m x 109.8 m 4.57 m x 91.5 m 5.33 m x 78.6 m

*Maximum average roll value.

H 2 M architects + engineers
2 Executive Boulevard, Ste 401
Suffern, NY 10901 | tel 845.357.7238

Union Hook & Ladder and Rescue Fire Police – SWPPP
29 Green Street
Village of Mount Kisco, NY 10549
New Croton Reservoir Drainage Basin
DEP Log #2018-CNC-0734-SP.1

Underground Storage Chambers: Inspection and Maintenance Procedure[1]

Step 1) Inspect Isolator Row for sediment
A) Inspection ports (if present)
i. Remove lid from floor box frame
ii. Remove cap from inspection riser
iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.
iv. If sediment is at, or above, 3-inch depth proceed to Step 2. If not proceed to step 3.
B) All Isolator Rows
i. Remove cover from manhole at upstream end of Isolator Row
ii. Using a flashlight, inspect down Isolator Row through outlet pipe
1.Mirrors on poles or cameras may be used to avoid a confined space entry
2. Follow OSHA regulations for confined space entry if entering manhole
iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

Step 2) Clean out Isolator Row using the JetVac process
A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

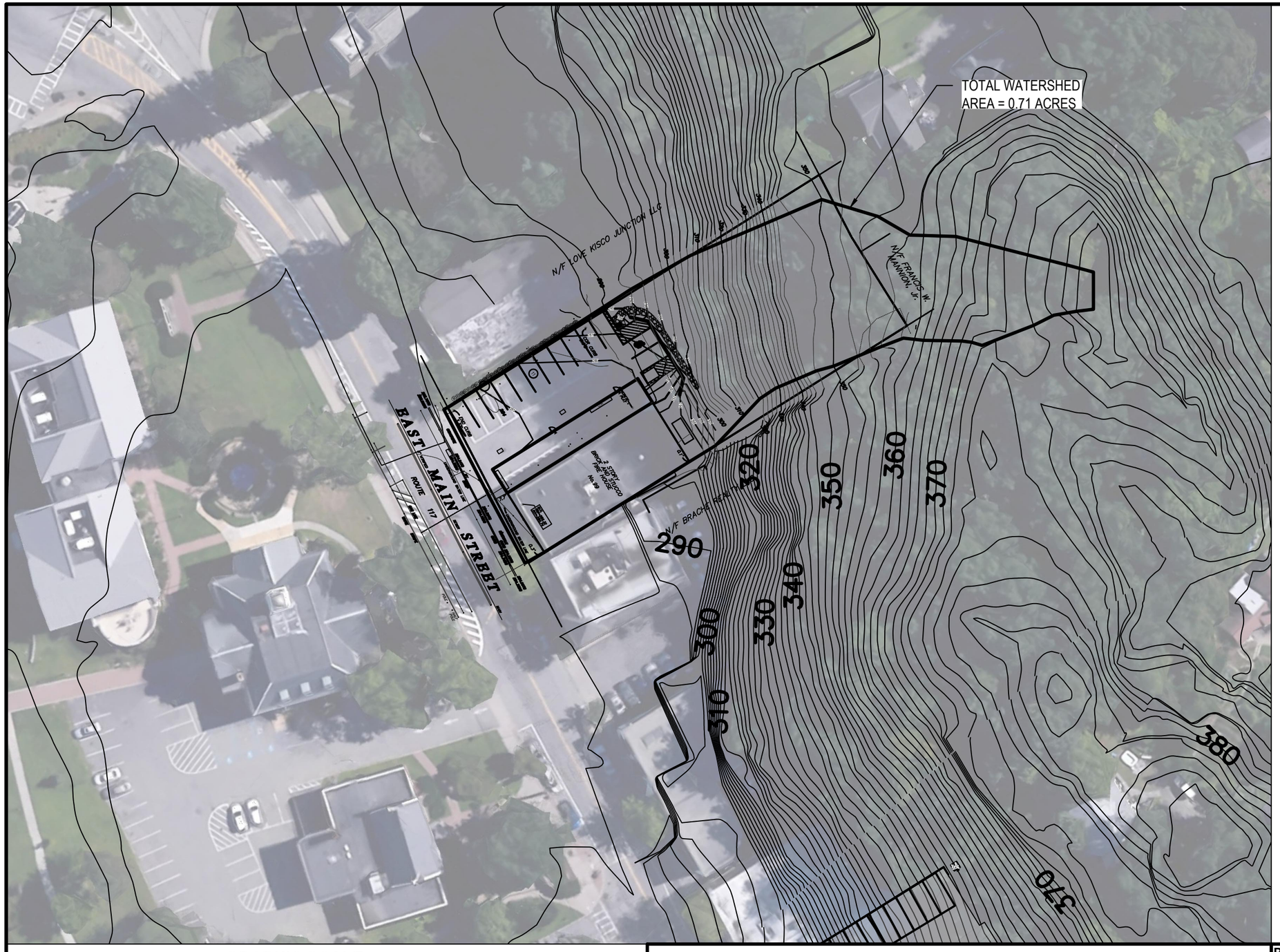
Document all inspections and maintenance items on the following page:

[1] Per Advanced Drainage Systems' StormTech Isolator Row O&M Manual last revised February 2013.

Date	Stadia Rod Readings		Sediment Depth (1) – (2)	Observations/Actions	Inspector
	Fixed Point to Chamber Bottom (1)	Fixed Point to Top of Sediment (2)			

Appendix I

Overall Drainage Map
Pre and Post Development Drainage Maps
Engineering Plans



DRAINAGE AREA NOTES:

1. THE DRAINAGE AREA MAP DEPICTS THE SITE'S POST-DEVELOPMENT CONDITION. THE TOTAL DRAINAGE AREA WILL NOT CHANGE FROM PRE TO POST DEVELOPMENT CONDITIONS. AS A RESULT, THE DRAINAGE AREA MAP IS INTENDED TO SHOW THE DRAINAGE AREA FOR THE SITE BOTH PRE AND POST-DEVELOPMENT.

2. THIS MAP HAS BEEN CREATED FOR DEP REVIEW AND SWPPP PURPOSES ONLY. THE DRAINAGE MAP IS NOT FOR CONSTRUCTION OR ANY OTHER PURPOSE.

GRAPHIC SCALE

60 0 30 60

(IN FEET)
1 inch = 60 ft.

DRAINAGE AREA MAP

Project #
MKIV-1802

DATE:
JAN 2019

H 2 M architects + engineers
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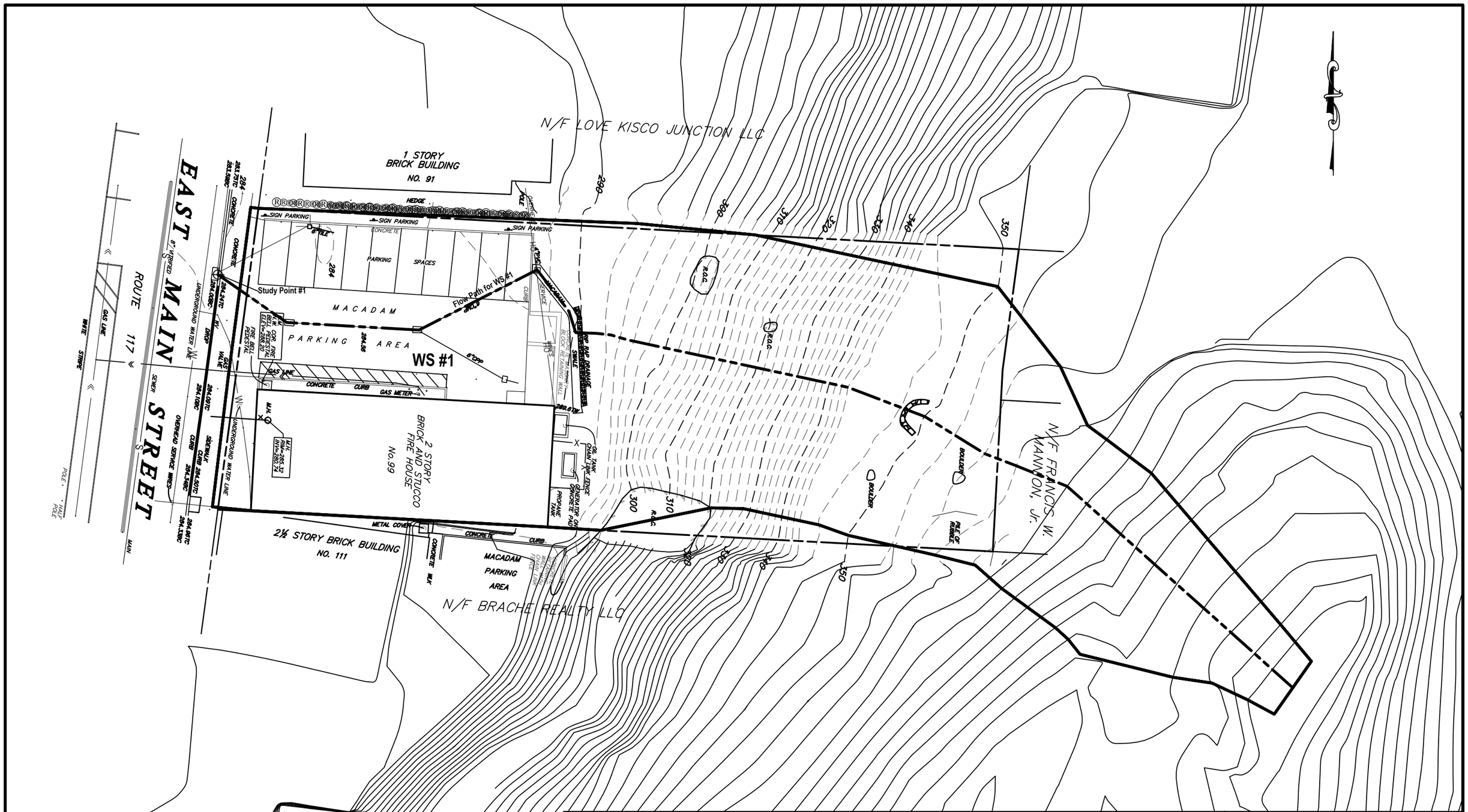

PRE-DEVELOPMENT DRAINAGE MAP

Project # MKIV-1802

DATE: NOV 2021

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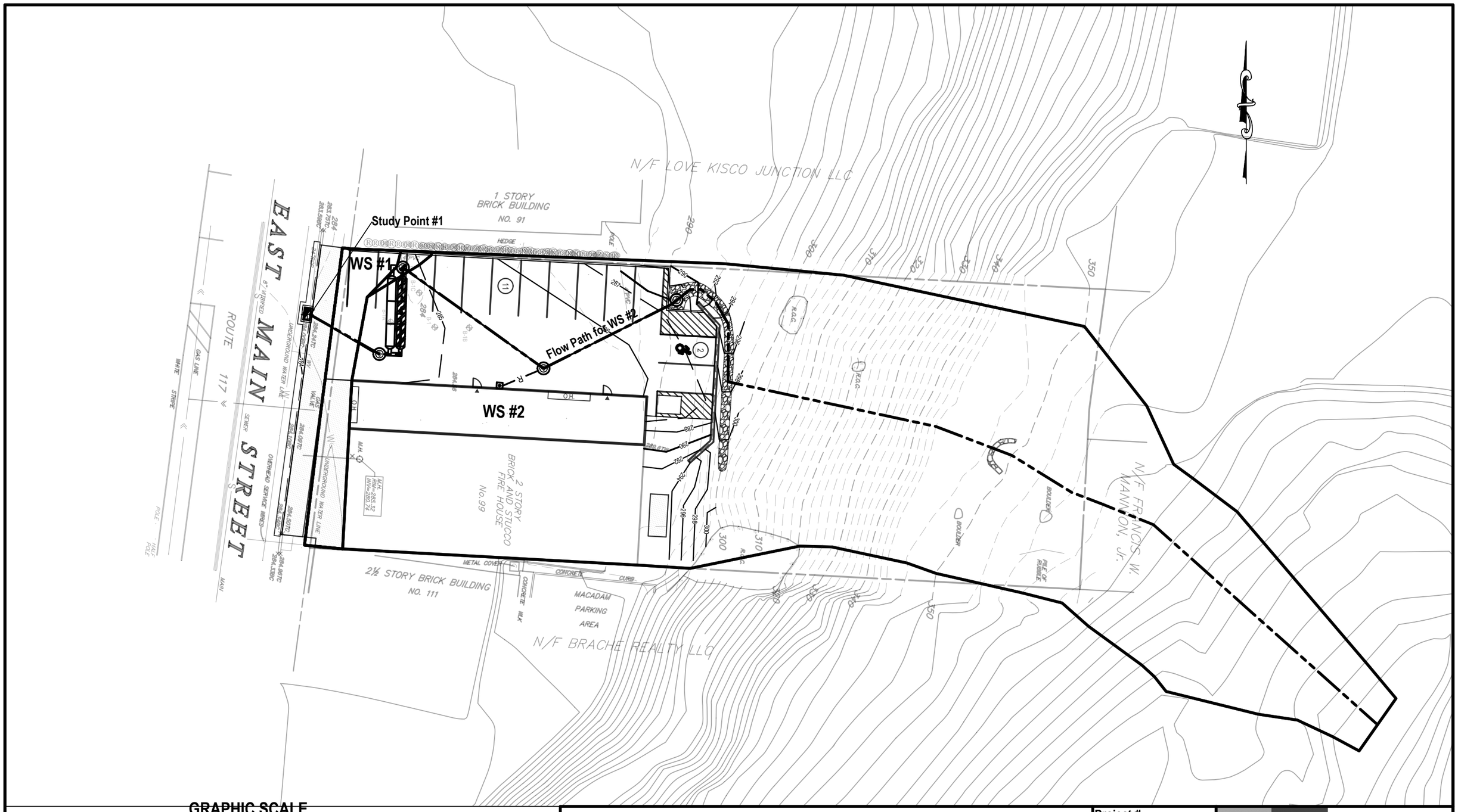
Melville, NY Purchase, NY Parsippany, NJ
New York, NY Latham, NY Howell, NJ



GRAPHIC SCALE

30 0 15 30

(IN FEET)

1 inch = 30 ft.

POST-DEVELOPMENT DRAINAGE MAP

Project # MKIV-1802

DATE: NOV 2021

H2M architects + engineers

Suffern, NY
Melville, NY Purchase, NY Parsippany, NJ
New York, NY Latham, NY Howell, NJ

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