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PROJECT MANUAL

VOLUME 4 OF 4: Divisions 26 - 33

Newburgh Enlarged City School District
New CTE Building

CTE Building SED No. 44-16-00-01-0-053-001

CSArch Project # 108-2303.00

REGISTRATION EXPIRATION DATE: 12/31/2026

The design of this project conforms to applicable provisions of the New York State Uniform Fire Prevention and Building Code the New York State Energy Conservation Construction Code and the Manual of Planning Standards of the New York State Education Department

CSARCH

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SECTION 260500 – GENERAL ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. The General and Supplementary Conditions are a part of the requirements for the work under this Division of the Specifications.

1.2 WORK INCLUDED

A. Provide labor and materials required to install, test and place into operation the electrical systems as called for in the Contract Documents, and in accordance with applicable codes and regulations.

B. Provide labor, materials, and accessories required to provide complete, operating electrical systems. Labor, materials or accessories not specifically called for in the Contract Documents, but required to provide complete, operating electrical systems shall be provided without additional cost to the Owner.

1.3 QUALITY ASSURANCE

A. Comply with the current applicable codes, ordinances, and regulations of the Authority or Authorities Having Jurisdiction, the rules, regulations and requirements of the utility companies serving the project, and the Owner's insurance underwriter.

B. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, the most stringent apply.

C. Should any change in drawings or specifications be required to comply with governing regulations, notify the Engineer prior to submitting bid.

D. All electrical equipment, materials, devices and installations shall meet or exceed minimum requirements of ADA, ANSI, ASTM, IEEE, IES, NEC, NEMA, NETA, NFPA, OSHA, SMACNA, UL, and the State Fire Marshal.

E. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, workperson-like manner by competent workpeople. Provide a competent, experienced, full-time Superintendent who is authorized to make decisions on behalf of the Contractor.

F. Equipment shall be certified for use in the state of New York and shall meet the New York State energy code.

1.4 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

1.	ADA	Americans with Disabilities Act
2.	ANSI	American National Standards Institute
3.	ASA	Acoustical Society of America
4.	ASTM	American Society for Testing and Materials
5.	BIL	Basic Impulse Level
6.	CBM	Certified Ballast Manufacturers
7.	ECC	Engineer's Control Center
8.	EIA	Electronic Industries Alliance
9.	ETL	Electrical Testing Laboratories, Inc.
10.	FCC	Fire Control Center
11.	FM	Factory Mutual
12.	IEEE	Institute of Electrical and Electronic Engineers
13.	IES	Illuminating Engineering Society
14.	IPCEA	International Power Cable Engineers Association
15.	LED	Light Emitting Diode
16.	NEC	National Electric Code
17.	NEMA	National Electrical Manufacturers Association
18.	NETA	National Electrical Testing Association
19.	NFPA	National Fire Protection Association
20.	OEM	Original Equipment Manufacturer
21.	OSHA	Occupational Safety and Health Administration
22.	SCC	Security Control Center
23.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
24.	TIA	Telecommunications Industry Association
25.	UL	Underwriters Laboratories Inc.

B. Definitions:

1. Where it is stated in these specifications to submit to Engineer for review, refer to Architectural General and Supplementary Conditions for proper procedures.
2. FURNISH means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.

3. INSTALL means to join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation.
4. PROVIDE means to FURNISH and INSTALL.
5. AS DIRECTED means as directed by the Engineer, or the Engineer's Representative.
6. CONCEALED means embedded in masonry or other construction, installed behind wall furring or within drywall partitions, or installed within hung ceilings.
7. SUBMIT means submit to Engineer for review.

1.5 GUARANTEE

A. Submit a single guarantee stating that the work is in accordance with the Contract Documents. Guarantee work against faulty and improper material and workmanship for a period of one year from the date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are provided or specified herein, the longer term shall apply. Manufacturer's warranty/guarantee on equipment shall be begin at time of equipment startup not upon receipt of equipment. Correct any deficiencies, which occur during the guarantee period, within 24 hours of notification, without additional cost to the Owner, to the satisfaction of the Owner. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.

1.6 USE OF THE ARCHITECT'S AND ENGINEER'S DRAWINGS

A. The Contractor shall obtain, at the Contractor's expense, from the Architect or Engineer a set of AutoCAD or compatible format architectural and engineering drawings on electronic media where desired by the Contractor and/or required by the Specifications for use in preparing the shop drawings, coordination drawings, and record drawings. The Contractor shall provide to the Architect and Engineer a written release of liability acceptable to the Architect and Engineer prior to receiving the electronic media.

PART 2 – PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide products and materials that are new, clean, free of defects, and free of damage and corrosion.

B. Products and materials shall not contain asbestos, PCB, or any other material that is considered hazardous by the Environmental Protection Agency or any other Authority Having Jurisdiction.

C. Replace materials of less than specified quality and relocate work incorrectly installed as directed by the Architect or Engineer at no additional cost to the Owner.

D. Provide name/data plates on major components of equipment with manufacturer’s name, model number, serial number, capacity data and electrical characteristics attached in a conspicuous place.

E. Install materials and equipment with qualified trades people.

F. Maintain uniformity of manufacturer for equipment used in similar applications and sizes.

G. Fully lubricate equipment where required.

H. Follow manufacturer’s instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.

I. Where factory testing of equipment is required to ascertain performance, and attendance by the Owner’s Representative is required to witness such tests, associated travel costs and subsistence shall be paid for by the Contractor.

J. Equipment capacities, ratings, etc., are scheduled or specified for job site operating conditions. Equipment sensitive to altitude shall be derated with the method of derating identified on the submittals.

K. Enclosures for electrical equipment installed in mechanical and electrical equipment rooms shall be NEMA type 1 gasketed. Enclosures for electrical equipment installed outdoors shall be NEMA type 3R unless otherwise noted.

L. Energy consuming equipment shall be certified for use in the state of New York and shall meet the New York State Energy Code and local energy ordinances.

2.2 SUBSTITUTIONS

A. Contract Documents are based on equipment manufacturers as called out in the Specifications and indicated on the Drawings. Acceptance of substitute equipment manufacturers does not relieve Contractor of the responsibility to provide equipment and materials, which meet the performance as, stated or implied in the Contract Documents.

B. Submit proposals to provide substitute materials or equipment, in writing, with sufficient lead time for review prior to the date equipment must be ordered to maintain project schedule. Reimburse Owner for costs associated with the review of the proposed substitution whether substitution is accepted or rejected.

C. Indicate revisions required to adapt substitutions including revisions by other trades. Substitutions that increase the cost of the work and related trades are not permitted.

D. The proposed substitution shall conform to the size, ratings, and operating characteristics of the equipment or systems as specified and shown on the Drawings.

E. Proposals for substitutions shall include the following information:

1. A description of the difference between the Contract Document requirements and that of the substitution, the comparative features of each, and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of additional costs to the other trades.
2. Schematic drawings and details.
3. List of revisions to the Contract Documents that must be made if the substitution is accepted.
4. Estimate of costs the Owner may incur in implementing the substitution, such as test, evaluation, operating and support costs.
5. Statement of the time by which a Contract modification accepting the substitution must be issued, noting any effect on the Contract completion time or the delivery schedule.
6. A statement indicating the reduction to the Contract price if the Owner accepts the substitution. Include required modifications to all related trades.

PART 3 – EXECUTION

3.1 FEES AND PERMITS

A. Pay all required fees and obtain all required permits related to the electrical installation.

B. Pay royalties or fees in connection with the use of patented devices and systems.

C. Provide an electrical inspection for all related electrical work by a qualified New York State electrical inspection agency. The inspection shall be performed, in the presence of the engineer or architect of record. An electrical approval certificate shall be issued by the electrical inspection agency.

3.2 SUBMITTALS AND REVIEWS

A. Submit shop drawings, manufacturer's product data sheets, samples, and test reports as specified.

B. After execution of Owner/Contractor Agreement, submit a complete typed list of all electrical equipment manufacturers and material suppliers for the equipment proposed to be provided on this project, as well as names of all subcontractors.

C. After execution of Owner/Contractor Agreement, prepare an index of all submittals for the project. Include a submittal identification number, a cross-reference to the Specification sections or Drawing number, and an item description. Prefix the submittal identification number by the Specification sections to which they apply. Indicate on each submittal, the submittal identification number in addition to the other data specified. All subcontractors shall utilize the assigned submittal identification number.

D. After the Contract is awarded, obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all materials and equipment as specified. Submit data and details of such materials and equipment for review. Prior to submission, certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Check all materials and equipment upon their arrival on the job site and verify their compliance with the Contract Documents. Modify any work, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

E. Review of submittals is for general compliance with the design concept and Contract Documents. Comments or absence of comments shall not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing the work in a safe manner, and for coordinating the work with that of other trades.

F. No part of the work shall be started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted and accepted.

G. A minimum period of ten working days, exclusive of transmittal time, will be required in the Engineer's office each time a shop drawing, product data and/or samples are submitted for review. This time period must be considered by the Contractor in the scheduling of the work.

H. Submit electronic copies, preferably in PDF format, of all items requiring shop drawings.

I. Submit materials and equipment by manufacturer, trade name, and model number. Include copies of applicable brochure or catalog material. Maintenance and operating manuals are not acceptable substitutes for shop drawings.

J. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as materials or paint finishes.

K. Include dimensional data for roughing in and installation and technical data sufficient to verify that equipment meets the requirements of the Contract Documents. Include wiring, conduit, outlet-type and service connection data; motor sizes complete with voltage ratings and schedules.

L. Maintain a complete set of reviewed and stamped shop drawings and product data on site.

M. Prepare and submit detailed shop drawings for major electrical and telecommunications conduit duct banks and other distribution services in 3/8" = 1'-0" sale, include locations and sizes of openings in floor decks, walls and roofs.

N. For each room or area of the building containing electrical equipment, submit the following:

1. Floor Plans: Plan and elevation layout drawings indicating the equipment in the exact location in which it is intended to be installed. These plans shall be of a scale not less than 1/4 inch to 1 foot. They shall be prepared in the following manner:
    a. Indicate the physical boundaries of the space including door swings and ceiling heights and ceiling types (as applicable).
    b. Illustrate all electrical equipment proposed to be contained therein. Include top and bottom elevations of all electrical equipment. The Drawings shall be prepared utilizing the dimensions contained in the individual equipment submittals. Indicate code and manufacturer's required clearances.

c. Illustrate all other equipment therein such as conduits, detectors, luminaries, ducts, registers, pull boxes, wireways, structural elements, etc.
d. Indicate the operating weight of each piece of equipment.
e. Indicate the heat release from each piece of electrical equipment in terms of BTU per hour. This information shall be that which is supplied by the respective manufacturers.
f. Illustrate concrete pads, curbs, etc.
g. Indicate dimensions to confirm compliance with code-required clearances.
h. Indicate maximum normal allowable operating temperature for each piece of equipment (as per each respective manufacturer's recommendation).
i. Equipment removal routes.
j. Any exterior wall or foundation penetrations.

O. All shop drawings shall be prepared using AutoCAD software. Hand drawn shop drawings will not be accepted.

P. The work described in shop drawing submissions shall be carefully checked by all trades for clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and coordination with other trades on the job. Each submitted shop drawing shall include a certification that related job conditions have been checked by the Contractor and each Subcontractor and that conflicts do not exist.

Q. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions, or for deviations from the requirements of the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superceded in any way by the review of shop drawings, product data and samples.

R. Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.

3.3 COORDINATION OF WORK

A. The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Drawings are diagrammatic.

B. Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay.

C. The electrical drawings show the general arrangement of equipment and appurtenances. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories, which may be required but not shown on the Drawings. Investigate the site, and review drawings of other trades to determine conditions affecting the work, and provide such work and accessories as may be required to accommodate such conditions.

D. The locations of lighting fixtures, outlets, panels and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions, or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

E. Exercise particular caution with reference to the location of panels, outlets, switches, etc., and have precise and definite locations accepted by the Engineer before proceeding with the installation.

F. The Drawings show only the general run of raceways and approximate locations of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Engineer for review before such alterations are made. Modifications shall be made at no additional cost to the Owner.

G. Verify with the Architect the exact location and mounting height of outlets and equipment not dimensionally located on the Drawings prior to installation.

H. Circuit tags in the form of numbers are used where shown to indicate the circuit designation numbers in electrical panels. Show the actual circuit numbers on the as-built Record Drawings and on the associated typed panelboard directory card. Where circuiting is not indicated, provide required circuiting in accordance with the loading indicated on the Drawings and/or as directed.

I. The Drawings generally do not indicate the number of wires in conduit for the branch circuit wiring of fixtures and outlets, or the actual circuiting. Provide the correct wire size and quantity as required by the indicated circuiting and/or circuit numbers indicated, the control intent, referenced wiring diagrams (if any), the specified voltage drop or maximum distance limitations, and the applicable requirements of the NEC. All power branch circuits shall be equipped with a ground conductor.

J. Carefully check space requirements with other trades to ensure that equipment can be installed in the spaces allotted.

K. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (remote LED Drivers, pull boxes, etc.) requiring access in order that the ceiling trade will know where to install access doors and panels.

L. Consult with other trades regarding equipment so that, wherever possible, motor controls and distribution equipment are of the same manufacturer.

M. Furnish and set sleeves for passage of conduits through structural masonry and concrete walls and floors and elsewhere as required for the proper protection of each conduit passing through building surfaces.

N. Provide firestopping around all pipes, conduits, ducts, sleeves, etc. which pass through rated walls, partitions and floors.

O. Provide detailed information on openings and holes required in precast members for electrical work.

P. Provide required supports and hangers for conduit and equipment, designed so as not to exceed allowable loadings of structures.

Q. Examine and compare the Contract Documents with the drawings and specifications of other trades, and report any discrepancies between them to the Engineer and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

R. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit these drawings to the Engineer for review. At completion include a set of these drawings with each set of Record Drawings.

S. Furnish services of an experienced Superintendent, who shall be in constant charge of all work, and who shall coordinate work with the work of other trades. No work shall be installed before coordinating with other trades.

T. Coordinate with the local electric utility company and the local telecommunications company as to their requirements for service connections and provide all necessary metering provisions, grounding, materials, equipment, labor, testing, and appurtenances.

U. Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

V. Adjust location of conduits, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication.

1. Right-of-Way: Lines which pitch have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets, transitions and changes in direction of conduit as required to maintain proper headroom and pitch on sloping lines.

W. In cases of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Engineer.

3.4 CONTRACTOR’S COORDINATION DRAWINGS

A. The Contractor shall coordinate efforts of all trades and shall furnish (in writing, with copies to the Engineer) any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. The Contractor and all trade contractors shall prepare a complete set of construction Coordination Drawings indicating the equipment actually purchased and the exact routing for all lines such as busway, conduit, piping, ductwork, etc., including conduit embedded in concrete floors and walls. The Coordination Drawings shall be submitted complete to the Architect and the Engineer, within three months after execution of Owner/Contractor Agreement, and in compliance with the construction schedule for the project. The sheet metal drawings, at a scale of not less than 1/4 inch to 1 foot, shall serve as the base drawings to which all other Contractors shall add their work. Each separate trade contractor shall draw their work on separate layers with different color assignments to facilitate coordination. Each Coordination Drawing shall be completed and signed off by the other Trade Contractors and the Contractor prior to the installation of the HVAC, plumbing, electrical and fire sprinkler work in the area covered by the specific drawing. The Contractor's work shall be installed according to the shop drawings and coordination drawings. If the Contractor allows one trade to install their work before coordination with the work of other trades, the Contractor shall make all necessary changes to correct the condition at no additional cost to the Owner.

C. The Contractors' Coordination Drawings shall indicate structural loads at support points for all piping 10 inch and larger, racked piping, racked conduit, busway, and suspended electrical equipment. Submit to Structural Engineer for review and approval. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. Coordination Drawings shall document all required structural penetrations for initial construction. Penetrations shall be dimensioned for walls, floors and roofs. These structural coordination requirements require review and approval by the Structural Engineer prior to completion and submittal of the Drawings.

D. This requirement for Coordination Drawings shall not be construed as authorization for the Contractor or trade contractors to make any unauthorized changes to the Contract Documents. Contract document space allocations shall be maintained such as ceiling height, designated clearance for future construction and flexibility, chase walls, equipment room size, unless prior written authorization is received from the Engineer to change them.

E. Prior to final acceptance of the Work, the Contractor shall submit the Coordination Drawings as part of the Record Drawings submittal.

3.5 EXAMINATION OF SITE

A. Prior to the submitting of bids, visit the project site and become familiar with all conditions affecting the proposed installation and make provisions as to the cost thereof.

B. The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work. Evaluate existing conditions, which may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for the satisfactory completion of the work.

3.6 EXCAVATION AND BACKFILL

A. Provide excavation for the work of this Division. Excavate all material encountered, to the depths indicated on the Drawings or as required. Remove from the site excavated materials not required or suitable for backfill. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water, which accumulates. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel.

B. Provide trenches of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum overdepth of four inches below the trench depths indicated on the Drawings or required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose, granular, moist earth, thoroughly machine-tamped to a compaction level of at least 95 percent to standard proctor density or 75 percent relative density or as specified by the Civil Engineer. Whenever unstable soil that is incapable of properly supporting the work is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.

C. Excavate trenches for utilities that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown:

1. Electric service: Three (3) feet minimum.
2. Telephone service: Three (3) feet minimum.
3. Cable TV service: Three (3) feet minimum

D. Trenches should not be placed within ten feet of foundation or soil surfaces, which must resist horizontal forces.

E. Do not backfill trenches until all required tests have been performed and installation observed by the Engineer. Comply with the requirements of other sections of the Specifications. Backfill shall consist of non-expensive soil with limited porosity. Deposit in 6 inch layers and thoroughly and carefully tamp until the work has a cover of not less than one foot. Backfill and tamp remainder of trench at one-foot intervals until complete. Uniformly grade the finished surface.

F. Install warning tape in the trench backfill

G. Prior to filling in or covering over work, photo document the as-built utilities for record.

H. After filing in or covering over work, provide video inspection of each underground utility's interior to ensure that no damage occurred during the installation.

3.7 CUTTING AND PATCHING

A. Where cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, lay out the work carefully in advance. Repair any damage to the building, piping, equipment or defaced finished plaster, woodwork, metalwork, etc., using skilled tradespeople of the trades required at no additional cost to the Owner.

B. Do not cut, channel, chase or drill unfinished masonry, tile, etc., unless permission from the Architect is obtained. If permission is granted, perform this work in a manner acceptable to the Architect.

C. Where conduit or equipment are mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Utilize cold galvanized bare metal whenever support channels are cut.

D. Provide slots, chases, openings and recesses through floors, walls, ceilings, and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.

3.8 MOUNTING HEIGHTS

A. Mounting heights shall conform to ADA requirements.

B. Verify exact locations and mounting heights with the Architect before installation.

C. Mounting heights of electrical device shall match what is indicated on the drawings. Use the following mounting heights if not indicated on the drawings (finished floor to center of device):

1. Electrical and telecommunications outlets: 15 inches, unless otherwise noted.
2. Lighting Switches/Wall Occupancy Sensors: 48 inches

3. Outlets for public and wall mounted telephones: conform to ADA mounting height.
4. Wall-mounted exit signs: 2 inches above top of door frame to bottom of sign.
5. Low-Level Exit Signs: 6″ to bottom of sign.
6. Stairwell and utility corridor wall mounted fixtures: 8′-6″ above finished floor or one foot below ceiling or structure above whichever is lower.

3.9 CLEANING UP

A. Avoid accumulation of debris, boxes, loose materials, crates, etc., resulting from the installation of this work. Remove from the premises each day all debris, boxes, etc., and keep the premises clean and free of dust and debris.

B. Clean all light fixtures and equipment at the completion of the project. Wipe clean exposed lighting fixture reflectors and trim pieces with a non-abrasive cloth just prior to occupancy.

C. All electrical equipment shall be thoroughly vacuumed and wiped clean prior to energization and at the completion of the project. Equipment shall be opened for observation by the Engineer as required.

3.10 WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings.

B. Restore waterproofing integrity of walls or surfaces after they have been penetrated without additional cost to the Owner.

3.11 SUPPORTS

A. Support work in accordance with the best industry practice. Provide supports, hangers, auxiliary structural members and supplemental hardware required for support of the work.

B. Provide supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric closets and mechanical equipment rooms.

C. Provide supporting frames or racks for equipment which is to be installed in a freestanding position.

D. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members, rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

E. Adequate support of equipment (including outlet, pull and junction boxes and fittings) shall not depend on electric conduits, raceways, or cables for support.

F. Electrical equipment shall not rest on or depend for support on suspended ceiling media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling). Provide independent support of electrical equipment. Do not attach to supports provided for ductwork, piping or work of other trades.

G. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure. Electrical equipment and supports shall not come in contact with work of other trades.

3.12 FASTENINGS

A. Fasten equipment to building structure in accordance with the best industry practice.

B. Where weight applied to building attachment points is 100 pounds or less, conform to the following as a minimum:

1. Wood: Wood screws.
2. Concrete and solid masonry: Bolts and expansion shields.
3. Hollow construction: Toggle bolts.
4. Solid metal: Machine screws in tapped holes or with welded studs.
5. Steel decking or sub-floor: Fastenings as specified below for applied weights in excess of 100 pounds.

C. Where weight applied to building attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following as a minimum:

1. At concrete slabs provide 24-inch by 24-inch by 1/2-inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and

grouted flush with the top of slab screed line, where no fill is to be applied.

2. At steel decking or sub-floor for all fastenings, provide through bolts or threaded rods. The tops of bolts or rods shall be set at least one inch below the top fill screed line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with their decking or sub-floor, such hangers shall be provided.

D. Where weight applied to building attachment points exceeds 300 pounds, coordinate with and obtain the approval of Engineer and conform to the following as a minimum:

1. Provide suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.

E. For items, which are shown, as being ceiling-mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.

F. Wall-mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars. Prefabricated steel channels as manufactured by Kindorf or Unistrut are acceptable.

3.13 IDENTIFICATION

A. Identify electrical equipment with permanently attached black phenolic nameplates with 1/2-inch high white engraved lettering. Identification shall include equipment name or load served as appropriate. Nameplates for equipment connected to the emergency power system shall be red with white lettering. Nameplates shall be attached with cadmium-plated screws; peel-and-stick tape or glue-on type nameplates are not allowed.

B. Cable tags shall be flameproof secured with flameproof non-metallic cord.

C. Provide an engraved nameplate for each switch controlling loads, which are not local to the switch.

D. Wherever raceways for future use are terminated outside of the building, stake the location with a 2-foot long, 1-inch by 1-inch clear heart redwood stake.

E. See individual Sections for additional identification requirements.

3.14 PROHIBITED LABELS AND IDENTIFICATIONS

A. In all public areas, the inclusion or installation of any equipment or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other source(s) from which such object has been obtained, is prohibited, unless otherwise approved by Owner.

B. Required UL labels shall not be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

3.15 EQUIPMENT PADS AND ANCHOR BOLTS

A. Provide concrete pads under all floor-mounted electrical equipment. Equipment pads shall conform to the shape of the piece of equipment it serves with a minimum 1-inch margin around the equipment and supports. Pads shall be a minimum of 4 inches high and made of a minimum 28 day, 2500 psi concrete reinforced with 6-inch by 6-inch 6/6 gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bullnosed to a 3/4-inch radius.

B. Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Provide bolts of the size and number recommended by the manufacturer of the equipment and locate by means of suitable templates. Equipment installed on vibration isolators shall be secured to the isolator. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation manufacturer.

C. Where equipment is mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and securely attach to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6 inches square, 18 gauge galvanized metal backplates, which are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not allowed.

3.16 DELIVERY, DRAYAGE AND HAULING

A. Provide drayage, hauling, hoisting, shoring and placement in the building of equipment specified and be responsible for the timely delivery and installation of equipment as required by the construction schedule. If any item of equipment is received prior to the time that it is required, the Contractor shall be responsible for its proper storage and protection until the time it is required. Pay for all costs of drayage or storage.

B. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for resulting disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc., at no additional cost to the Owner.

3.17 EQUIPMENT AND MATERIAL PROTECTION

A. Protect the work, equipment, and material of other trades from damage by work or workmen of this trade, and correct damaged caused without additional cost to the Owner.

B. Take responsibility for work, materials, and equipment until finally inspected, tested and accepted. Protect 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 obstructing material. Cover and protect equipment and materials from damage due to water, spray-on fireproofing, construction debris, etc. Store equipment to moisture damage in dry, heated spaces.

C. Provided adequate means for fully protecting finished parts of materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair.

3.18 TESTING OF ELECTRICAL SYSTEMS

A. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and Contract close-out. Complete any adjustments and/or alterations, which the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. See individual Sections for extent of testing required.

B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when field testing will be performed. Submit completion schedule for review within six months after the notice to proceed by Owner's Representative has been given. Update this schedule periodically as the project progresses.

3.19 OPERATING INSTRUCTIONS

A. Provide the services of factory-trained specialists to provide an operating instructions seminar for equipment and systems. The seminar shall be conducted over a five-day (consecutive) period. Instruction time is defined as straight time working hours and does not include nights, weekends, or travel time to and from the project.

B. Submit seminar agenda, schedule and list of representatives to the Owner for approval 30 days prior to suggested date of seminar. Do not commence seminar until the Owner has issued a written acceptance of the starting time and attendees. Confirm attendance of seminar by written notification to participants.

C. Instruct Owner's operating personnel in proper starting sequences, operation, shut-down, general maintenance and preventative maintenance procedures, including normal and emergency procedures.

D. Submit final copies of Record Drawings and Operating and Maintenance Manuals to Owner at seminar.

E. Submit a written record of minutes and attendees of the seminar to the Owner.

3.20 OPERATING AND MAINTENANCE MANUALS

A. Provide Operating and Maintenance Manuals for equipment and materials furnished under this Division.

B. Submit three final copies of Operating and Maintenance Manuals for review at least ten weeks before the completion date. Assemble data in a completely indexed volume or volumes in three-ring binders and identify the size, model, and features indicated for each item. Print the project name on the outside of the binders.

C. Maintenance manuals shall include complete cleaning and servicing data compiled in a clear and easily understandable format. Show model numbers of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.

D. Provide the following information where applicable:

1. Identifying name and mark number
2. Locations (where several similar items are used, provide a list)
3. Complete nameplate data
4. Certified Record Drawings and Final Reviewed submittals
5. Parts list
6. Performance curves and data
7. Wiring diagrams
8. Manufacturer’s recommended operating and maintenance instructions with all non-applicable information deleted
9. List of spare parts recommended for normal service requirements
10. Assembly and disassembly instructions with exploded-view drawings where necessary
11. Test reports
12. Trouble shooting diagnostic instructions, where applicable

3.21 RECORD DRAWINGS

A. The Contractor shall maintain on a daily basis at the Project site a complete set of black and white “As-built Drawings” reflecting an accurate dimensional record of all deviations between work shown on the Contract Drawing and that actually installed.

B. Record dimensions clearly and accurately to delineate the work as installed. Suitably identify locations of all equipment by at least two dimensions to permanent structures. In addition, mark the Record Drawings to show the precise location of concealed work and equipment, including concealed or embedded conduit and all changes and deviations in the electrical work from that shown on the Contract Documents. This requirement is not construed as authorization for the Contractor to make changes in the layout or work without written instructions from the Engineer.

C. AutoCAD files shall be electronically updated to record all revisions of the original drawings as actually installed. Bear the cost of making required changes. Upon completion of the installation, submit electronic PDFs and (1) set of black and white prints of these revised drawings to the Architect and Engineer for review of completeness.

D. After the Architect's and Engineer's review, and any required Contractor revisions, the Record Drawings shall be delivered to the Owner on electronic media in AutoCAD format.

E. The Contractor and Subcontractor shall mark all in-progress Record Drawings on the front lower right hand corner with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING **(3/8-inch high letters)** **To be used for recording Field Deviations and Dimensional Data Only** **(5/16-inch high letters)**

F. Upon completion of the work, the Contractor shall certify all Record Drawings on the front lower right hand corner adjacent to the above marking with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING **CERTIFIED CORRECT** **(3/8-inch high letters)** **(Printed Name of General Contractor)** **(5/16-inch high letters)** **Date:______________________________** **(Printed Name of Subcontractor)** **(5/16-inch high letters)** **Date:______________________________**

G. Indicate Contractor’s firm name on the record and as-built drawings.

3.22 FINAL PUNCHLIST

A. Prior to the Final Punchlist, certify that systems and equipment are complete, operational, and are in compliance with the Contract Documents.

B. At a time designated by the Owner with assistance from the Contractor, the installation will be reviewed for compliance with the Contract Drawings and Specifications. Contractor shall be available at all time during these surveys.

C. During the Final Punchlist, provide personnel with access keys, hand held radios, and necessary expertise to operate each system and piece of equipment to demonstrate operational compliance with the Contract Documents.

D. Any deficiencies noted on the Final Punchlist shall be expeditiously corrected and certified in writing.

3.23 PROJECT CLOSEOUT

A. At the time of project closeout and prior to the final payment, this contractor shall provide/submit the following for owner to review and sign off:

1. Review with Owner and confirm that all field issues are resolved.
2. Submit two (2) binder books with all electrical system testing report, equipment certificate and operation manual as per these specifications.
3. Submit electrical 3-phase load balancing report with the Engineer's review
4. Provide the Owner with required training as per these specifications.
5. Provide spare parts, fuses, switches, components, as per these specifications.
6. Turn all keys, including door access keys and panelboard keys to the Owner with proper tags.
7. Submit construction record as-built sets with A/E review stamp.
8. All proposals and change orders are fully executed and submit a certified statement that no change orders will be submitted after project closeout.
9. Submit copies of the Authority's inspection and approval letters.

END OF SECTION 260500

SECTION 260501 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The drawings are diagrammatic, unless detailed dimensioned drawings are included, and show only approximate locations of equipment, fixtures, panelboards, conduits, and wiring devices. Exact locations are subject to the approval of the Owner's Representative. The general run of electrical feeders, branch circuits, and conduits, indicated on the drawings, is not intended to be the exact routing. Exact routings of conduit shall suit the job conditions.

B. Circuit designations, in the form of "Home Runs" on branches, indicate the designation of the branch circuit, the size and the quantity of branch circuit conductors, and the panel board or interconnection box from which the branch circuit is served.

C. Make measurements at the site and in the building during construction for all systems installed as the work progresses in such a manner that the equipment, piping, vents, ducts, conduit, and boxes will fit in the space available. Maintain headroom and if in unfinished areas, be as neatly installed, as obscure and "out-of-the-way" as physically possible. Where more than one trade is involved in an area, space or chase, all shall cooperate and install their own work to utilize the space equally between them in proportion to their individual requirements. In general, ductwork shall be given preference except where grading of piping becomes a problem, followed by piping then electrical wiring. If, after installation of any equipment, piping, ducts, conduit, and boxes, it is determined that ample maintenance and passage space has not been provided, rearrange work and /or furnish other equipment as required for ample maintenance space.

D. Any changes in the size or location of the material or equipment supplied, which may be necessary in order to meet field conditions or in order to avoid conflicts between trades, shall be brought to the immediate attention of the Owner's Representative and approval received before such alterations are made.

1.2 QUALITY ASSURANCE

A. Electric equipment shall be installed in a neat and workmanlike manner. All methods of construction, details of workmanship, that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative.

B. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc., correspond to the nomenclature dictated by those manufacturers. Where "or equal" is stated, equipment shall be equal in every way to that of the equipment specified and subject to approval. All equipment shall be tested at the factory. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

1.3 SUBMITTALS

A. Submit product data for the following equipment, materials and products, including all fittings and accessories:

1. Conduit
2. Expansion Fittings
3. Wireway and Wire Trough
4. Cable Tray
5. Channel Support Systems
6. Conductors
7. Terminal and Equipment Cabinets
8. Telephone/Data Communication Outlets
9. Television Outlets
10. Clocks
11. Water Proofing Seals
12. Flashing, Sealing, Firestopping Materials

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit, Raceway and Tubing:

1. Rigid Metal Conduit (RMC) shall be hot-dipped galvanized or electro-galvanized steel, UL listed "rigid metal conduit."

   a. Acceptable Manufacturers:

      1) Nucor Tubular Products
      2) Allied Tube and Conduit
      3) Wheatland Tube
      4) Approved equal

2. Electrical Metallic Tubing (EMT) shall be electro-galvanized steel with corrosion resistant zinc coating; UL listed.

   a. Acceptable Manufacturers:

      1) Nucor Tubular Products
      2) Allied Tube and Conduit
      3) Wheatland Tube
      4) Approved equal

3. Flexible Metal Conduit (FMC) shall be constructed of one continuous length of electro-galvanized, spirally wound steel strip with interlocking convolutions and interior surfaces free from burrs and sharp edges; UL listed.

a. Acceptable Manufacturers:

1) AFC (American Flexible Conduit) Cable Systems
2) Anaconda Sealtite by ANAMET Electrical, Inc.
3) Southwire

4. Liquidtight Flexible Metal Conduit (LFMC) shall be constructed of one continuous length of electro-galvanized, spirally wound steel strip with interlocking convolutions, interior surfaces free from burrs and sharp edges, and an outer liquidtight, nonmetallic, sunlight-resistant jacket; UL listed.

a. Acceptable Manufacturers:

1) AFC (American Flexible Conduit) Cable Systems
2) Anaconda Sealtite by ANAMET Electrical, Inc.
3) Southwire

5. Electrical Nonmetallic Tubing (ENT) shall be a nonmetallic, pliable, corrugated raceway of circular cross section with integral or associated couplings, connectors, and fittings, and made of materials that is resistant to moisture and flame retardant; UL listed. ENT shall me the requirements of NEMA TC-13 and shall be recognized by a CABO National Evaluation Report for use in one (1) hour and two (2) hour rated construction. Only cement recommended specifically for use with the brand of ENT used shall be used. Unless indicated differently on drawings, ENT systems shall be color coded BLUE for branch and feeder circuit wiring, YELLOW for communications, and RED for fire alarm and emergency systems.

a. Acceptable Manufacturers:

1) Carlon
2) Heritage Plastics
3) Approved equal

6. Rigid Polyvinyl Chloride Conduit (PVC) shall be made from polyvinyl chloride compound and be homogenous plastic material free from visible cracks, holes, or foreign inclusions. Conduit bore shall be smooth and free of blisters, nicks, or other imperfections. Conduit shall be rated for use with 90ºC conductors and UL listed. Conduit and fittings shall be tested in accordance with the testing requirements defined in NEMA TC-2, NEMA TC-3, UL-651 and UL-514. Schedule 40 shall be white in color; Schedule 80 shall be gray in color.

a. Acceptable Manufacturers:

1) Carlon
2) Heritage Plastics
3) JM Eagle
4) Cantex

B. Conduit Fittings:

1. Fittings for rigid metal conduit shall be fully threaded and shall be of the same material as the respective raceway system. Fittings for electrical metallic tubing shall be single screw indenter fittings for conduits up to 2 in. and double screw indenter fittings for conduits 2 in. and larger. Connectors shall also have insulated throat or plastic insulating bushing up to and including 1 in. size. For sizes 1-1/4 in. and larger, provide plastic insulating bushing. Die-cast, pressure cast fittings shall not be used. Fittings for rigid non-metallic conduit shall be solvent cemented in accordance with the manufacturer's instructions.

a. Acceptable Manufacturers:

1) O.Z. Gedney
2) Steel City
3) Thomas & Betts
4) Crouse-Hinds
5) Carlon

2. Expansion Fittings shall be watertight, combination expansion and deflection type designed to compensate for movement in any direction. Fittings shall have flexible copper braid bonding jumpers, neoprene sleeve and stainless steel bands, use aluminum body fittings for rigid aluminum conduit.

a. Acceptable Manufacturers:

1) Crouse-Hinds, Type "XD"
2) O.Z./Gedney, Type "DX"
3) Approved equal

C. Wireway, Wire Trough, and Auxiliary Gutters:

1. Wireway and Wire Trough shall be hinged cover type wireway with provisions for full lay-in along the entire length of run. Wireway shall be steel, enclosed with gray enamel finish. Provide NEMA 1 units for interior/dry/clean locations and NEMA 12 for interior dry maintenance/shop/utility locations. Size to meet NEC fill requirements or larger as noted on Contract Documents. Provide knockouts along runs. Recess in wall where required for flush mounted equipment. Hinge shall be on the bottom of front face for horizontal mounting. Provide all covers, couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, tees, pullboxes, hangers, reducers, supports, and other fittings to match and mate with wireways as required for complete system.

a. Acceptable Manufacturers:

1) Square D "Square Duct"
2) General Electric
3) Hoffman
4) Meco

D. Cable Trays:

1. Solid Bottom Cable Trays shall be aluminum construction, including accessories. One-piece construction bottom and side, sheet aluminum 080 ±5%. Aluminum alloy side rails and bottom channel with flanges in standard lengths 12 ft. - 0 in. long. Wrap around type bolted connector to connect tray sections. Cover required where indicated on Contract Documents and in all areas used as return air plenums. Use three-piece construction, consisting of a solid corrugated bottom welded to the side rails. Provide divider strip where noted on Contract Documents. Minimum inside radius of horizontal elbows shall be 12 in. Provide special radius elbows where required for field conditions. Horizontal and vertical bends for solid bottom trays shall have solid bottoms. Loading data:

Tray Width	Load Depth	Usable NEMA Depth	Standard	Span	Lbs. Per Feet	Deflection
12 in.	4 in.	3 in.	12B	10 ft.	115	0.15 in.
18 in.	4 in.	3 in.	12B	10 ft.	115	0.015 in.
18 in.	6 in.	3 in.	12C	10 ft.	144	0.15 in.

a. Provide a safety-loading factor of 1.5 for uniformly distributed loads when supported as a simple span in accordance with the NEMA standard listed.

b. Shall be painted as directed by the architect.

c. Acceptable Manufacturers:

1) P-W
2) B-Line Systems
3) Chalfant
4) Globe

E. Low Voltage (600V or less) Conductors and Cables:

1. Conductors shall be insulated for 600 volts, unless otherwise noted, and shall be standard AWG and kcmil sizes. Conductors shall be 98% copper, thermal plastic or cross-linked polymer insulated, heat and moisture resistant. Conductor sizes No. 18 AWG and smaller shall be a solid single strand; No. 16 AWG and larger shall be multiple stranded. Minimum conductor size shall be #12 AWG except smaller sizes may be used for communications and special systems. Conductor sizes shall be as called for. Conductors shall be labeled with UL seal and be marked with the manufacturer's name, wire size and insulation type. Insulation for all 600 volt conductors shall be Type THHN/THWN-2 or Type XHHW-2, unless otherwise noted. All exterior and underground conductors shall be XHHW-2. Luminaire fixture wire shall conform to the latest Underwriters Laboratories requirements. Flexible cords and cables for general portable use shall be Type SO or SOOW or as noted. Cables for special use shall be of the type specified for the application.

a. Color Coding:

1) All circuits shall be color coded according to the following schedule.

	Three Phase 120/208V 240V	**Three Phase 277/480V**
Ground	Green	Green
Neutral	White	Gray
A or L1	Black	Brown
B or L2	Red	Orange
C or L3	Blue	Yellow

b. Acceptable Manufacturers:

1) General Cable (Brand of Prysmian Group)
2) Southwire
3) The Okonite Company
4) Service Wire Co.
5) Encore Wire

2. Terminal Lugs and Connectors:

a. The lug shall be capable of continuous operation at the current rating of the cable it is used on. The lug shall be UL listed per UL 486A, using industry standard crimping tools and dies. Terminal lugs shall be solderless, pressure type with UL label for "CU/AL" conductor terminations. The lug shall be a closed-end compression (crimp) type, constructed of seamless, alloy suitable for copper and/or aluminum conductors to match the conductor. The lug shall be made with a chamfered inside end, for ease of conductor insertion. Both one and two hole lugs shall be NEMA sized for standard stud sizes and spacing. The lug shall be designed for use at the system voltage.

1) Acceptable Manufacturers:

a) 3M Scotchlok 30,000 and 31,000 Series
b) Burndy
c) O.Z./Gedney
d) Thomas and Betts

b. The conductor connection shall be capable of continuous operation at the current rating of the cables it is used on. The connection shall be UL listed per UL 486A, using industry standard crimping tools and ides. The connector shall be an inline compression (crimp) type, constructed of seamless, tin-plated copper. The connector shall be constructed with chamfered inside-ends and with center cable stops. The connector shall be designed for use at the system voltage.

1) Acceptable Manufacturers:

a) 3M Scotchlok 10,000 and 11,000 Series
b) Burndy
c) O.Z./Gedney
d) Thomas and Betts

c. "Split-bolt" Connectors shall be solderless type.

1) Acceptable Manufacturers:

a) Burndy
b) Kearney
c) O.Z./Gedney
d) Thomas and Betts
e) Anderson

d. "TWIST ON" Connectors shall be spiral steel spring type and insulated with vinyl cap and skirt.

1) Acceptable Manufacturers:

a) 3-M Company "Scotch-Lok"
b) Ideal "Wing-Nuts"
c) Approved equal

F. Outlet Boxes, Device Boxes, Rings, and Covers:

1. Outlet Boxes having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit or cable fittings, or cables, with provisions for mounting outlet box cover. Outlet boxes shall be galvanized steel, not less than 2-1/2 in. deep, unless restricted by the surroundings, 4 in. square or octagonal. Boxes and associated fittings, plates and devices shall be mechanically fastened (screwed), friction fitting is not acceptable. Outlet boxes exposed to moisture, surface mounted, exterior, wet or damp locations shall be cadmium cast alloy complete with external threaded hubs and gasketed screw fastened covers. Minimum box size shall be as indicated in the NEC for the conductors and devices installed. Boxes shall be approved for the environmental condition where they will be installed.

2. Conduit bodies providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point and listed in accordance with outlet box requirements.

3. Extension ring intended to extend sides of outlet box or device box to increase box, volume, or both.

a. Acceptable Manufacturers:

1) Steel City
2) Raco

3) Appleton
4) Crouse Hinds

4. Telephone/Data Communications Outlet Boxes:

   a. 2 in. x 4 in. outlet box with single gang plaster ring with cover plate suitable for indicated communications outlet and conduit routed to cable tray. Cover plate shall match the receptacle cover type.

5. Pull and junction boxes shall be constructed of not less than 14 gauge galvanized steel with trim for flush or surface mounting in accordance with the location to be installed. Provide screw-on type covers. Boxes installed in damp or wet locations shall be of raintight construction with gasketed cover and threaded conduit hubs. In no case shall boxes be sized smaller than as indicated NEC for conduit and conductor sizes installed. Boxes shall be approved for the environmental condition of the location where they will be installed.

   a. Acceptable Manufacturers:

      1) Hoffman
      2) Keystone
      3) Approved equal

G. Terminal and Equipment Cabinets:

1. Terminal and equipment cabinets shall be code gauge galvanized steel with removable endwalls. Fronts shall be of code gauge steel, flush or surface type (as indicated) with concealed trim clamps, concealed hinges, flush lock, and grey baked enamel finish. Boxes and front shall be UL listed and shall be minimum 35 in. H x 24 in. W x 6 in. D. Provide removable insulated plywood terminal board mounted on inside back wall of cabinet.

   a. Acceptable Manufacturer:

      1) Square D "Mono-Flat"
      2) Approved equal

H. Waterproofing Seals:

1. Provide expanding link type seal, for installation between duct/conduit, and sleeve or core-drilled hole in concrete.

2. Make: Link Seal, manufactured by Thunderline Corp., or approved equal.

I. Flashing, Sealing, Fire-stopping:

1. Fire-Stopping for Openings Through Fire and Smoke Rated Wall and Floor Assemblies:

   a. Provide materials and products listed or classified by an approved independent testing laboratory for "Through-Penetration Fire-Stop

Systems". The system shall meet the requirements of "Fire Tests of Through-Penetration Fire-Stops" designated ASTM E814.

b. Provide fire-stop system seals at all locations where piping, tubing, conduit, electrical busways/cables/wires, ductwork and similar utilities pass through or penetrate fire rated wall or floor assembly. Provide fire-stop seal between sleeve and wall for drywall construction.

c. The minimum required fire resistance ratings of the wall or floor assembly shall be maintained by the fire-stop system. The installation shall provide an air and watertight seal.

d. The methods used shall incorporate qualities, which permit the easy removal or addition of electrical conduits or cables without drilling or use of special tools. The product shall adhere to itself to allow repairs to be made with the same material and permit the vibration, expansion and/or contraction of any items passing through the penetration without cracking, crumbling and resulting reduction in fire rating.

2. Acceptable Manufacturers:

a. Dow Corning Fire-Stop System Foams and Sealants
b. Nelson Electric Fire-Stop System Putty, CLK and WRP
c. S-100 FS500/600, Thomas & Betts
d. Carborundum Fyre Putty
e. 3-M Fire Products

2.2 WIRE GUARD

A. Where specified herein or shown on the drawings provide a wire guard for devices or equipment. Units shall be custom as needed for the application.

B. Wire guard shall be a minimum #6 wire gage of zinc plated steel, overall clear coating and welded at joints. For any unit needing access it shall have an integral hinge and locking means.

C. Wires shall have 2 in. maximum spacing.

D. Acceptable Manufacturers:

1. Design Make: American Time and Signal

2. Approved equal

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA NEIS (National Electrical Installation Standard) latest edition.

B. Unless otherwise noted, wiring for all systems indicated in the contract documents shall consist of insulated conductors installed in raceways. Raceways shall be continuous from outlet box to outlet box and from outlet box to cabinet, junction or pull box. Secure and bond raceways to all boxes and cabinets so that each system of raceways is electrically continuous throughout. Unless otherwise indicated on the drawings, install all wiring in the following raceway system:

1. Wiring 600 Volts or Less in Dry Locations: EMT.

2. Wiring 600 Volts or Less in Dry Locations and Subject to Physical Damage: RMC**.**

3. Wiring 600 Volts or Less in Outdoors, Above Grade Locations: PVC-80**.**

4. Wiring 600 Volts or Less Installed Below Grade, in Concrete Floor Slabs or Below Ground Floor Slab: PVC-40 encased in concrete with rigid metal conduit bends and penetrations through building floors and walls.

5. Flexible metal conduit shall be used for final connection to all motors, final connection to rotating or vibrating equipment, final connections to dry type transformers and final connections to recessed lighting fixtures. Liquidtight flexible conduit shall be used in all wet or damp locations. Maximum length of flexible conduit shall be 36 in., except that from outlet boxes to lighting fixture maximum length shall be 6 ft. Provide green insulated equipment grounding conductor in all flexible metal conduit.

C. Raceways:

1. Sized as indicated on the drawings. Where sizes are not indicated, raceways shall be sized as required by the National Electrical Code in accordance with the quantity, size, and type of the insulation conductors to be installed. Raceways shall be minimum 1 in. trade size for all telephone, data, intercommunications, instrumentation, fire alarm, television and computer systems and for all branch circuit "Home Runs" to panelboards. Installed to provide adequate grounding between all outlets and the established electrical system ground.

2. Arranged in a neat manner for access and allow for access to work installed by other trades.

3. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts handtight, plus one-quarter turn more.

4. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4 inch trade size and insulated throat metal ground bushings on 1-1/2 inch trade size and larger conduits terminated with locknuts. Install throat metal grounding bushings on service conduit.

5. Complete raceway installation before starting conductor installation.

6. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 feet above finished floor. Wherever a cluster of four (4) or more raceways rise out of floor exposed, provide neatly formed 6 in. high concrete envelop, with chamfered edges, around raceways.

7. Installed with a minimum of bends and offsets. All bends shall be made without kinking or destroying the cross section contour of the raceway. Factory made bends are acceptable and should be considered for raceways larger than 2 in.

8. Make bends in raceway using large-radius performed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.

9. Conceal conduit within finished walls, ceilings, and floors unless otherwise noted, or where permitted by the Owner's Representative. All exposed raceways shall be painted to match existing adjacent surface as directed by the Architect. Install conduit parallel or perpendicular to building lines.

10. Support conduit within 12 inches of enclosure to which attached.

11. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.

12. Seal raceway opening that penetrate rooms or walls with acoustical requirements on both sides of rooms or walls with acoustically rated putty or firestopping.

13. Differing Temperatures: For raceways routed between areas with differing temperatures (interior to exterior, walk in coolers/freezers, environmental chambers, etc.) install raceway as follows:

    a. Provide a thermal break, 4 in. minimum of stainless steel or Schedule 40 PVC conduit within space wall/separation.

    b. Seal raceway penetration through the wall/separation.

    c. Provide a box on each side of the space wall/separation.

    d. Provide raceway interior sealant (duct seal or suitable foam) to provide a complete air barrier after conductors are installed.

    e. Mounting of raceway and boxes on equipment shall be coordinated and approved by the equipment manufacturer.

    f. Installed with exterior surfaces not less than 6 in. from any surface with normal operating temperature of 200°F or higher.

14. Expansion-Joint Fittings:

    a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg. F and that have straight-run length that exceeds 25 feet. Install in runs of aboveground RMC and EMT conduit that are located where environmental temperature change may exceed 100 deg. F and that have straight-run length that exceeds 100 feet.

    b. Install expansion fittings at locations where conduits cross building or structure expansion joints.

    c. Install with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

    d. Installed such that no undue stress is placed on any electrical raceway due to the proper functioning of expansion joints.

15. Raceway installed in wet/damp locations or on exterior walls shall have a spacer manufactured for this purpose provided to maintain a space/void between the mounting surface and the raceway.

16. Do not install conduits within 2 inches of the bottom side of a metal deck roof.

17. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

18. Cut conduit perpendicular to the length. For conduits 2 inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs. Bush where necessary.

19. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

20. Plugged at the ends of each roughed-in raceway with an approved cap or disc to prevent the entrance of foreign materials during construction.

21. Installed with UL approved rain-tight and concrete-tight couplings and connectors.

22. Raceways shall not be attached to or supported by wooden plug anchors or supported from mechanical work such as ductwork, piping, etc.

23. Raceways installed in concrete slabs shall be located so as not to affect structural integrity of slab, and such that conduit shall have a minimum of 1 in. of concrete cover on all sides. Obtain approval from the Owner's Representative prior to

installing conduit larger than 1 in. trade size in concrete slabs. Raceways in slabs shall be for floor box use only, or routing vertically through.

24. If it is necessary to burn holes through webs of beams or girders, call such points to the attention of the Owner's Representative and receive written approval both as to location and size of hole before proceeding with work. All holes shall be burned no larger than absolutely necessary.

25. Become familiar with the general construction of the building and place sleeves, inserts, etc., as required. All penetrations through existing floors shall be core drilled and sleeved.

26. All raceways shall be supported adequately by malleable iron pipe clamps or other approved methods. In exterior or wet locations, supports shall allow not less than 1/4 in. air space between raceway and wall. Firmly fasten raceway within 3 ft. of each outlet box, junction box, cabinet or fitting. The following table lists maximum spacing between conditions, strength of supporting members, etc.

27. Furnish and install such supports at no additional cost to owner.

Conduit Trade Size	**Type of Run**	**Horizontal Spacing in Feet**	**Vertical Spacing in Feet**
1/2 in., 3/4 in.	Concealed	7	10
1 in., 1-1/4 in.	Concealed	8	10
1-1/2 in. and larger	Concealed	10	10
1/2 in., 3/4 in.	Exposed	5	7
1 in., 1-1/4 in.	Exposed	7	8
1-1/2 in. and larger	Exposed	10	10

28. Where raceways puncture roof, install pitch pockets as required in order that the roof warranty is maintained. Coordinate with representative of roofing material manufacturer.

29. At each flush mounted panelboard, terminal cabinet, control cabinet, etc., provide four (4) spare 1 in. raceways from panelboard, etc., to an area above the nearest accessible ceiling space. Make 90° turn above the ceiling, arranged for further continuation of raceway, and cap.

30. Raceways containing medium voltage circuits shall have adhesive labeling every 20' on center minimum indicating "MEDIUM VOLTAGE".

D. Cable Trays:

1. Tray supports shall be hung using threaded, galvanized rod hangers, with rods extended through support steel and double nutted. Size support member within load rating of member section; and without visible deflection. Install cable tray level and straight.

2. Provide aluminum body expansion connectors at building expansion joints. Minimum 4 in. movements, greater if expansion movement conditions warrant.

3. Provide external grounding strap at expansion joints, crossovers and at other locations where tray continuity is interrupted.

4. Provide necessary elbows, tees, crosses, risers, offsets, fittings, reducers, connectors, clamps, rod suspension, trapeze hangers, etc., as required to make a complete job, coordinate with the manufacturer.

5. Provide conduit to tray fitting at each conduit entrance to tray.

6. Install divider in trays as called for.

7. Install fire stop wall frames around cable tray at penetrations through fire rated walls, and where called for. Seal these openings with pliable fire resistant sealant.

E. Outlet Boxes:

1. Consider location of outlets shown on drawings as approximate only. Study architectural, process piping, mechanical, plumbing, structural, roughing-in, etc., drawings and note surrounding areas in which each outlet is to be located. Locate outlet so that when fixtures, motors, cabinets, equipment, etc., are placed in position, outlet will serve its desired purpose. Where conflicts are noted between drawings, contact Owner's Representative for decision prior to installation. Comply with the NEC relative to position of outlet boxes in finished ceilings and walls.

2. Prior to installation, relocate any outlet location a distance of 5 ft. in any direction from location indicated on drawings if so directed by the Owner's Representative. Prior to completion of wall construction, adjust vertical height of any outlet from height indicated if so directed by Owner's Representative. The above modifications shall be made at no additional cost to the Owner.

3. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Outlet boxes shall be sized to accommodate the wiring, splices and device(s) to be installed in accordance with the NEC.

4. Saw-cut opening for boxes recessed in masonry walls in center of cell of masonry block, and install box flush with surface of wall. Box shall have extra-deep type raised tile covers or shall be 3-1/2 in. deep boxes with square corners and dimensions to accommodate conductors installed. Prepare block surfaces to provide a flat surface for a raintight connection between box and coverplate or supported equipment and box, whether installed indoors or outdoors.

5. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

6. Locate boxes so that cover or plate will not span different building finishes. Install a device cover plate over each and every outlet indicated on drawings. Do not install plates until painting, cleaning and finishing of surfaces surrounding the outlet are complete. Install single one-piece multi-gang covers over multi-gang devices.

7. Where outlets at different mounting heights are indicated on drawings adjacent to each other (due to lack of physical space to show symbol on drawings), install outlets on a common vertical line.

8. Where switch outlets are shown adjacent to strike side of door, locate edge of outlet box approximately 3 in. from door frame.

9. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.

10. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

11. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

12. Floor outlet boxes shall be installed flush with finished floor, adjust level and tile as required. Where finished floor is terrazzo, provide boxes specifically designed for installation in terrazzo. Where floors are to receive carpet or flooring material, coordinate with appropriate trade and provide insert. Rectangular covers shall be parallel and perpendicular with the building or, if used, floor tile/floor joints/pattern. Coordinate cover type with the flooring and device type.

13. Outlet boxes installed in plaster, gypsum board or wood paneled hollow cavity walls shall be installed flush with raised plaster covers or raised tile covers. Boxes shall be mechanically fastened and supported by two (2) adjacent structural members (studs) with cross brackets (Garvin Industries Model BMB or approved equal).

14. Surface ceiling mounted outlet boxes shall be minimum 4 in. square, 1-1/2 in. deep, galvanized sheet metal.

15. Surface wall mounted outlet boxes shall be cast type boxes.

16. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.

17. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

18. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty for boxes and enclosures in areas of walls with acoustical requirements. Provide gaskets for wallplates and covers.

19. Seal openings and knockouts in back and sides of boxes and enclosures in areas of walls with lead shielding requirements.

F. Wiring Methods:

1. Conductors shall not be installed until raceway system, including all outlets, cabinets, bushings and fittings, is completed. Verify that all work of other trades which may cause conductor damage is completed. Use only U.L. approved cable lubricants when necessary. Do not use mechanical means to pull conductors No. 8 or smaller.

2. In general, conductors shall be the same size from the last protective device to the load.

3. Wiring systems shall be properly grounded and continuously polarized throughout, following the color-coding specified. Connect branch circuit wiring at panelboards, as required, in order to provide a "balanced" three-phase load on feeders.

4. Provide insulated green ground conductor in each branch circuit.

5. All feeder connections shall be made to bus and other equipment using solderless, pressure type terminal lugs.

6. Branch circuits connected to a 20A circuit breaker shall be sized as indicated except for lengths exceeding 75 ft. For circuits longer than 75 ft. to 100 ft. utilize No. 10 AWG conductors (line, neutral and ground) and for circuits from 100 ft. to 150 ft. utilize No. 8 AWG (line, neutral and ground) unless otherwise indicated. Conduit size shall be modified in accordance with the NEC.

7. For splices and taps, No. 10 AWG and smaller, use solderless "twist on" connectors having spiral steel spring and insulated with a vinyl cap and skirt.

8. For splices and taps, No. 8 and larger, use insulated solderless set screw AL/CU or hydraulically compressed sleeve fittings suitable for the intended use.

9. Use cast connections for ground conductors.

10. Provide minimum 6 in. of spare/slack of each conductor in each junction or pull box and termination.

11. Make all splices and connections in accessible boxes and cabinets only.

12. Cover uninsulated splices, joints, and free ends of conductor with rubber and friction tape of PVC electrical tape. Plastic insulating caps may serve as insulation. Heat shrink sleeves shall be acceptable for crimp type splices.

13. On termination at branch circuit outlets, leave a minimum of 8 in. free conductor for installation of devices and fixtures.

14. Provide conduit seals and explosion proof devices as indicated on the plans and as dictated by the NEC for all hazardous locations indicated on the drawings.

15. Provide cable/conductor vertical support in accordance with the NEC.

16. The following systems are permitted to be installed in cable tray in compliance with the NEC:

    a. Communication cable.

    b. Security cable.

G. Junction and Pull Boxes:

1. Install junction and pull boxes in readily accessible locations. Access to boxes shall not be blocked by equipment, piping, ducts and the like. Provide all necessary junction or pull boxes required due to field conditions and size as require by the National Electrical Code.

H. Equipment Mounting Heights: Coordinate with architectural interior and exterior elevations.

1. Unless otherwise noted, mount devices and equipment at heights measured from finished floor to device/equipment centerline as follows:

a.	Clock outlets (104 in. AFF or 10 in. below ceiling, whichever is lower)	104 in.
b.	Telephone outlets	18 in.
c.	Telephone outlets, wall mounted	46 in.
d.	T.V. outlet	18 in.
e.	Terminal cabinets, control cabinets, to top of backbox	72 in.

2. Where structural or other interferences prevent compliance with mounting heights listed above, consult Owner's Representative for approval to change location before installation.

I. Hangers and Supports:

1. Provide steel angles, channels and other materials necessary for the proper support and erection of motor starters, distribution panelboards, large disconnect switches, large circuit breakers, pendant mounted lighting fixtures, etc.

2. Panelboards, disconnect switches, circuit breakers, cabinets, large pull boxes, adjustable speed drives, cable support boxes and starters shall be secured to the building structure and not supported from conduits. Small panelboards, etc., as approved by Owner's Representative, may be supported on walls. Racks for

support of conduits and heavy electrical equipment shall be secured to building construction by substantial structural supports.

J. Identification:

1. Nameplates shall be engraved black, with white core, with Helvetica medium 3/16 in. lettering. 1/8 in. lettering is acceptable where space of 3/16 in. is not available.

2. Using adhesive backed printed tape label (white background, black lettering) all receptacle and switch coverplates, power poles, etc. listing panel designation and circuit number. Tape shall be attached to inside of receptacle or switch coverplates.

K. Spare Parts:

1. Deliver to Owner and obtain receipt for spare parts including key switches, fuses, etc.

END OF SECTION 260501

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Metal-clad cable, Type MC, rated 600 V or less.
3. Connectors, splices, and terminations rated 600 V and less.

1.2 DEFINITIONS

A. PV: Photovoltaic.

B. RoHS: Restriction of Hazardous Substances.

C. VFC: Variable-frequency controller.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

C. Qualification Data: For testing agency.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

D. Conductor Insulation:

1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type THHN and Type THWN-2: Comply with UL 83.
3. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
4. Type XHHW-2: Comply with UL 44.
5. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
   a. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent braided shields with full size drain wire, full sized insulated ground wire, and sunlight- and oil-resistant outer PVC jacket. Provide this cable between VFCs and motor loads as indicated on drawings.

2.2 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Comply with UL 1569.

3. RoHS compliant.
4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Circuits:

1. Single circuit and multicircuit with color-coded conductors.

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Ground Conductor: Insulated.

F. Conductor Insulation:

1. Type TFN/THHN/THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

G. Armor: Steel, interlocked.

H. Jacket: PVC applied over armor (when specified).

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2.4 INSULATING TAPE

A. Provide vinyl plastic tape that meets the requirements of UL 510 and has the following characteristics:

1. 8.5 Mil minim thickness.
2. ASTM D-3005 Standard specification for low-temperature resistant vinyl Chloride plastic pressure-sensitive electrical insulating type – type1.
3. Rated 600 volts and 150°C, suitable for indoor and outdoor applications.
4. Retains flexibility, adhesion, and applicable at temperature ranges from 0 through 100°F without loss of physical or electrical properties.
5. Resistant to abrasion, moisture, alkalis, acid, corrosion, and sunlight
6. Tape manufacturer: 3M “Scotch Super 88” or approved equal.

2.5 MANUFACTURERS

A. Wire Manufacturers: subject to compliance with requirements, provide products by one of the following (no exceptions):

1. Southwire Company
2. General Cable
3. The Okonite Company
4. Belden
5. VitaLink
6. Pyrotenax

B. Connectors Manufacturers: subject to compliance with requirements, provide products by one of the following (no exceptions):

1. Hubbell
2. Thomas & Betts
3. 3M Company

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders/Branch circuits: Copper; solid for No. 10 AWG and No. 12 AWG; stranded for No. 8 AWG and larger.

B. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway;

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway;

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

I. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. VFC Output Circuits: Type XHHW-2 in metal conduit; Type TC-ER cable with dual tape shield.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Contract drawings do not indicate size of branch circuit wiring; use No.12 AWG as a minimum wire size for branch circuit wiring. For 20 Ampere branch circuits whose length from the panel to the furthest outlet exceeds 100 feet for 120-volt circuits or 150 feet for 277-volt circuits; use No. 10 AWG or larger for the entire branch circuit installation.

C. A shared neutral may be utilized for circuits other than circuits used for dimmers, ground fault interrupter receptacles or circuit breakers, isolated ground receptacles, and isolated ground surge suppressor type devices.

D. Complete raceway installation between conductor and cable termination points prior to pulling conductors and cables.

E. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

F. Do not install wire in incomplete conduit runs nor until after concrete work and plastering is completed and moisture is swabbed from the conduits. Eliminate splices where possible. Where necessary, splice in readily accessible pull, junction or outlet box.

G. Take precautions to avoid entrance of dirt and water into the conduit and cuts. Clean conduits and ducts to remove and pulling compound prior to pulling cables. Do not damage conductor insulation, braid jacket or sheet during installation. Any damaged conductors shall be replaced immediately.

H. Use pulling means, including fish tape, cable, rope, cable reels on jacks, and basket-weave wire/cable grips, that will not damage cables or raceway. Do not exceed maximum recommended pulling tension of wire and cable

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

J. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Except where lugs are furnished with equipment, Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Circumferential compression type connector (provide for splices and connections No. 6 AWG and larger)
   1. Use for incoming and outgoing cable connections at enclosures and for ground connections.
   2. Use manufacturer’s approved tool and correct size hex head with embosses die number on the connector or lug.
   3. Make crimped indentions parallel with insulation putty.
   4. Fill voids and irregularities with insulation putty.
   5. Cover nearly with four (4) layers of vinyl plastic tape except where insulated covers are permitted; half-lap tape in two (2) directions.

D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.5 IDENTIFICATION

A. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to the project specifications.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:

3. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line/riser diagram.
b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.

d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.
i. Insulation resistance to comply with ICEA values.

4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

   a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

E. Cables will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide a complete grounding system in accordance with the Contract Documents and as specified herein.

1.2 SUBMITTALS

A. Minimum 1/8” scale floor plan drawings depicting the building ground electrode system as to be installed.

B. Detailed riser diagram depicting the building ground electrode system and bonding as to be installed.

C. Product data sheets (cut sheets) for all ground bus bars and other components of the grounding system.

D. Field test reports.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

J. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

K. Straps: Solid copper, copper lugs. Rated for 600 A.

L. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.

M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

N. Water Pipe Clamps:

1. Mechanical type, two pieces with stainless-steel bolts.
   a. Material: Die-cast zinc alloy.
   b. Listed for direct burial.
2. U-bolt type with malleable-iron clamp and copper ground connector.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

B. Ground Plates: 1/4-inch-thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.

1. Bury at least 24 inches below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated on drawings.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

B. At utility transformer, ground per utility company requirements and standards.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Grounding Manholes and Handholes: Install a driven ground rod within 2 inches of wall and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

E. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Install conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

F. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise conductor circling the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with the transformer or switch by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for counterpoise loop and for taps to equipment grounding pad. Bury counterpoise loop not less than 18 inches below grade and 6 inches from the foundation.

G. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

H. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

I. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors. Refer details on drawings.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use Exothermic welds for all below-grade connections.
3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

F. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building area or item indicated.

1. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
4. Substations and Pad-Mounted Equipment: 5 ohms.
5. Manhole Grounds: 10 ohms.

Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
   a. Hangers.
   b. Steel slotted support systems.
   c. Nonmetallic support systems.
   d. Trapeze hangers.
   e. Clamps.
   f. Turnbuckles.
   g. Sockets.
   h. Eye nuts.
   i. Saddles.
   j. Brackets.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which hangers and supports will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Projectors.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Performed steel channels and angles with a minimum of 13/32-inch diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Stainless Steel, Type 304
3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel, Stainless-steel or Glass-fiber-resin hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: Stainless-steel springhead type.
6. Hanger Rods: Threaded stainless- steel.

2.2 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. B-line, an Eaton business.
3. CADDY; a brand of nVent.
4. Thomas & Betts Corporation; A Member of the ABB Group.
5. Unistrut; Part of Atkore International.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Provide nonmetallic coated steel slotted channel to support PVC conduit run inside building and in damp/corrosive environments.

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway:
1. Support vertically installed raceways less than 2 inches trade size at intervals no greater than 8 feet. Support such raceways 2 inches trade size or larger and made up with threaded couplings, at intervals no greater 15 feet.
2. Support horizontally installed raceways less than 1 inch trade size at intervals no greater than 6 feet. Support such raceways 1 inch trade size or larger, at intervals no greater than 10 feet.
3. Minimum rod size shall be 1/4 inch in diameter.

D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clampers.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
   6. To Light Steel: Sheet metal screws.
   7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing

B. FMC: Flexible metal conduit

C. GRC: Galvanized rigid steel conduit.

D. MC: Metal Clad Cable

E. LFMC: Liquid-tight flexible metal conduit

F. RNC: Rigid nonmetallic conduit

1.3 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. MC: Comply with UL 1569 and NEC article 330.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1,
2. External PVC Coating Thickness: 0.040 inch, minimum.
3. Internal urethane coating Thickness: 0.002 inch, minimum.
4. Hot dipped galvanized threads
5. PVC Coating shall be of the same manufacturer of the conduit.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; single strip, continuous, flexible interlocked double-wrapped steel, galvanized inside and outside forming smooth internal wiring channel.

G. LFMC: Flexible steel conduit with PVC jacket, UV stable, machine tool gray in color, lightweight aluminum core internal construction and complying with UL 360.

H. Metal Fittings: Comply with NEMA FB 1 and UL 514:

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:
   a. Set-screw type.
   b. In slab or concrete work, concrete tight fittings
3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Fittings for PVC-coated Rigid Steel Conduits: Minimum PVC thickness of 0.040 inch, 0.002 inch thickness of internal urethan, overlapping sleeves protecting threaded joints. All conduit bodies shall be NEMA 4x Rated with encapsulated stainless steel screws.

5. Fittings for LFMC: Body, gland and lock nut shall be steel of malleable iron. Ground cone shall be steel, sealing ring and insulator shall be blue molded thermoplastic at 150°C (221°F) maximum.
6. Fittings for GRC: Threaded rigid steel conduit fittings. Comply with NEMA FB 2.10.

I. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. RNC: Type EPC-40-PVC or EPC-80-PVC for 90°C, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. Materials must have tensile strength of 7,000-7,200 psi at 73.4°F, flexural strength of 12,000 psi and compressive strength of 9,000 psi.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Raceway, fittings, and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years’ experience in manufacturing of these products.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

C. Wireway Covers: Hinged cover secured with captive screws unless otherwise indicated.

D. Finish: Manufacturer's standard enamel finish NEMA 250 rated.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways:
   1. Refer to drawings for location(s), type(s), and quantity(s) of surface metal raceway.
      a. Surface finish: be satin, anodized #204 type clear, Class R1 mil-Spec with minimum anodized finish of .004” unless otherwise noted.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

F. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

K. Gangable boxes are allowed.

L. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 MANUFACTURERS

A. Raceway and Fitting Manufacturers: subject to compliance with requirements, provide products by one of the following (no exceptions):

1. Wheatland Tube
2. Allied Tube & Conduit
3. Thomas & Betts

4. Hubbell
5. Legrand
6. Calbond
7. Plasti Bond
8. Western Tube and Conduit
9. Republic Conduit
10. Crouse-Hinds

B. Wireways, surface raceways, boxes, enclosure and cabinets Manufacturers: subject to compliance with requirements, provide products by one of the following (no exceptions):

1. Legrand
2. Hubbell
3. Thomas & Betts
4. Hoffman
5. OZ Gedney
6. Appleton Electric Company
7. Crouse-Hinds

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. The following application must be adhered to. Raceways installed that are not conforming to this listing must be removed and replace with specified material at no additional expense.

Raceway Types	Applications
Galvanized Rigid Steel Conduit (GRC)	Where exposed to mechanical injury, where specifically required; indoors where exposed to moisture; where required by codes and for all circuits in excess of 600 volts. Outdoor locations, sump and ejector pits, elevator pits, loading docks, garage, rooftops and gymnasium.
PVC Coated Galvanized Rigid Steel Conduit (GRC)	Where exposed to extreme outdoor and indoor corrosion and or weather conditions: Stub out of Concrete applications. In

Raceway Types	Applications
	applications where two (2) UL Listed Layers of Corrosion protection is required and Hot Dipped Galvanized Conduit as Primary Protection is listed PVC Coating is listed as Primary Corrosion is also UL Listed.
Electrical Metallic tubing (EMT)	Use in every instance except where another material is not specified.
Metal Clad Cable (MC)	Lighting and receptacle branch circuits concealed in dry hollow spaces of a building. May not be used in areas where it would be subjected to physical damage, or where prohibited by Code.
Flexible Metal Conduit (FMC)	Use in dry areas for connections to lighting fixtures in hung ceilings, connections to equipment installed in removable panels of hung ceilings; at all transformer or equipment raceway connections where sound and vibration isolation is required.
Liquid-Tight Flexible Metal Conduit (LFMC)	Use in areas subject to moisture where flexible metal conduit is unacceptable, at connections to all motors, and all raised floor areas.
Rigid Non-Metallic Conduit (RNC)	Schedule 40 - Where raceways are in a slab below grade levels; for raceway duct banks. Schedule 80 - For underground raceways outside of the building which are not encased in concrete.
Wireways and Auxiliary Gutters	Where indicated on the Contract Documents and as otherwise specifically required.
Boxes and Enclosures	NEMA 250, Type 1, except use NEMA 250, Type 4 in kitchens and damp/or wet locations. Outdoors use NEMA 250, Type 3R.

B. Provide separate raceways for all wiring systems, including security, data, paging, low voltage et al. All 480Y/277 volt wiring must be kept independent of 208Y/120 volt wiring. Emergency system wiring must be kept independent of the normal system wiring. Provide grounding conductor within all circuits. Minimum size 3/4-inch for home runs and 1-inch minimum for power distribution. Wiring of each type and system must be installed in separate raceways.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Galvanized Steel Conduit (GRC): Use threaded rigid steel conduit fittings. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Install capped bushings on the raceways as soon as they are installed and remove only when cables are pulled. Securely tie embedded raceway in place prior to embedment.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab. Raceways installed below or in floor slabs must extend a minimum of 4 inches above the finished slab to the first connector.

F. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Install exposed raceways parallel or at right angles with building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Provide one (1) empty 3/4 inch raceway for each three (3) spare unused poles or spaces of each flush-mounted panelboard. Terminate empty 3/4 inch conduits in a junction box, which after completion is accessible to facilitate future branch circuit extension. Provide pull lines in each raceway.

J. Raceways in hung ceilings shall be installed on and secured to the slab or primary structural members of the ceiling, not to lathing channels or T-bars, Z-bars or other elements which are direct supports of the ceiling panels. Secure conduit firmly to the steel with clips and fittings designed for that purpose. Install as high as possible but not less than 1'-0" above the hung ceilings.

K. Raceways Embedded in Slabs:

1. Install no raceway in the concrete slab except with the permission of the Structural Engineer and written consent of the Owner.
2. Do not install raceways larger than 1-1/4 inch size in structural concrete slabs.
3. In no case will the installation of raceways be permitted to interfere with proper placement of principal reinforcement.
4. Place raceways in the structural slabs between the upper and lower layers of reinforcing steel. Careful bending of the conduits is required.
5. Space the raceways embedded in concrete slabs not less than eight (8) inches on centers and as widely spaced as possible where they converge at panels or junction boxes.
6. Install raceways running parallel to slabs supports, such as beams, columns and structural walls, not less than 12 inches from such supporting elements.
7. Secure saddle supports for conduit, outlet boxes, junction boxes, inserts, etc. with suitable adhesives during concrete pour of the slab to prevent displacement.
8. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

L. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

P. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

R. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

S. Clear all raceways of all obstructions and dirt prior to pulling in cables. Use ball mandrel (diameter approximately 85% of the conduit inside diameter) followed by close fitting wire brush and wad of felt. This assembly may be pulled in together with, but ahead of any cable being installed. Clean all empty raceways similarly. Clear any raceway which rejects ball mandrel, then re-attempt mandrel application.

T. Install labeled pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 5 feet of slack at each end of pull wire. Tag both ends of the cable denoting opposite and termination location with black India ink on flameproof linen tag. Cap underground raceways designated as spare above grade alongside raceways in use.

U. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

Y. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
6. Provide necessary bonding conductor for each raceway expansion joint.

Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFNC in damp or wet locations not subject to severe physical damage.

AA. OUTLET, JUNCTION, AND PULL BOXES

1. Provide outlet, junction, and pull boxes as indicated on the Contract Documents and as required for the complete installation of the various electrical systems, and to facilitate proper pulling of the cables. Size the junction boxes and pull boxes per the NEC. Size the boxes on any empty conduit systems as if containing conductors of No.4 AWG.
2. The exact location of outlets and equipment is governed by the structural conditions and obstructions, or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels equipment, etc., with the Architect prior to installation.
3. Back-to-back outlets in the same wall, or "thru-wall" type boxes are not permitted. Provide 12-inch minimum spacing for outlets shown on opposite sides of a common wall to minimize sound transmission.
4. Fit outlet boxes in finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one (1) switch or device is located at one (1) point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes are not permitted. Provide tile box or 4 inch square box with tile ring in masonry walls not plastered or furred. Where drywall material is utilized, provide plaster ring. Provide outlet boxes of type and size suitable for the specific application. Where outlet boxes contain two (2) or more 277 volt devices, or where devices occur of different applied voltages, or where normal and emergency devices occur in the same box, provide suitable barrier(s).
5. All outlet and device box depths shall have sufficient depth to prevent damage to the conductors when devices or utilization equipment are installed as intended in
6. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
7. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
8. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
9. Locate boxes so that cover or plate will not span different building finishes.
10. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

11. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
12. Types of Boxes and Fittings for Various Locations:

Location	Type
Outlet	Galvanized pressed steel
Outlet exposed to moisture or outdoors	Cast type conduit fitting
Splice	Galvanized pressed steel
Splice exposed to moisture or outdoors	Cast type conduit fitting or sheet metal (4½" x 5" x 3" minimum)
Pull or Junction	Cast type conduit fitting or sheet metal (4½" x 5" x 3" minimum)
Pull or Junction - Outdoors	Aluminum (4½" x 5" x 3" minimum)
Terminal	Sheet steel (6" x 6" x 3" minimum)
Terminal - Outdoors	Aluminum (6" x 6" x 3" minimum)

BB. PULL BOX SPACING

1. Provide pull boxes so no individual conduit run contains more than the equivalent of four (4) quarter bends (360° total).
2. Conduit Sizes 1¼" and Larger:
   a. Provide boxes to prevent cable from being excessively twisted, stretched or flexed during installation.
   b. Provide boxes so that maximum pulling tensions do not exceed the cable manufacturer's recommendations.
   c. Provide support racks for boxes with multiple sets of conductors so that the conductors do not rest on any metal work inside the box.
3. Conduit Sizes 1 inch and Smaller, provide boxes at every (Maximum Distances):

Distance	Run Type
150 feet	straight runs
100 feet	runs with one (1) 90° bend or equivalent
75 feet	runs with two (2) 90° bends or equivalent
50 feet	runs with three (3) or (4) four 90° bends or equivalent.

4. Boxes shall be sized to permit pulling, racking and splicing of cables (if not indicated on the contract drawings). They shall be sized to avoid exceeding the manufacturer's minimum bending radius recommendations for conductors.
5. Provide access for the removal and replacement of the conductors, splices and equipment.
6. Minimum distance of boxes in runs of 1-1/2 inch or larger conduit:
   a. Straight pulls: size length 8 times nominal diameter of the largest conduit.
   b. Angle or U-pulls: size such that the distance between the conduit entry and the opposite wall of box is 6 times the nominal diameter of the largest conduit.
7. Covers: fasten to the flange or framework of the box with machine bolts, machine screws threaded into tapered holes or sheet metal screws as required.
8. Identification labels for all pull, splice and junction boxes in main feeder and sub-feeder runs, shall indicate nominal system voltage:
   a. Apply labels after painting of any boxes, conduits, and surrounding areas are completed.
   b. Clean surfaces before applying labels; clean aluminum surfaces with solvent wipe.
   c. Apply labels on the cover and a minimum of 1 fixed side; 1 label visible from the floor where the boxes are installed exposed.

3.3 FIRESTOPPING

A. Install firestopping at penetrations of all fire-rated floor and wall assemblies, per the project specifications.

3.4 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260534 – MANHOLES AND HANDHOLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section Includes the following:

1. Manholes
2. Handholes.
3. Accessories.

1.2 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casting materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as a component of a duct bank.

C. Duct Bank:

1. Two or more duct installed in parallel, with or without additional casting materials.
2. Multiple duct banks.

D. GRC: Galvanized rigid (steel) conduit.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.3 SUBMITTALS

A. Product Data:

1. Manholes and handholes.
2. Accessories.
3. Warning tape.
4. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include dimensioned plans, elevations, sections, details, attachments to other work, and accessories, including frame and cover design, grounding detail, cable rack inserts, sumps and pulling irons.

1.4 QUALITY ASSURANCE

A. Comply with the latest applicable provisions and latest recommendations of the governing codes and the Contract Documents.

B. Power Utility Company Standards.

C. U.L. Listing of all products.

1.5 COORDINATION

A. Coordinate layout and installation of manholes and handholes with the final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of manholes and handholes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manholes

1. Provide precast concrete manholes consisting of 3000 psi compressive strength at 28 days. Prefabricated maintenance structures shall be designed to resist a vertical pressure of approximately 3,000 pounds per square foot and a uniform lateral earth pressure of 1,500 pounds per square foot. Where applicable, the structure should be designed to resist hydrostatic pressure acting against the side walls and the bottom.
2. Provide manhole sizes as required by the application and to accept the quantity and location of the entry and exit points.
3. Manhole collar and shaft sections shall have minimum of 30 inches diameter clear opening.

4. Windows for duct entry shall be sized as required to meet incoming and outgoing ductbanks.
5. Maintain access to the sump to place portable pump.
6. Provide two (2) cable pulling irons opposite each conduit entry window, one (1) above and one (1) below.
7. Provide galvanized steel cable, support rack, cast iron frame and cover, ground rod with copper bonding tree, galvanized steel ladder, and galvanized steel conduit end ball.
8. Manhole Accessories
    a. Manhole Frames and Covers: Provide manhole frames and covers gray cast iron, machine finished with flat bearing surfaces. All manhole frames and covers shall be heavy duty type with highway load bearing capacity with sealed cover. Reinforcing steel to withstand ASHTO-HS20 loading. All hardware shall be stainless.
    b. Sump Covers: Provide sump covers gray cast iron.
    c. Pulling Irons: Provide pulling irons of 7/8 inch diameter steel bar forming a triangle of 9 inches per side when set. Galvanize for irregular shaped articles.
    d. Cable Rack Inserts: Provide steel channel insert with minimum load rating of 800 pounds, length to match cable rack channel.
    e. Cable Rack Channel: Provide 4 by 1-1/2-inch by 3/16 inch steel channel wall bracket, 48-inch length, with cable rack arm mounting slots on 8-inch centers. Cable-racking shall be fiber type.
    f. Cable Racks: Provide cable racks; fiber type, 2-1/2 by 14 inches with high-glazed wet-process porcelain insulators. Cables to be secured with plastic tie-wraps, stainless throat fasteners.
    g. Manhole Steps: Provide manhole steps which are cast iron, suitable for manhole shape and constructions.
    h. Hardware: All hardware and accessories for the manhole shall be stainless steel.
9. Heavy Duty Non-Metallic Cable Rack.
    a. Manhole Hardware. Cables shall be well supported on walls by heavy duty non-metallic cable racks. The cable racks consist of a stanchion that shall be attached to the manhole wall in accordance with the manufacturer's recommendations and adjustable arms that lock into the stanchion. Unless otherwise specified:
        (1) At least two (2) stanchions shall be installed on each manhole wall.
            (a) Cable rack arm lengths shall be appropriate for the manhole size and amount of cable being installed.

(b) At least two (2) spare arms shall be installed at each stanchion position.

b. Cable Rack: Stanchions and arms shall be made from 50% glass-reinforced nylon or a non-metallic material having equal mechanical strength, thermal resistance, chemical resistance, dielectric strength and physical properties. The stanchion shall be 36 inches long, shall incorporate multiple arm mounting holes that are 4 inches apart and recessed bolt mounting holes. Holes or slots shall be provided in the arms for cable wire ties. The cable racks shall be marked with the manufacturer’s name, plant location and date manufactured. Cable racks shall be Underground Devices, Inc. CR36, 3HDS, RA04, RA06, RA08, RA11, RA14, and RA20.

c. Cable Rack Mounting Hardware. Either one of the following corrosion resistant hardware sets may be used to secure the stanchion to the manhole wall.

(1) Drop-in anchors (UDI Catalog No. FSRM – 12) shall have a rated pullout working capacity of 1200 lbs. and shall be made from either 303 or 316 stainless steel. A 316 stainless steel ½ - 13 hex head cap screw (UDI Catalog No. FHC316-16-044) and a 316 stainless steel .562 ID X 1.250 OD X .078 THK. Flat washer (UDI Catalog No. FFW316-18-40) shall be used with each drop-in anchor.

(2) Cast-in-place anchors (UDI Catalog No. FNMA-16) shall have a ½ - 13 thread, a working load capacity of 1260 lbs. and shall be made from Acetal Copolymer. A special 316 stainless steel ½ - 13 hex head cap screw (UDI Catalog No. FHC316-16-088) and a 316 stainless steel washer (UDI Catalog No. FFW316-18-40) shall be used with each cast-in-place anchor.

B. Comply with ASTM C 858. Manholes shall be provided with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

E. Acceptable Manufacturers:

1. Carder Concrete Products.
2. Christy Concrete Products.
3. Elmhurst-Chicago Stone Co.

2.2 HANDHOLES

A. Description: Factory-fabricated, reinforced pre-cast concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of the enclosure and shall have a load rating consistent with that of a handhole.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing stainless-steel bolts.
2. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing stainless-steel bolts.
3. Cover Legend: Molded lettering, "**ELECTRIC"** or "**COMMINICATION"**
4. Configuration: Units shall be designed for flush burial and have a closed bottom.
5. Extensions and Slabs: Designed to mate with the bottom of enclosure. Same material as the enclosure.
6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
   a. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   b. Window openings shall be framed with at least two (2) additional No. 4 steel reinforcing bars in concrete around each opening.
7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
8. Handholes shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Acceptable Manufacturers:

1. Quazite
2. Christy Concrete Products

3. Oldcastle Precast Group.
4. Utility Concrete Products, LLC.

2.3 HANDHOLES OTHER THAN PRECAST CONCRETE

A. Description: Comply with SCTE 77.

1. Configuration: Units shall be designed for flush burial and have closed bottom.
2. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with the enclosure.
3. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
4. Cover Legend: Molded lettering, “**ELECTRIC”** or “**COMMUNICATIONS”**
5. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings.
6. Duct Entrance Provisions: Duct-terminating fittings shall mate with the entering ducts for secure, fixed installation in the enclosure wall.
7. Handholes shall have factory-installed inserts for cable racks and pulling-in irons.

B. Polymer Concrete Handholes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two. Handholes shall comply with the requirements of SCTE 7 minimum Tier 8 loading.

1. Acceptable Manufacturers:
    a. Quazite
    b. Armorcast Products Company.
    c. Oldcastle Enclosure Solutions
    d. Hubbell Power Systems

C. Fiberglass Handholes with Polymer Concrete Frame and Cover: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.

1. Acceptable Manufacturers:
    a. Quazite
    b. Armorcast Products Company.
    c. Oldcastle Enclosure Solutions.
    d. Hubbell Power Systems.

D. Fiberglass Handholes: Molded of fiberglass-reinforced polyester resin, with covers of hot-dip galvanized-steel diamond plate.

1. Acceptable Manufacturers:
   a. Quazite
   b. Oldcastle Enclosure Systems
   c. Armorcast Products Company
   d. Hubbell Power Systems.

2.4 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858.

1. Concrete shall have a minimum compressive strength of 3000 psi (20 MPa).

2.5 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037 and SCTE 77.

PART 3 - EXECUTION

3.1 GENERAL

A. Excavation, sharing, bracing, back-filling and grading provided by other section.

B. Manholes shall be constructed as shown on the Contract Drawings. Manholes shall not be constructed until final conduit grading has been determined, including any field changes required by underground interferences. Shop drawings shall be submitted for all manhole details that differ in any way from those shown on the Contract Drawings.

C. Cables to be secured with tie-wraps. Cable racks shall be fiber.

D. Provide a copper clad steel ground rod, 3/8 inch by 10 feet long, in each manhole. All noncurrent-carrying metal parts in manholes and handholes including metallic sheaths of cables, shall be connected to the ground rod by a bare copper ground conductor. Install the ground rod with top protruding 4 inches above manhole floor.

E. Provide a cast iron sump frame and cover for each manhole. Provide 12-by 12-by 6-inch deep sump. Excavate below sump 6 inches and fill sump bottom with clean gravel. Slope floor of manhole 1/8-inch per foot to the edge of the sump.

F. Waterproof exterior surfaces, joints, and interruptions of manholes after concrete has cured 28 days minimum.

G. Attach cable racks to inserts after manhole.

H. Manholes and handholes are shown on the Contract Documents in approximate locations. The exact location shall be field determined after careful consideration of other utilities, grading, and paving.

I. In paved areas, set top of frame and cover flush with finished surface. In unpaved areas, set top of frame and cover approximately ½ inch above finished grade.

J. The installation of manholes shall be in an excavated area free of obstructions for a minimum 6 inches around outside perimeter, with a 6 inch compact gravel base of uniform thickness and level. The preparation of the base shall insure no settlement. Backfill shall consist of good compactable material, such as pea gravel, sand or clean earth fill. Backfilling should be done progressively from bottom to top surface. Minimum earth cover from roof of manhole to finished grade shall be 8 inches.

K. Concrete encased duct banks entering wall may be cast in the concrete or enter through opening of suitable dimensions and arrangement. Where openings are provided, caulk the space between duct bank and walls tight with lead wool or other suitable material. Reinforce iron of the ductbank to be connected to the wall.

L. Flush end bells shall be mounted on side walls where duct enters.

M. Duct entrances shall be carefully planned via the field for best application of cable pulling and racked. All cables shall be secured with tie-wraps to porcelain saddles.

N. Waterproofing shall be done in accordance with manufacturer’s instructions.

O. Collar shall be cast concrete rings, stacked to required height. Set height in field per final grade elevations.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Traffic Paths: Precast concrete.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 22 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf "Light-Duty" vertical loading.

3.3 EARTHWORK

A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades unless otherwise indicated on the Contract Documents. Replace removed sod immediately after backfilling is completed.

3.4 INSTALLATION OF CONCRETE MANHOLES AND HANDHOLES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below the frost line.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.

C. Drainage: Install drains in bottom of manholes where indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening.

E. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors.

F. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

H. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.5 INSTALLATION OF HANDHOLES OTHER THAN PRECAST CONCRETE

A. Install handholes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use pull box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.
B. Unless otherwise indicated, support units on a level 6-inch- thick bed of crushed stone or gravel, graded and compacted to same density as adjacent undisturbed earth.

C. Elevation: Set so cover surface will be flush with finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors.

E. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

F. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength.
2. Dimensions: 10 inches wide by 12 inches or as indicated.

3.6 GROUNDING

A. Ground underground ducts and utility structures.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

   1. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in this division."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.8 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260534

SECTION 260543 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

1. Underground Duct System
2. Conduits
3. Nonmetallic Ducts
4. Duct Accessories

1.2 DEFINITIONS

A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.

B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.

C. Duct Bank: Two or more ducts installed in parallel, with or without additional casing materials.

D. GRC: Galvanized rigid (steel) conduit.

E. RNC: Rigid nonmetallic Conduit.

F. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.3 SUBMITTALS

A. Product Data:
1. Duct bank materials, including separators and miscellaneous components.
2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Warning tape.
4. Warning planks.

B. Shop drawings for dimension underground structure: including plans, elevations, sections, details, attachments to other work, and accessories, including the following:
1. Duct entry provisions, including locations and duct sizes.
2. Reinforcement details.

3. Grounding details.
4. Duct bank coordination drawings showing dimensioned duct profiles and coordination with other utilities and underground structures. Include plans and sections drawing to scale, and show bends and locations of expansion fittings.

C. Submittal results of field tests.

D. Record documents: show dimensional locations of all underground ducts, handholes, and manholes.

PART 2 - PRODUCTS

2.1 UNDERGROUND DUCT SYSTEM

A. Contractor shall furnish and install raceways and fittings for an underground duct system, as indicated on the Contract Drawings and specified herein.

B. All bends at underground duct system shall be per the manufacturer's bending requirements.

C. Bending for the medium voltage service lines shall also comply with the Utility Company requirements.

D. The minimum bend radius for Telco carrier conduit, under any circumstances shall be greater than 12 times the conduit diameter. Comply with Utility Company requirements.

E. Raceways shall transform from EPC (electrical plastic conduit) PVC to rigid galvanized steel conduit within 10 feet of any foundation walls. Run EPC PVC duct bank to the manholes. Contractor shall furnish and install proper couplings to accommodate aforementioned transition.

F. Where offsets are required to clear obstructions and other underground services, a maximum of 5° angle will be allowed at duct joints.

G. Ducts shall be installed so as to drain to the manholes. Ducts entering into the point of entry (P.O.E.) room shall be installed with upward slope of minimum of 0.125 inch/foot.

H. All raceways as previously described shall utilize a mandrel of sufficient size to thoroughly clear raceways of all obstructions prior to the installation of any wiring.

I. All concrete construction, excavation and backfill for the underground ductbank system shall be described under other sections of the project specifications. Red dye shall be added to the concrete mixture.

J. All conduits penetrating into the buildings shall be totally sealed in order to prevent any migration of water through the ductbank into the building.

K. Prior to backfilling of the underground duct system, provide conducting underground-line warning tape. Bury tape 12 inches below grade for all ducts and ductbanks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12 inch increment of duct bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

2.2 CONDUITS

A. Galvanized Rigid Steel Conduit (GRC): Comply with ANSI C80.1 and UL 6.

B. Rigid nonmetallic conduit (RNC): Type EPC-80-PVC and Type EPC-40-PVC complying NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by the same manufacturer as the conduit.

2.3 NONMETALLIC DUCTS

A. Schedule EPC-80-PVC conduit shall be used for all concrete encased duct banks.

B. PVC conduits shall not be used within the building area unless otherwise noted.

C. All penetrations through floor slabs or foundation walls shall be rigid steel conduits. No RNC conduit shall be used in or through any floor slab.

D. Concrete encased Schedule EPC-80-PVC shall be allowed under paved areas, subjected to vehicular traffic. Schedule EPC-40-PVC is not allowed.

2.4 DUCT ACCESSORIES

A. Duct Separators (Spacers)
   1. Factory-fabricated rigid PVC interlocking spacers, High impact polystyrene sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
   2. Telco carrier ducts shall be separated from electrical ducts by a minimum of 36” and shall cross electrical ductbanks at 90-degree angle only, when unavoidable.

3. In general, duct spacers should be of the type recommended by the conduit manufacturers and approved by the Utility Company.

2.5 MANUFACTURES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. CANTEX INC.
3. Crown Line Plastics.
4. IPEX USA LLC.
5. National Pipe & Plastics.
6. Thomas & Betts Corporation; A Member of the ABB Group.
7. O-Z/Gedney; a brand of Emerson Industrial Automation.
8. Western Tube and Conduit Corporation.
9. Wheatland Tube Company.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Feeders 600 V and Less: NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

B. Ducts smaller than 2” trade size for Electrical Branch Circuits: NEMA Type EPC-40-PVC, in direct-buried duct bank unless otherwise indicated.

C. Ducts 2” and larger trade size for Electrical Branch Circuits: NEMA Type EPC-80-PVC, in direct-buried duct bank unless otherwise indicated.

D. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.

3.2 EARTHWORK

A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, frizzling, liming, seeding, sodding, springing, and mulching.

3.3 DUCT INSTALLATION

A. Concrete for conduit envelopes shall be as required or as specified under other Divisions of the project specifications. Red dye shall be added to concrete mixture. Concrete shall extend at least 3 inches beyond exterior surface of each conduit in bank.

B. Trenches shall not be backfilled until concrete envelopes have had sufficient time to set. After concrete envelopes have set, nonmetallic conduits shall be cleared with mandrel of the same size as the conduit.

C. Cap ends of spare conduits 5 feet beyond pavement and protect them from mechanical damage. Mark the location of conduit ends with concrete monuments, 6 inches in diameter by 18 inches long, set flush in the ground with “S/C” indented in the top.

D. Arrange multiple conduits as shown on the Contract Drawings. Make minor changes in location, or cross-sectional arrangement as necessary. Where conduit runs cannot be installed as shown because of conditions not discoverable prior to digging of trenches, request the Architect’s instructions before further work is done. Coordinate this work with other outside service work.

E. Slope: Pitch ducts a minimum slope of 0.125 inch/ft down toward the manholes and handholes and away from the buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

F. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 12 times the conduit diameter, both horizontally and vertically, at other locations unless otherwise indicated.

G. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

H. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches on center for 5-inch ducts, and vary proportionately for other duct sizes.

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 ft. outside the building wall without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition.

J. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

K. Pulling Cord: Install 200-lbf test nylon cord in ducts, including spares. Label each line.

3.4 Concrete-Encased Ducts:

A. Support ducts on duct separators coordinated with duct size, duct spacing and outdoor temperature.

B. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 ft. of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

C. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   1. Where more than one (1) pour is necessary, provide ¾ inch reinforcing rod dowels extending 18 inches into concrete on each side of joint. Concrete envelopes installed over extensive area of disturbed earth shall have a separate concrete base.

D. Concrete envelopes that cross other conduits or pipelines or are run under roads and driveways shall be reinforced. Provide reinforcement where envelopes connect to manhole and building walls. Concrete envelopes that terminate for future extension shall have dowels as specified for joints between pours.

E. Use walls of trench to form side walls of duct bank where soil is self-supporting, and concrete envelope can be poured without soil inclusions; otherwise use forms. Remove loose dirt and extraneous material. Concrete shall be spaced during pouring to eliminate voids under and between conduits and to prevent honeycombing of exterior surfaces. Power-driven tampers or agitators shall not be used. Secure bolts sufficiently to prevent movement during concrete placement.

F. Minimum Space between Duct: 3 inches between edge of ducts and exterior envelope wall, 3 inches between ducts for like services, and 4 inches between power and communication ducts.

G. Depth: Install top of duct bank at least 36 inches below the finished grade unless otherwise indicated.

H. Stub-Ups: Use manufactured GRC elbows for stub-ups at utility poles, equipment and at building entrances through the floor.

1. Couple RNC to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
2. For equipment mounted on outdoor concrete bases, extend concrete encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.

3.5 Direct-Buried Duct and Duct Bank:

A. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

B. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 ft. of duct. Stagger spacers approximately 6 inches between tiers.

C. Excavate trench bottom to provide firm and uniform support for duct bank.

D. After installing first tier of ducts, backfill and compact. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Place a minimum of 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.

E. Install ducts with a minimum of 3 inches between ducts for like services and 6 inches between power and communication ducts.

F. Depth: Install top of duct bank at least 36 inches below finished grade unless otherwise indicated.

G. Set elevation of bottom of duct bank below the frost line.

H. Install manufactured GRC elbows for stub-ups at utility poles, equipment and at building entrances through the floor.

1. Couple RNC to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
2. For equipment mounted on outdoor concrete bases, extend GRC horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

I. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches on center.

3.6 FIELD QUALITY CONTROL

A. Preform the following tests and inspections:

1. Demonstrate capability and compliance with requirements on the completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through each duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole grounding to ensure electrical continuity of bonding and grounding connections. Measure ground resistance at each ground rod and report results. Use an instrument specifically designed for ground-resistance measurements.
4. Water Tightness: Make internal inspection of manholes 3 months after completion of construction for indications of water ingress. Where leakage is noted, remove water and seal leak sources. Reinspect after 2 months and reseal remaining leak sources. Repeat process at 2 month intervals until leaks are corrected.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.7 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

1.2 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.3 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

2.5 MANUFACTURERS

A. Manufacturers subject to compliance with requirements, provide products by one of the following (no exceptions):

1. BWM Company
2. Flexicraft Industries.
3. GPT Industries

4. Metraflex Company (The).
5. Proco Products, Inc.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

    a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Paint for identification.
8. Fasteners for labels and signs.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

1. Color shall be factory applied.
2. Colors for three-phase 208Y/120V systems:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Neutral: White.
3. Colors for single-phase 120/240V systems:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Neutral: White.
4. Colors for three-phase 120/240V Delta systems:
    a. Phase A: Blue.
    b. Phase B: Black.
    c. Phase C: Orange (208V hi-leg).
    d. Neutral: White.
5. Colors for three-phase 480Y/277V systems:
    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Neutral: Gray.
6. Color for Equipment Grounds: Green.

7. Colors for Isolated Grounds: Green with yellow stripe.

C. Raceways and Cables Carrying Circuits at more Than 600 V:

1. Black letters on an orange field.
2. Legend: “DANGER – CONCEALED HIGH VOLTAGE WIRING.”

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification labels:

1. Black Letters on a white field unless otherwise noted.
2. Equipment supplied by the emergency system shall be white letters on a red field.

2.3 LABELS

A. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

2.4 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Underground-Line Warning Tape:

1. Tape:
   a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape shall be permanent and shall not be damaged by burial operations.
   c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
2. Color and Printing:
   a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
   b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
   c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

D. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.5 TAGS

A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015-inch-thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

B. Write-on Tags:

1. Polyester Tags: 0.010-inch-thick, with corrosion-resistant grommet and cable tie for attachment.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.6 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
   a. For signs up to 20 sq. in., minimum 1/16 inch.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with black letters on white face.

d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

J. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. “POWER."

3. "FIRE ALARM."

K. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

L. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

M. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

N. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.

O. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

P. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "FIRE ALARM."

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted cable tags to identify each conductor. Tags shall indicate the load served, type, and size of cable the overcurrent device protecting the cable.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

F. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

G. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.
2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

    a. Power-transfer switches.
    b. Controls with external control power connections.
    c. Switchboards
    d. Switchgear

I. Operating Instruction Signs: Self-adhesive labels.

J. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch high letters for emergency instructions at equipment used for power transfer.

K. Equipment Identification Labels:

1. Indoor Equipment: Engraved Backlite plates mounted with rivers or screws.
2. Outdoor Equipment: Laminated acrylic.
3. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Mount label at top of panel
    a. Include on directory of the panel the cable and raceway size of panel feeder and the feeder origination point.
4. Switchgear, Switchboards, substations, meter center, and motor controls center: furnish and install a master nameplate on each switchboard, substation, meter center and motor control center engraved with the equipment identification indicated on Contract Drawings. Mount at top of the incoming section.

a. Provide on each main switch an identifying nameplate. Where multiple mains are employed each switch shall be numbered. Inscription shall be “Main Switch” or “Main Switch No. 1” et al.

5. Feeder switches in Switchboards, switchgear and motor control centers:
   a. One nameplate engraved with the words “REPLACE ONLY WITH ____ FUSE”. Engrave with proper fuse trade name and ampere rating (i.e. Bussman LPS-R-100).
   b. One nameplate engraved with the load served, the size and type of cable and raceway used. Example:
      Panels LP-4,LP-5,LP-6
      4#500MCM-THWN-CU-3-1/2”C
6. Transformers: Provide nameplate that includes tag designation indicated on Contract Drawings for the transformer. Identify panelboards or equipment supplied by the secondary on nameplate label.
7. Enclosed disconnect switches and circuit breakers: nameplate engraved with equipment designation.
8. Variable-speed controllers and motor controllers: nameplate engraved with equipment designation. Coordinating final equipment names with mechanical contractor prior to fabrication.
9. Automatic Transfer Switches: Nameplate engraved with switch number, load served, feeder sizes and the sources of normal and generator power.
10. Generator control Panel: nameplate engraved with generator designation.
11. Lighting control panels: Provide nameplate similar to that of panelboards.

END OF SECTION 260553

SECTION 260573 - ELECTRICAL POWER SYSTEM STUDY

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish an Electrical Power System Study for the electrical distribution system as defined herein.

B. The study shall begin at the point of electrical service for the facility (utility transformer secondary bushing) and include all downstream distribution and branch panelboards, motor control centers and significant motor locations (50HP and larger). In addition, all equipment that is required to be rated for the available fault current shall be evaluated in the study including but not limited to transformers, enclosed switches, individual motor controllers, contactors, variable speed drives, and enclosed circuit breakers. The project study shall include all generators and any associated emergency power distribution equipment, including automatic transfer switches.

C. Where any part of the electrical system is served by multiple power sources, the system configuration that delivers the highest level of fault current shall be used for the evaluation.

1.2 SUBMITTALS

A. The final report shall be indexed and contain individual, tabbed sections. The tabbed sections shall contain the information as outlined in Part 2 of this document including the following:

1. Firm Name, Address, Phone Number and Professional Engineer's signature and seal of the registered professional Engineer that performed the study,
2. Method used to perform the study and analysis,
3. Short-circuit analysis with protective device evaluation,
4. Protective device coordination study,
5. Arc Flash Analysis,
6. Input Data,
7. One-line diagram.

1.3 REFERENCE STANDARDS

A. All studies shall be performed in accordance with the latest applicable industry standards including the following:

1. IEEE/ANSI Std 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
2. NEMA AB 3 – AB 3 Molded Case Circuit Breakers and their Application
3. NFPA 70 – National Electrical Code
4. NFPA 70E – Standard for Electrical Safety in the Workplace

1.4 QUALITY ASSURANCE

A. Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems.

B. Short-Circuit Analysis, Arc Flash Analysis and Coordination Study shall be performed by a New York State registered Professional Engineer. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years' experience in the analysis, evaluation, and coordination of electrical distribution systems.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. If it complies with the specifications, the engineering study specified herein shall be prepared by the manufacturer providing the electrical switchboards and panelboards for this project or manufacturer's authorized engineer.

2.2 SHORT-CIRCUIT ANALYSIS WITH PROTECTIVE DEVICE EVALUATION

A. The study shall be submitted with the electrical service and distribution equipment submittal and shall indicate where device substitutions are being made in order to achieve adequate interrupting capacity ratings for each piece of equipment.

B. The study shall include recommended settings of adjustable overcurrent and ground fault devices.

C. Provide overcurrent protective devices of suitable type and rating to meet or exceed the available short circuit currents indicated in the short circuit study.

D. Interrupting capacities shall be based on a fully rated protection system where all overcurrent protection devices are rated for the full prospective short circuit current (as indicated in the final short circuit submittal). Series-rated panelboards are not permitted.

E. Obtain from the utility company (and confirm in writing) the short circuit current available at the utility company's transformer secondary.

F. Systematically calculate fault currents based on the available fault current at the facility service entrance. Study preparer shall obtain the maximum available fault current and power factor or X/R ratio of the fault current at the service entrance from the local utility.

G. Motor contribution for motors 50HP and larger shall be incorporated in determining fault levels.

H. Evaluate the distribution device and equipment ratings compared to the calculated fault current and make recommendations where equipment is overdutied. Analyze the short-circuit currents by preparing a tabulation comparing the fault levels to the device interrupting ratings. Indicate equipment in which series ratings are utilized.

I. When the power factor or X/R ratio of the maximum symmetrical fault calculated at the device location is determined to be more inductive than that used to establish the device interrupting rating adjust the available short circuit current in accordance with ANSI/IEEE standard 242.

J. Calculations shall be presented in tabular form and shall include:

1. Location identification
2. Voltage
3. Manufacturer and type of equipment
4. Equipment short-circuit current rating
5. Calculated short-circuit current (and adjustments due to high X/R ratio where required)
6. Calculated X/R ratio of the fault
7. Indicate if series ratings are used
8. Recommendations where equipment is calculated to be overdutied

2.3 PROTECTIVE DEVICE COORDINATION STUDY

A. The study shall be submitted with the electrical service and distribution equipment submittal and shall indicate where device substitutions are being made in order to achieve coordination for each piece of equipment.

B. Prepare coordination time-current characteristic curves to determine the required settings of the protective devices to achieve selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves provided shall reflect actual protective devices (manufacturer and model number) to be installed. Adequate time-current curves shall be generated to depict coordination.

C. Circuit breakers and fuses serving the emergency power system as well as circuit breakers protecting elevators, including all upstream feeder circuit breakers, shall be of the appropriate frame size to ensure 100 percent selectivity in the instantaneous region of the trip curves at the calculated fault current. Coordination study shall demonstrate selective coordination is achieved and shall include the effects of ground fault protection devices indicated on the Drawings.

D. The study shall include recommended settings of adjustable overcurrent and ground fault devices.

E. The coordination study shall include ground fault protection coordination and recommended device settings for the devices provided with ground fault protection.

F. Protective device characteristics shall be plotted to reflect calculated short-circuit levels at the location.

G. A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection. All curve sheets shall be multi-color or use hatching for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide recommendations to improve coordination.

H. The following information shall be provided on all curve sheets.

1. Device identification and associated settings/size.
2. Voltage at which curves are plotted.
3. Current multiplier.
4. ANSI frequent fault damage curve.
5. Cable insulation damage curves.

6. Transformer inrush point.
7. Single-line for the portion of the system.
8. Motor starting profiles (where applicable).

I. The recommended device settings shall be provided in tabular form and shall include:

1. Location Identification
2. Voltage
3. Device Manufacturer
4. Device catalog number/series
5. Adjustable long time pickup and delay
6. Adjustable short time pickup and delay
7. Adjustable ground fault pickup and delay
8. Adjustable instantaneous pickup

2.4 ARC FLASH ANALYSIS

A. An arc flash analysis shall be performed based on the short circuit values and device settings in conjunction with a short circuit and coordination study. The results from the short circuit and coordination study shall be used to determine arc energy levels at each power distribution location in the facility where work could be performed on energized parts.

B. Where any part of the electrical system is served by multiple power sources the system configuration that delivers the highest level of arc flash incident energy shall be used for the evaluation. Include significant motor contribution in the calculations.

C. For each location with a main device, the line and load side fault contributions shall be included in the calculations.

D. Arc Flash Calculation results shall be presented in tabular form and shall include:

1. Location identification
2. Voltage
3. Arcing fault magnitude
4. Protective device clearing time
5. Duration of arc
6. Arc flash boundary
7. Working distance
8. Incident energy
9. Hazard Risk Category

2.5 ARC FLASH WARNING LABELS

A. Arch Flash warning labels shall be provided as part of the report. Labels shall be self-adhesive Polyester, thermal, transfer-printer, 3-mil-thick, multicolor, weather and UV-resistant in accordance with ANSI Z535.4. Produce a minimum 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number, and issue date.

C. Labels shall be machine painted, with no field-applied markings.

2.6 INPUT DATA

A. The study shall be conducted based on the equipment and conductors being installed. Input data for the report shall be compiled from the contractor, manufacturers, and codes and standards as required providing the studies and conducting a proper evaluation.

B. Conductor lengths, sizes, material, and raceway information shall be provided by the Electrical Subcontractor to the engineer performing the study so that the study is performed based on the final installation.

C. Input data used for the studies shall be provided in the final report. The input data for the report shall include supporting data from the manufacturer used for the evaluation, lengths of all feeders provided by the contractor, transformer data, motor data, utility company and motor generator data and any other supporting data to the report.

2.7 SINGLE-LINE DIAGRAM

A. The final report shall include a single-line diagram of the electrical distribution system within the scope of the project. The single-line shall include:

1. Transformer rating, voltage ratio, impedance, and winding connection.
2. Feeder cables per phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.
3. Switchboards, panelboards, MCC's, individual motor controllers, variable speed drives, fuses, circuit breakers, ATS's and enclosed switches.
4. Protective relays with appropriate device numbers and CT's and PT's with associated ratios.
5. Motor identification and horsepower used in the evaluation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The electrical equipment and protective devices shall not be installed prior to confirmation of adequate equipment fault ratings as specified herein.

3.2 FIELD SETTINGS

A. Adjustments shall be made to the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.

B. Arc Flash Labels shall be affixed to the equipment after the study is approved by the Engineer.

1. One label shall be affixed at a height and location that is clearly visible on the front of panelboards, switchboards, switchgear, motor control centers and other electrical equipment that is less than 8 feet in length unless otherwise noted.

2. Switchboards, motor control centers, and switchgear that are longer than 6 feet shall have labels affixed at a height and location that is clearly visible on the front of the equipment at each end of the equipment.
3. Unit Substations shall have different labels associated with the primary, transformer, and secondary equipment.
4. Transformers shall be labeled based on the high voltage side of the transformer.
5. Labels shall be affixed at similar locations on each type of equipment. For example, multiple panelboards of similar size shall have labels located at the same location on the front of each panelboard cover.
6. Where multiple labels are affixed to equipment, the labels shall be identical and identify the worse case information for that equipment.
7. Where equipment is rear connected affix labels on both the front and rear of the equipment. Locate the labels on the rear at a similar height and location as on the front.
8. Label each plug-in section of busway. Affixed at a height and location that is clearly visible. Labels shall be affixed on both sides of the busway.

C. Device settings and adjustments and affixing of Arc Flash Hazard Labels shall be by the manufacturer or the manufacturer's authorized service and testing organization.

END OF SECTION 260573

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Photoelectric switches.
2. Daylight-harvesting dimming controls.
3. Indoor occupancy and vacancy sensors.
4. Switchbox-mounted occupancy sensors.
5. Digital timer light switches.
6. Emergency shunt relays.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:
   a. Daylight-harvesting dimming controls.
   b. Occupancy sensors.
   c. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or on manufacturer's website. Provide names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.
2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Description: Solid state, with dry contacts, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
6. Failure Mode: Luminaire stays ON.

2.2 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:
   a. When no daylight is present (target level).
   b. When significant daylight is present.
2. System programming is done with two hand-held, remote-control tools.
   a. Initial setup tool.

b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

B. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with integrated or separate power pack mounted on luminaire, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

D. Power Pack: Digital controller capable of accepting 3 RJ45 inputs with two outputs rated for 20A incandescent or LED load at 120V and 277V AC, for 16A ballast load or LED at 120V and 277V AC, and for 1 HP at 120V AC. Sensor has 24V DC Class 2 power source, as defined by NFPA 70.

1. With integral current monitoring
2. Compatible with digital addressable lighting interface.
3. Plenum rated.

2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

1. Wall and Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated or Separate power pack.
4. Hardwired or Wireless connection to switch and BAS; and BAS and lighting control system.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.

7. Power: Low voltage or Line voltage.
8. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
9. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
10. Bypass Switch: Override the "on" function in case of sensor failure.
11. Automatic Light-Level Sensor: Adjustable from 2 to 100 fc; turn lights off when selected lighting level is present.

B. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage: Select sensor(s) to provide full coverage of room and detect occupancy anywhere within the room where installed.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Sensing Technology – Dual Technology.

2.5 DIGITAL TIMER LIGHT SWITCH

A. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval.

1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
2. The digital time switch shall be programmable to turn lights off after a preset time.
3. Time switch shall be a completely self-contained control system that replaces the standard toggle switch. It shall have a ground wire and ground strap for safety. Switching mechanism shall be a latching air gap relay.
4. Zero Crossing Circuitry shall be used to increase the relay life, protect from the effects of inrush current, and increase the switch’s longevity.
5. Time switch shall be compatible with all electronic ballasts, motor loads, compact fluorescent and inductive loads. Triac and other harmonic generating devices shall not be allowed.
6. Time switch shall have no minimum load requirement and shall be capable of controlling all types of light sources.
7. Time scroll feature shall allow manual overriding of the preset time-out period.
8. Time switch shall have the option for a one second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
9. Time switch shall have the option for a beep warning that shall sound every five seconds once the time switch countdown reaches one minute.
10. Time switch shall have manual feature for timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
11. Time switch shall have an electroluminescent backlit Liquid Crystal Display that shows the timer’s countdown.
12. Time switch shall fit behind a decorator style faceplate. The calibration switch for setting time-out, time scroll, one second light flash, and beep warning shall be concealed to prevent tampering of adjustments and hardware.
13. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
14. Time switch shall be capable of operating as an ON/OFF switch.
15. For safety, the time switch shall have a 100% OFF override switch with no leakage current to the load.
16. For safety, in the event there is an open circuit in the AC line such as a ballast or lamp failure, the time switch shall automatically switch to OFF mode

2.6 EMERGENCY SHUNT RELAY

A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120 and 277 V.

2.7 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Manufacturing Co., Inc.
4. Lutron Electronics Co., Inc.
5. NSi Industries LLC.
6. WattStopper; a Legrand® Group brand.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 WIRING INSTALLATION

A. Comply with NECA 1.

B. Minimum conduit size is 3/4 inch.

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 LIGHTING SYSTEM FUNCTIONAL TESTING

A. The lighting control system manufacturer, manufacturer’s authorized representative, or a qualified testing agency shall perform all functional testing required by the 2015 International Energy Conservation Code, Section C408.

B. Functional Testing:

1. Prior to passing final inspection, the manufacturer’s authorized representative shall provide evidence that the lighting control systems have been tested to ensure that control hardware and software are calibrated, adjusted, programmed and in proper working condition in accordance with the construction documents and manufacturer’s instructions.

C. Occupancy Sensor Controls:

1. Certify that the occupancy sensors have been located and aimed in accordance with manufacturer recommendations.

a. For projects with seven or fewer sensors, each sensor shall be tested.

b. For projects with more than seven sensors, testing shall be done for each unique combination of sensor type and space geometry. Where multiples of each unique combination of sensor type and space geometry are provided, not less than 10 percent, but in no case less than one, of each combination shall be tested. Where 20 percent or more of the tested controls fail, all remaining identical combinations shall be tested.

2. For occupancy sensor controls to be tested, verify the following:

a. Where occupancy sensor controls include status indicators, verify correct operation.

b. The controlled lights turn off or down to the permitted level within the required time.

c. For auto-on sensors, the lights turn on to the permitted level when an occupant enters the space.

d. For manual-on sensors, the lights turn on only when manually activated.

e. The lights are not incorrectly turned on by movement in adjacent areas or by HVAC operation.

D. Time Switch Controls:

1. Where time switch controls are provided, the following procedures shall be performed:

a. Confirm that the time-switch control is programmed with accurate weekday, weekend and holiday schedules.

b. Provide documentation to the owner of time switch controls programming including weekday, weekend, holiday schedules, and set-up and preference program settings.

c. Verify the correct time and date in the time switch.

d. Verify that any battery backup is installed and energized.

e. Verify that the override time limit is set to not more than 2 hours.

2. Simulate occupied condition. Verify and document the following:

a. All lights can be turned on and off by their respective area control switch.

b. The switch only operates lighting in the enclosed space in which the switch is located.

3. Simulate unoccupied condition. Verify and document the following:

a. Nonexempt lighting turns off.

b. Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shutoff occurs.

E. Daylight Responsive Controls:

1. Where daylight responsive controls are provided, the following shall be verified:

a. Control devices have been properly located, field calibrated and set for accurate set points and threshold light levels.

b. Daylight controlled lighting loads adjust to light level set points in response to available daylight.

c. The locations of calibration adjustment equipment are readily accessible only to authorized personnel.

F. Documentation Requirements:

1. Documents certifying that the lighting controls meet documented performance criteria of the IECC are to be provided to the building owner within 90 days from the date of receipt of the certificate of occupancy.

3.6 TRAINING

A. The lighting control system manufacturer or the manufacturer’s authorized representative shall conduct formal training for all users of the automatic lighting control systems.

END OF SECTION 260923

SECTION 260943 – PERFORMANCE LIGHTING CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes a networked lighting control system comprised of the following components:
   1. System Software Interfaces
      a. Management and Visualization Interface
      b. Historical Database and Analytics Interface
      c. Personal Control Applications
      d. Smartphone Programming Interface for wired devices
   2. System Backbone and Integration Equipment
      a. System Controller
      b. OpenADR Interface
   3. Wired Networked Devices
      a. Wall Switches and Scene Controllers
      b. Graphic Wall Stations
      c. Auxiliary Input/Output Devices
      d. Occupancy and Photocell Sensors
      e. Power Packs and Secondary Packs
      f. Networked Luminaires
      g. Relay and Dimming Panel
   4. Wireless Networked Devices
      a. Sensor Interface
      b. Light Controllers
      c. Digital Sensor Attachments
      d. Networked Luminaires
      e. Communication Bridge

B. The networked lighting control system shall meet all of the characteristics and performance requirements specified herein.

C. The contractor shall provide, install and verify proper operation of all equipment necessary for proper operation of the system as specified herein and as shown on applicable drawings.

1.3 SUBMITTALS

A. Submittals shall be provided including the following items.
   1. Bill of Materials necessary to install the networked lighting control system.
   2. Product Specification Sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
   3. Riser Diagrams showing device wiring connections of system backbone and also typical per room/area type.
   4. Information Technology (IT) connection information pertaining to interconnection with facility IT networking equipment and third-party systems.
   5. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
   6. Contractor Startup/Commissioning Worksheet (must be completed prior to factory start-up).
   7. Service Specification Sheets indicating general service descriptions, including startup, training, post-startup support, and service contract terms.
   8. Hardware and Software Operation Manuals.

1.4 APPROVALS

A. Prior approval from the Engineer of Record is required for products or systems manufactured by companies not specified in this specification.
B. Substitutions must be submitted in writing for approval at least 10 days prior to bid date.
C. Proposed substitute products must be documented with a line by line compliance review. Alternate products or systems require submission of catalog datasheets, system overview documents and installation manuals.
D. For any alternate system that does not support any form of wireless communication to networked luminaires, networked control devices, networked sensors, or networked input devices, bidders shall provide a total installed cost including itemized labor costs for installing network wiring to luminaires, control devices, sensors, input devices and other required system peripherals.

1.5 QUALITY ASSURANCE

A. Product Qualifications
   1. System electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
   2. System shall be listed as qualified under DesignLights Consortium Networked Lighting Control System Specification V2.0.

3. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
4. All components shall be subjected to 100% end of line testing prior to shipment to the project site to ensure proper device operation.
5. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

B. Installation and Startup Qualifications
   1. System startup shall be performed by qualified personnel approved or certified by the manufacturer.

C. Service and Support Requirements
   1. Phone Support: Toll free technical support shall be available.
   2. Remote Support: The bidder shall offer a remote support capability.
   3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
   4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.6 WARRANTY

A. The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of final acceptance of system installation and programming, by the owner and Engineer of Record.

B. The hardware warranty shall cover repair or replacement any defective products within the warranty period.

1.7 MAINTENANCE & SUSTAINABILITY

A. The manufacturer shall make available to the owner new parts, upgrades, and/or replacements available for a minimum of 5 years following final acceptance of system installation.

PART 2 – EQUIPMENT

2.1 MANUFACTURERS

A. Basis of Design: Acuity Brands Lighting, Inc. – System: nLight by Acuity Controls

B. Basis of Design Manufacturer: Acuity Brands, One Lithonia Way, Conyers GA 30012, www.acuitycontrols.com

2.2 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) optional system backbone for remote, time based and global operation between control zones.

    a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.

    b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wallstations without requiring connection to a higher level system backbone; this capability is referred to as “distributed intelligence.”

    c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone (see *Control Zone Characteristics* sections for each type of network connection, wired or wireless).

2. The system shall be capable of providing individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.

3. Lighting control zones shall be capable of being networked with a higher level system backbone to provide time based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.

4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality at a later date.

5. System shall be capable of "out of box" sequence of operation for each control zone. Standard sequence is:
    a. All switches control all fixtures in a zone
    b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networked Control Zone Characteristics

1. Following proper installation and provision of power, all networked devices connected together with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The "out of box" default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
    c. Emergency egress devices shall be provided and UL labeled by the lighting control manufacturer.

C. Wireless Networked Control Zone Characteristics

1. Following proper installation and provision of power, all wireless networked devices paired, meshed or grouped together shall automatically follow the "out of box" default sequence of operations.
2. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wallstation signal.
3. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wallstations to networked luminaires and wireless load control devices, without

requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.

4. All wireless communication shall be encrypted using at least 128-bit Advanced Encryption Standard (AES).
5. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
   a. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard, and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss or interruption of power sensed via line voltage connections.

D. System Integration Capabilities

1. The system shall interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.

2.3 SYSTEM SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
3. All system software updates must be available for automatic download and installation via the internet.

B. Historical Database and Analytics Interface

1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud based server.

C. Visualization Interfaces

1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.

D. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
    a. Switch/occupancy/photosensor group configuration
    b. Manual/automatic on modes
    c. Turn-on dim level
    d. Occupancy/Vacancy sensor time delays
    e. Dual technology occupancy sensors sensitivity
    f. Photosensor calibration adjustment and auto-setpoint
    g. Trim level settings

2.4 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT

A. System Controller
1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
2. System Controller shall perform the following functions:
    a. Facilitation of global network communication between different areas and control zones.
    b. Time-based control of downstream wired and wireless network devices.
    c. Linking into an Ethernet network.
    d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
    e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.

6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
   a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
   b. BACnet/MSTP shall support 9600 to 115200 baud.
   c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
   d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

B. OpenADR Interface

1. System shall provide an interface to OpenADR protocol Demand Response Automation Servers (DRAS) typically provided by local electrical utility.
2. OpenADR interface shall meet all of the requirements of Open ADR 2.0a Virtual End Nodes (VEN), including:
   a. Programmable with the account information of the end-user's electrical utility DRAS account credentials.

2.5 WIRED NETWORKED DEVICES

A. Wired Networked Wall Switches, Scene Controllers

1. Wall switches shall support the following device options:
   a. Number of control zones: per the Drawings.
   b. Control Types Supported: On/Off or On/Off/Dimming
2. Scene controllers shall support the following device options:
   a. Number of scenes: per the Drawings.
   b. Control Types Supported:
      1) On/Off or On/Off/Dimming
      2) Preset Level Scene Type
      3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene

4) Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones

B. Wired Networked Graphic Wall Stations

1. Device shall have a full color touch screen.
2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
3. Graphic wall stations shall support the following device options:
    a. Number of control zones: Minimum of 16
    b. Number of scenes: Minimum of 16
    c. Optional password protection for setup screens.

C. Wired Networked Auxiliary Input / Output (I/O) Devices

1. Auxiliary Input/Output Devices shall be specified as an input or output device with the following options:
    a. Contact closure input
        1) Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
    b. 0-10V analog input
        1) Input shall be programmable to function as a daylight sensor.
    c. RS-232/RS-485 digital input
        1) Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
    d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current
        1) Output shall be programmable to support all standard sequence of operations supported by system.

D. Wired Networked Occupancy and Photosensors

1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
2. Sensing technologies that are acoustically passive, meaning they do not transmit sound waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.

3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
4. Sensor mounting type shall match project design requirements as shown on plans.
    a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
5. The system shall support the following types of photocell-based control:
    a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
    b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networked Wall Switch Sensors
    1. Wall switches sensors shall support the following device options:
        a. User Input Control Types Supported: On/Off or On/Off/Dimming
        b. Occupancy Sensing Technology: PIR only or Dual Tech
        c. Daylight Sensing Option: Inhibit Photosensor

F. Wired Networked Embedded Sensors
    1. Embedded sensors shall support the following device options:
        a. Occupancy Sensing technology: PIR only or Dual Tech
        b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor

G. Distributed System Power, Switching and Dimming Controls
    1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
    1. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
    2. Device shall be plenum rated.
    3. Devices shall be UL Listed for load and load type as specified on the plans.

H. Wired Networked Luminaires (if indicated on the Drawings)

1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
2. Networked LED luminaire shall provide low voltage power to other networked control devices.
3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

I. Wired Networked Relay and Dimming Panel

1. Relay and dimming panel(s) shall be capable of providing the required amount of relay capacity, as required per panel schedules shown on drawings, with an equal number of individual 0-10V dimming outputs.
2. Standard relays used shall have the following required properties:
    a. Configurable in the field to operate with normally closed or normally open behavior.
    b. Provides visual status of current state and manual override control of each relay.
    c. Be individually programmable
3. 0-10 dimming outputs shall support a minimum of 100mA sink current per output.
4. Panel shall be UL924 listed for control of emergency lighting circuits.
5. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open or normally closed) in the panel.

2.6 WIRELESS NETWORKED DEVICES

A. Wireless Networked Sensor Interface

1. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.

B. Wireless Networked Light Controllers (No Sensor)

1. The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.
2. An external antenna attached to the luminaire shall not be allowed.
    a. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.

C. Wireless Networked Digital Sensors

1. In addition to providing Wireless Networked Light Controllers functionality, also provides:
    a. Integrated digital occupancy sensing and digital photocell sensor.
    b. Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
    c. Sensor shall have software-adjustable settings
    d. Photocell shall be suitable for closed and open loop applications.

D. Wireless Network Communication Bridge

1. A communication bridge device shall be provided that interfaces with the System Controller via Owner’s LAN connection and interfaces with wireless network.
2. Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, so as to reduce the amount of communication bridges required in the system.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Installation Procedures and Verification

1. The successful bidder shall review all required installation and pre-startup procedures with the manufacturer’s representative through pre-construction meetings.
2. The successful bidder shall install and connect the networked lighting control system components according to the manufacturer’s installation instructions, wiring diagrams, the project submittals and plans specifications.
3. The successful bidder shall be responsible for testing all low voltage network cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
    a. Wire Map (continuity, pin termination, shorts and open connections, etc.)
    b. Length

c. Insertion Loss

B. Coordination with Owner's IT Network Infrastructure

1. The successful bidder is required to coordinate with the owner's representative to secure all required network connections to the owner's IT network infrastructure.

    a. The bidder shall provide to the owner's representative all network infrastructure requirements of the networked lighting control system.

    b. The bidder shall provide, to the manufacturer's representative, all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.

C. Coordination with Mechanical Division

1. The successful bidder shall provide all integration equipment detailed in this specification.

2. The successful bidder shall verify integration scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

D. Documentation and Deliverables

1. The installing contractor shall be responsible for documenting installed location of all networked devices, including networked luminaires. This includes responsibility to provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

2. The installing contractor is also responsible for the following additional documentation to the manufacturer's representative if visualization / graphical floorplan software is provided as part of bid package:

    a. As-Built floor plan drawings showing wired network control zones outlined, in addition to device address locations required above. All documentation shall remain legible when reproducing\scanning drawing files for electronic submission.

    b. As-Built electrical lighting drawings (reflected ceiling plan) in PDF and CAD format. Architectural floor plans shall be based on as-built conditions.

        1) CAD files shall have layers already turned on/off as desired to be shown in the graphical floorplan background images. The following CAD elements are recommended to be hidden to produce an ideal background graphical image:
        Titleblock
        Text- Inclusive of room names and numbers, fixture tags and drawings notes
        Fixture wiring and homeruns

Control devices
Hatching or poché of light fixtures or architectural elements

2) CAD files shall be of AutoCAD 2013 or earlier. Revit file overall floor plan views shall be exported to AutoCAD 2013.

3.2 SYSTEM STARTUP

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.

1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.

B. System start-up and programming shall include:

1. Verifying operational communication to all system devices.
2. Programming the network devices into functional control zones to meet the required sequence of operation.
3. Programming and verifying all sequence of operations.
4. Customization of owner’s software interfaces and applications.

C. Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

3.3 PROJECT TURNOVER

A. System Documentation

1. Submit software database file with desired device labels and notes completed.

B. Owner Training

1. Provisions for onsite training for owner and designated attendees to be included in submittal package.

END OF SECTION 260943

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Distribution dry-type transformers rated 600 V and less, with capacities up to 1500 kVA.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
3. Include diagrams for power, signal, and control wiring.

1.3 FACTORY TESTING

A. Ratio tests at the rated voltage connection and at all tap locations.

B. Polarity and phase relation tests on the rated voltage connection.

C. Applied and induced potential tests.

D. No-load and excitation current at rated voltage on the rated voltage connection.

E. Sufficient information on the vibration isolators for the design to be checked for approval.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Electric Corporation.
2. Eaton.
3. General Electric Company.
4. Hammond Power Solutions Inc.
5. Siemens Industry, Inc., Energy Management Division.
6. Square D; by Schneider Electric.

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Efficiency: Transformers Rated 15 kVA and larger must comply with DOE 2016 Efficiency energy-efficiency levels and be marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

1. One leg per phase.
2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
3. Grounded to enclosure.

C. Coils: Continuous windings without splices except for taps.

1. Coil Material: Copper.
2. Internal Coil Connections: Brazed or pressure type.
3. Terminal connections Welded

D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

E. Enclosure: Ventilated.

1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
2. NEMA 250, Type 3R: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
3. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.

F. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: NSF/ANSI 61 gray weather-resistant enamel.

G. Taps for Transformers 3 kVA and Smaller: None.

H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity. For step up transformers provide two 2.5 percent taps above and two 2.5 percent below normal full capacity.

J. Insulation Class, Smaller than 30 kVA: 185 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

K. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115-deg C rise above 40-deg C ambient temperature.

L. Grounding: Provide ground-bar kit or a ground bar installed on the inside of transformer enclosure.

M. Low Magnetizing inrush current transformer: Provide low magnetizing inrush current type transformers rated for 4 times the full load current rating of all step-up transformers.

N. Wall Brackets: Manufacturer's standard brackets.

O. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:

1. Up to 50 kVA: 45dB.
2. 51 to 150 kVA: 50dB.
3. 151 to 300 kVA: 55dB.
4. 301 to 500 kVA: 60dB.
5. 501 to 700 kVA: 62dB.
6. 701 to 1000 kVA: 64dB

P. Vibration Isolation:

1. All transformers shall have vibration isolation that isolates the enclosure from the core and the coil assembly. Additional vibration isolators shall be provided between trapeze or universal hangers of suspended transformer and its case and between transformer enclosure and floor for floor mounted units.
2. Each dry type transformer shall be resiliently suspended on double deflection neoprene in the shear hanger rod isolator assemblies, capable of providing a minimum of 3/8 inch static deflection.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution and buck-boost transformer, mounted with corrosion-resistant screws.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at the rated voltage connections and at all tap connections.
2. Ratio tests at the rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at the rated voltage connections.
4. No load losses, and excitation current and rated voltage at the rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at the rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation Resistance Tests:
    a. High-voltage to ground.
    b. Low-voltage to ground.
    c. High-voltage to low-voltage.
9. Temperature tests.

B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in the project specifications have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to the contract documents and anchor floor-mounted transformers according to manufacturer's written instructions.

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to the project specifications.

B. Connect wiring according to the project specifications.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, and grounding.
c. Verify that resilient mounts are free and that any shipping brackets have been removed.
d. Verify the unit is clean.
e. Verify that as-left tap connections are as specified.

2. Electrical Tests:

a. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
b. Verify correct Primary and secondary voltages, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.2 SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

9. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Utility company approval for components subject to their specifications.

D. Qualification Data: For Installer and testing agency.

E. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in other sections, include the following:
   a. Routine maintenance requirements for switchboards and all installed components.
   b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.4 QUALITY ASSURANCE

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Ground Fault Circuit Protection UL 1053.
2. QMQB Operators UL E1818.
3. Bolted Pressure Switches UL 977.
4. Switchboards NEMA Standards PB-2, PB-2.1, PB-2.2; UL 891 and UL Service Entrance Label.
5. Meters ANSI Specification C 39.1.
6. ANSI C37.13.
7. ANSI C37.51.
8. NETA
9. Molded Case Circuit Breakers UL 489 and NEMA AB1.
10. NRTL labeled for service equipment.

B. Each switchboard as a complete and finished product shall receive a single integrated equipment rating by the manufacturer. The integrated equipment short-circuit rating shall certify that all equipment is capable of withstanding the thermal and magnetic stress of a fault equal to the value calculated by the Contractor/manufacturer's coordination study. Such rating shall be established by actual tests by the manufacturer on similar equipment. This certification shall be permanently affixed to each switchboard. Test data shall be submitted to the Engineer at the time of submission of Submittal Drawings.

C. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.6 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, obstacles and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and (temporary) HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding 104 deg F.
   b. Altitude: Not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
   1. Switchboard Warranty Period: 18 months from the date of Substantial Completion.

B. Manufacturer's Warranty: Manufacturer agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

   1. SPD Warranty Period: 3 years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. Approved manufacturers:
   1. Eaton

2. Square D
3. Siemens
4. General Electric

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

F. Nominal System Voltage: as indicated on the drawings.

G. Main-Bus Continuous: as indicated on the drawings.

H. Indoor Enclosures: Steel, NEMA 250, Type 2.

I. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

J. Barriers: Between adjacent switchboard sections.

K. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

L. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

M. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks.

N. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

O. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

P. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
3. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
4. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

Q. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity.
3. Copper feeder circuit-breaker line connections.
4. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
5. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
6. Disconnect Links:
   a. Isolate neutral bus from incoming neutral conductors.
   b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
7. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

R. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

S. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective deices and other components including instruments and instrument transformers.

2.2 SURGE PROTECTION DEVICES

A. SPDs: Comply with UL 1449, Type 1 or Type 2, depending on location of SPD as indicated on the drawings.

B. Features and Accessories:

1. Integral disconnect switch when type 1 SPD installed ahead of service disconnect.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Indicator light display for protection status.
4. Form-C contacts rated at 2 A and 24-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
5. Surge counter.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V or 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 480Y/277 V; 700 V for 208Y/120 V.
3. Line to Line: 2000 V for 480Y/277 V; 1000 V for 208Y/120 V.

E. SCCR: Equal or exceed 200 kA.

F. Nominal Rating: 20 kA.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Bolted Pressure Switch:
1. Switches 800 amperes and above and all main switches and service switches shall be bolted pressure type. Labeled for use as service equipment when required.
2. Manually operated and, where indicated, electrically tripped. Dead front, totally enclosed in a cabinet designed as a complete magnetic circuit. Interlock to

prevent access to a closed switch. Interlock capable of intentional bypass by knowledgeable personnel.

3. Fuse compartment shall be interlocked to prevent access when a switch is in the "CLOSED" position.
4. Maximum temperature rise at full load - 30°C spot temperature.
5. Short-Circuit Rating: As indicated on drawings.
6. Main-Contact interrupting capability shall be a minimum of 12 times the switch current rating. Switch opening under these conditions requires no major physical effort.
7. Arc barriers and replaceable arcing contacts shall be provided.
8. Switch shall be of the charge before closing type.
9. U.L. listed for continuous operation.
10. Handle shall be capable of being padlocked in the "OFF" position.
11. Ground Fault Relay (when provided): Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
    a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
    c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
    d. Test Control: Simulates ground fault to test relay and switch (or relay only if "NO TRIP" mode is selected).

B. Self-Contained Switch Units:
1. Switches 600 amperes and below shall be self-contained type, in accordance with NEMA KS1.
2. Switches shall be quick-make, quick-break, dead-front type. Each switch shall be a self-contained unit, externally operated from the front.
3. Fuse and switch compartment shall be interlocked to prevent access to the fuse compartment until the switch is thrown to the "OFF" position. Interlock shall be intentionally releasable by an externally applied tool to permit checking of the switch and fuses under load.
4. Switches shall be equipped with rejection type clips suitable for Class R fuses.
5. Handle shall be capable of being padlocked in the "OFF" position.

C. Feeder Circuit Breakers:
1. Thermal magnetic molded case circuit breakers:
    a. Molded case circuit breakers shall have integral and instantaneous thermal magnetic trip in each pole. Provide adjustable trip setting for circuit breaker frame sizes 250A and larger; adjustable instantaneous trip circuit

branches; or magnetic trip element with front-mounted field adjustable trip setting.

b. Circuit breaker(s) shall be standard interrupting. Ampere ratings shall be as shown on the Contract Documents. Manufacturer shall submit one (1) set of published Ip and I^2t let-through curves (as required by UL) to the Owner.

2. Molded-Case Circuit Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Suitable for number, size, trip ratings, and conductor material.
   c. Ground-Fault Circuit Protection (when provided): Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   d. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
   e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
   a. Instantaneous trip.
   b. Long and short-time pickup levels.
   c. Long and short-time time adjustments.
   d. Ground-fault pickup level, time delay, and I^2t response.

4. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
   a. Fixed circuit-breaker mounting.
   b. Two-step, stored-energy closing.
   c. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
      1) Instantaneous trip.
      2) Time adjustments for long- and short-time pickup.
      3) Ground-fault pickup level, time delay, and I2t response.

5. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.4 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
    a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
    d. Megawatts: Plus or minus 1 percent.
    e. Megavars: Plus or minus 1 percent.
    f. Power Factor: Plus or minus 1 percent.
    g. Frequency: Plus or minus 0.1 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

2.6 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified elsewhere in the project specifications.

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to switchboards.
6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, surge protection devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Comply with NECA 1.

3.3 CONNECTIONS

A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

B. Support and secure conductors within the switchboard according to NFPA 70.

C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with the project specification requirements for identification.

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with the project specifications.

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with the project specifications.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Acceptance Testing:

a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Perform the following infrared scan tests and inspections, and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Instruments and equipment
      1) Use an Infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 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 as specified in Coordination Studies furnished by the Contractor.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.3 SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for SPD as installed in panelboard (where applicable).
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
8. Include wiring diagrams for power, signal, and control wiring.
9. Key interlock scheme drawing and sequence of operations.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

C. Qualification Data: For testing agency.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in other sections, include the following:
    a. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
    b. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from the date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: 3 years from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMMON PANELBOARD REQUIREMENTS

A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.
    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall and ceiling or floor.
5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
6. Finishes:
    a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Galvanized steel.
    c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

F. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
5. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate on load side of main device unless otherwise noted on plans.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

I. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent or what is shown on contract drawings (whichever value is greater).

K. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

L. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1 or Type 2.

2.2 DISTRIBUTION PANELBOARDS

A. Approved manufactures:
1. Eaton: Pow-R-Line 4,
2. Siemens: Type P4/P5
3. General Electric: Spectra Series

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker or lugs only.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers where individual positive-locking device requires mechanical release for removal.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-Power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

2.3 BRANCH-CIRCUIT PANELBOARDS

A. Approved manufacturers:
1. Eaton
2. Square D
3. Siemens
4. General Electric

B. Panelboards: NEMA PB 1, branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-Power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Electronic Trip Circuit Breakers:

a. 100 percent rated
b. RMS sensing.
c. Field-replaceable rating plug or electronic trip.
d. Digital display of settings, trip targets, and indicated metering displays.
e. Multi-button keypad to access programmable functions and monitored data.

f. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
g. Integral test jack for connection to portable test set or laptop computer.
h. Field-Adjustable Settings:
    1) Instantaneous trip.
    2) Long- and short-time pickup levels.
    3) Long and short time adjustments.
    4) Ground-fault pickup level, time delay, and I squared T response.

2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
5. Subfeed Circuit Breakers: Vertically mounted.
6. MCCB Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Communication Capability: Circuit-breaker-mounted or integral communication module with functions and features compatible with power monitoring and control system.
    h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    i. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
    j. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

m. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
n. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Mount top of trim at a height so that the operating handle of the top-most switch or circuit breaker, in ON position, is not higher than 79 inches (2000 mm) above finished floor or grade, unless otherwise indicated.

G. Mount panelboard cabinet plumb and rigid without distortion of box.

H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

I. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

J. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

K. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

L. Install filler plates in unused spaces.

M. Stub four 1-inch empty conduits from recessed mounted panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

N. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with the project specification requirements for identification.

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with the project specifications.

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with the project specifications.

E. Install warning signs complying with requirements of the project specifications.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

        1) Use an infrared scanning device to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 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 as specified in Coordination Studies.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Engineer of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Owner.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.
5. Update panelboard directories accordingly, and provide updated directories to Owner within five business days of load balancing.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard-Grade receptacles.
2. USB receptacles.
3. GFCI receptacles.
4. SPD receptacles.
5. Twist-locking receptacles.
6. Pendant cord-connector devices.
7. Cord and plug sets.
8. Toggle switches.
9. Wall plates.
10. Floor Service Fittings
11. Poke-through assemblies.
12. Prefabricated multioutlet assemblies.
13. Service poles.

1.2 SUBMITTALS

A. Product Data: For each type of product. Highlight exact model being proposed in each submittal

1.3 WARRANTY

A. Provide five (5) year manufacturer’s warranty on all components.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

D. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES

A. Simplex or Duplex Receptacles: 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with NEMA WD 1, UL498, and FS W-C-596.

B. Isolated-Ground, Duplex Receptacles: 125 V, 20 A:

1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with NEMA WD 1, UL498, and FS W-C-596.

C. Weather-Resistant Duplex Receptacles: 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with NEMA WD 1, UL498.
4. Marking: Listed and labeled as complying with NFPA 70, “Receptacles in Damp or Wet Locations” Article.

2.3 USB RECEPTACLES

A. Duplex and USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all brass grounding system. Nickel-plated, brass mounting strap.

2. Line Voltage Receptacle: Two pole, three wire, and self-grounding; NEMA WD 6, configuration 5-20R
3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with NEMA WD 1, UL498, UL 1310, USB 3.0 devices FS W-C-596.

2.4 GFCI RECEPTACLES

A. Duplex GFCI Receptacles: 125 V, 20 A:

1. Description: Integral GFCI with “Test” and “Reset” buttons. Two pole, three wire, and self-grounding, Feed Through type.
2. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
3. GFCI shall interrupt ground leak currents between 4-6 mA with a tripping time of .025 seconds.
4. Configuration: NEMA WD 6, Configuration 5-20R.
5. Standards: Comply with NEMA WD 1, UL498, UL 943 Class A, and FS W-C-596.

2.5 SPD RECEPTACLES

A. Duplex SPD Receptacles: 125 V, 20 A:

1. Description: Two pole, Three wire, and Self-Grounding. Integral SPD in line to ground, line to natural, and neutral to ground. Led Indicator light
2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
4. Configuration: NEMA WD 6, Configuration 5-20R.
5. Standards: Comply with NEMA WD 1, UL498, UL 1449, and FS W-C-596

2.6 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Convenience Receptacles: comply with NEMA WD 1, NEMA WD 6 Configurations and UL 498. Refer to contract drawings for voltage rating, ampere rating and plug configuration.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. Unless otherwise noted on drawings, provide NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A, Single pole:

C. Key-Operated Switches: 120/277 V, 20 A.

1. Description: Single pole, with factory-supplied key in lieu of switch handle.

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

E. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: As selected by the Architect.

3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift gasketed cover, and listed and labeled for use in wet and damp locations (Mechanical rooms, pool rooms, garages etc).

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.11 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type or flap-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Data Communication Outlet: Blank cover with bushed cable opening.

2.12 POKE-THROUGH ASSEMBLIES

A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
1. Comply with UL 514 scrub water exclusion requirements.
2. Type as indicated on the drawings. Match components with floor thickens.
3. Size: Core hole size as indicated on the drawings.
4. Fire Rating: two (2) hours minimum.
5. Closure Plug: Arranged to close unused cored openings (size to match core opening) and reestablish fire rating of floor.
6. Covers: Countered flush mounted, die cast cover with finish as selected by Architect.

B. Wiring raceway and compartments: provide minimum wiring and cabling to support data jacks and receptacle quantity/types indicated on the drawings.

2.13 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Description: two-piece surface mounted multiple compartment metal raceway, lengths as indicated on drawings. Provide all required fittings, device brackets, and palates to accommodate a complete code compliant system.

B. Components shall be from the same manufacturer designed for use as a complete matching assembly of raceways and receptacles. Raceways shall be utilized for power branch circuits and data wiring, each in its own dedicated channel.

C. Raceway construction: Raceways shall be two-piece design with base and snap-on cover, or three-piece design with base and two snap-on covers which snap side by side on a common base. Base shall be dividable with a fixed barrier for up to 4 compartments. Raceway shall be in widths of ¾" to 10" and depths of 17/32" to 5" as indicated on the Contract Documents

D. Raceway material: Aluminum with finish color as selected by architect.

E. Provide receptacle types, quantities, and spacing as indicated on the Contract Documents. Provide device cover plates (power & communication) in a satin finish with circuiting identification tags. Colors of power and communication devices shall be by the Architect.

2.14 SERVICE POLES

A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

B. Poles: Nominal 2.5-inch- square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.

C. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.

D. Finishes: Manufacturer's standard painted finish and trim combination.

E. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 3 or Category 5 voice and data communication cables.

F. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.

2.15 DEVICE FINISHES

A. Device Color:

1. All normal Wiring Devices: As selected by Architect unless otherwise indicated.
2. Receptacles Connected to Emergency Power System: Red.
3. SPD Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

2.16 Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pass & Seymour/Legrand.
2. Hubbell
3. Leviton
4. Eaton

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

B. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

C. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical. Group adjacent switches under single, multigang wall plates.

G. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

H. Switch Installation:

1. Install all switches vertically with the “ON” position on top, unless otherwise noted or specified.
2. Where switches are indicated near doors, corner walls, etc. install not less than two (2) inches and not more than twelve (12) inches from the trim.
3. Carefully coordinate location of switches to insure locations are at the strike side of the doors.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

B. Swab all conduits and outlet boxes clear of moisture.

C. Do not combine GFCI protected circuits with other circuits in the same raceway: only one (1) GFCI circuit per raceway.

D. Do not substitute GFCI circuit breakers for GFCI receptacles.

E. All GFCI receptacles shall be installed in a ready accessible location per the NEC.

3.3 IDENTIFICATION

A. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Wiring device will be considered defective if it does not pass tests and inspections.

3.5 SPARE PARTS

A. Provide Five (5) spare devices for each type used on the project. Turn over to owner after project completion.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
   a. Control circuits.
   b. Motor-control centers.
   c. Switchboards.
   d. Enclosed controllers.
   e. Enclosed switches.
   f. Spare-fuse cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann
2. Mersen
3. Littelfuse

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.

2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay
2. Feeders: Class L, time delay.
3. Motor Branch Circuits: Class RK1, time delay.
4. Large Motor Branch (601-4000 A): Class L, time delay.
5. Other Branch Circuits: Class RK1, time delay.
6. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Enclosures.

1.2 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Approved manufacturers:
1. Eaton
2. Square D
3. Siemens
4. General Electric

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

A. Manufacturer shall be the same as the switchboards and panelboards.

B. Type HD, Heavy Duty:

1. Single throw.
2. Three or six pole. Provide six pole for connection to motors requiring six motor leads.
3. 600-V ac.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
5. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
6. Amperage rating as indicated on the drawings.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and copper conductors.
5. Service-Rated Switches: Labeled for use as service equipment.

2.3 NONFUSIBLE SWITCHES

A. Manufacturer shall be the same as the switchboards and panelboards.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position. Provide six pole switch for connection to motors requiring six motor leads.

D. Refer to drawings for amperage rating of switch(es).

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and copper conductors.
5. Service-Rated Switches: Labeled for use as service equipment.

2.4 SHUNT TRIP SWITCHES

A. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.

B. Type HD, Heavy-Duty, Nonfusible or fusible Switches:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
5. Integral shunt trip mechanism
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
7. Amperage rating and type as indicated on the drawings.

C. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturer shall be the same as the switchboards and panelboards.

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 194 deg F rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.

G. Standards: Comply with UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

M. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Alarm Switch: One NO/NC contact that operates only when circuit breaker has tripped.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
9. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12) a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

E. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain code required workspace clearances and required clearances for equipment access doors and panels, regardless of location indicated on the drawings.

B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 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 as specified in the Coordination studies and furnished by the Electrical Contractor.

END OF SECTION 262816

SECTION 263213 - ENGINE GENERATOR SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes engine generator systems for non-emergency use with the following features:

1. Natural gas engine.
2. Gaseous fuel system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Load banks.
7. Outdoor generator-set enclosure.
8. Remote radiator motors.
9. Vibration isolation devices.
10. Finishes.
11. Automatic transfer switches

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in cubic feet per hour (cubic meters per hour) at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

C. Field quality-control reports.

D. Warranty

E. Operation and Maintenance Data: For engine generators to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Caterpillar, Generac, Cummins, Kohler or approved equal.

B. Source Limitations: Obtain packaged engine generators and auxiliary components through one source from a single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. B11 Compliance: Comply with B11.19.

B. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.

C. UL Compliance: Comply with UL 2200.

D. Engine Exhaust Emissions: Comply with EPA Certified requirements and applicable state and local government requirements.

E. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

F. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C).
2. Altitude: Sea level to 1000 feet (300 m).

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency acceptable to authorities having jurisdiction, and marked for intended location and use.

C. Power Rating: Standby.

D. Service Load: as indicated on the Drawings.

E. Power Factor: 0.8, lagging.

F. Frequency: 60 Hz

G. Voltage: 480 V ac.

H. Phase: Three-phase, four wire.

I. Governor: Adjustable isochronous, with speed sensing.

J. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

K. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

L. Engine Generator Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
8. Start Time: 10 seconds maximum.

2.4 GASEOUS ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid-mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.

E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet (8 m) from exhaust discharge after installation is complete shall be 78 dBA or less.

G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.
4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least twice without recharging.
5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35 A minimum continuous rating.
6. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead acid batteries. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg F (minus 40 deg C) to 140 deg F (plus 60 deg C) to prevent overcharging at high temperatures and undercharging at low temperatures.
c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 GASEOUS FUEL SYSTEM

A. Natural Gas Piping: Comply with requirements in Section 221613 "Natural Gas Piping."

B. Gas Train: Comply with NFPA 37.

C. Engine Fuel System:

D. Natural Gas, Vapor-Withdrawal System:

1. Carburetor.
2. Secondary Gas Regulators: One for each fuel type, with atmospheric vents piped to building exterior.
3. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.
4. Fuel Filters: One for each fuel type.
5. Manual Fuel Shutoff Valves: One for each fuel type.
6. Flexible Fuel Connectors: Minimum one for each fuel connection.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates generator-set shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:

1. Digital controller with integrated LCD, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.

   a. Engine lubricating-oil pressure gage.
   b. Engine-coolant temperature gage.

c. DC voltmeter (alternator battery charging).
d. Running-time meter.
e. AC voltmeter.
f. AC ammeter.
g. AC frequency meter.
h. Generator-voltage adjusting rheostat.

3. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication, including the following:

a. Cranking control equipment.
b. Run-Off-Auto switch.
c. Control switch not in automatic position alarm.
d. Overcrank alarm.
e. Overcrank shutdown device.
f. Low water temperature alarm.
g. High engine temperature prealarm.
h. High engine temperature.
i. High engine temperature shutdown device.
j. Overspeed alarm.
k. Overspeed shutdown device.
l. Low fuel main tank.
m. Coolant low-level alarm.
n. Coolant low-level shutdown device.
o. Coolant high-temperature prealarm.
p. Coolant high-temperature alarm.
q. Coolant low-temperature alarm.
r. Coolant high-temperature shutdown device.
s. EPS supplying load indicator.
t. Battery high-voltage alarm.
u. Low cranking voltage alarm.
v. Battery-charger malfunction alarm.
w. Battery low-voltage alarm.
x. Lamp test.
y. Contacts for local and remote common alarm.
z. Low-starting air pressure alarm.
aa. Low-starting hydraulic pressure alarm.
bb. Remote manual stop shutdown device.
cc. Air shutdown damper alarm when used.
dd. Air shutdown damper shutdown device when used.
ee. Hours of operation.
ff. Engine generator metering, including voltage, current, Hz, kW, kVA, and power factor.

F. Remote Emergency-Stop Switch: Locate in Main Electrical Room.

G. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when engine generator is shut down by remote emergency-stop switch.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over-speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

E. Enclosure: Drip proof.

F. Voltage Regulator: Solid-state type, separate from exciter.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 15 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 10 percent and stabilize at rated frequency within 2 seconds.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof steel housing, wind resistant up to 100 mph (160 km/h). Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph (160 km/h).

C. Hinged Doors: With padlocking provisions.

D. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

E. Muffler Location: Within enclosure.

F. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.
2. Minimum Deflection: 1 inch (25 mm).

B. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with IEEE 115.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation.

C. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in on the Drawings.
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
3. Install packaged engine generator with vibration isolators having a minimum deflection of 1 inch on 6-inch high concrete base. Secure engine generator and enclosure to anchor bolts installed in concrete bases.

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

E. Gaseous Fuel Piping:

1. Natural gas piping, valves, and specialties for gas distribution are specified in Section 221613 "Natural Gas Piping."

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Drawings indicate general arrangement of piping and specialties.

B. Gaseous Fuel Connections:

1. Connect fuel piping to engines with a gate valve and union and flexible connector.
2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.
3. Vent gas pressure regulators outside building a minimum of 60 inches (1500 mm) from building openings.

C. Ground all equipment according to NEC requirements. The Automatic Transfer Switch shall be three-pole with a bonded neutral. The system is designed to not be separately derived.

3.4 FIELD QUALITY CONTROL

A. Field Tests:

1. Field tests shall be conducted by factory-certified technicians.
2. Field inspection and testing shall occur after installation is complete.
3. Test transfer switches, engine start circuits, time delay circuits, status points, and system control points.
4. Perform 4-hour 100-percent full resistive load test using a temporary load bank. Unsuccessful tests shall be fully documented, submitted, and re-tested until successful.
5. Conduct field tests in accordance with NFPA110.

3.5 DEMONSTRATION

A. The engine generator-set supplier shall provide a minimum of four hours of operating instructions on maintenance and operation of the emergency power system. Classes shall be open for up to three representatives of the Owner's maintenance staff. Instructions shall be administered by a full-time employee of the supplier.

END OF SECTION 263213

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes automatic transfer switches rated 600 V and less.

1.2 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

C. Field quality-control reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.3 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.

F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Short-time withstand capability for three to 30 cycles.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

J. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

K. Neutral Terminal: Solid and fully rated unless otherwise indicated.

L. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

M. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

N. Enclosures: General-purpose NEMA 250, Type 1, Type 3R, or Type 4X, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using contactor-based components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Main and Neutral Lugs: Mechanical type.
6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
7. Ground bar.
8. Connectors shall be marked for conductor size and type according to UL 1008.

C. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.

1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

D. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

E. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.

F. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.

2. Undervoltage Sensing for Each Phase of Normal and Alternative Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.

c. Integral battery operation of time switch when normal control power is unavailable.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency and legally required systems. Include results of test for the following conditions:

a. Overvoltage.
b. Undervoltage.
c. Loss of supply voltage.
d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.
f. Temperature rise.
g. Dielectric voltage-withstand; before and after short-circuit test.
h. Overload.
i. Contact opening.
j. Endurance.
k. Short circuit.
l. Short-time current capability.
m. Receptacle withstand capability.
n. Insulating base and supports damage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

B. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

E. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. The following tests and inspections shall be performed:

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

a. Compare equipment nameplate data with Drawings and Specifications.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and required clearances.
d. Verify that the unit is clean.
e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
f. Verify that manual transfer warnings are attached and visible.
g. Verify tightness of all control connections.
h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

1) Use of low-resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

a. Perform insulation-resistance tests on all control wiring with respect to ground.
b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
c. Verify settings and operation of control devices.
d. Calibrate and set all relays and timers.
e. Verify phase rotation, phasing, and synchronized operation.
f. Perform automatic transfer tests.
g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
c. Verify that manual transfer warnings are properly placed.
d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
b. Simulate loss of phase-to-ground voltage for each phase of normal source.
c. Verify time-delay settings.
d. Verify pickup and dropout voltages by data readout or inspection of control settings.
e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Transfer switches will be considered defective if they do not pass tests and inspections.

F. Remove and replace malfunctioning units and retest as specified above.

G. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.2 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

B. Maintenance Data: For SPDs to include in maintenance manuals.

1.4 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. SPDs: Comply with UL 1449, Type 1 or Type 2, depending on location indicated on the drawings.

B. Comply with UL 1283.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, 208Y/120 V, or 120/240 V delta, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral:
   a. 1200 V for 480Y/277 V
   b. 700 V for 208Y/120 V.
   c. 700 V for 120/240 V delta.
2. Line to Ground:
   a. 1200 V for 480Y/277 V
   b. 700 V for 208Y/120 V.
   c. 700 V for 120/240 V delta.
3. Neutral to Ground:
   a. 1200 V for 480Y/277 V

b. 700 V for 208Y/120 V.
c. 700 V for 120/240 V delta.

4. Line to Line:
   a. 2000 V for 480Y/277 V
   b. 1200 V for 208Y/120 V.
   c. 1200 V for 120/240 V delta.

E. SCCR: Equal or exceed 200 kA.

F. Inominal Rating: 20 kA.

2.3 PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449, Type 2.

1. Include LED indicator lights for power and protection status.
2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

C. Comply with UL 1283.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, 208Y/120 V, or 120/240 V delta, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral:
   a. 1200 V for 480Y/277 V
   b. 700 V for 208Y/120 V.
   c. 700 V for 120/240 V delta.

2. Line to Ground:
   a. 1200 V for 480Y/277 V
   b. 700 V for 208Y/120 V.
   c. 700 V for 120/240 V delta.

3. Neutral to Ground:
   a. 1200 V for 480Y/277 V

b. 700 V for 208Y/120 V.
c. 700 V for 120/240 V delta.

4. Line to Line:
a. 2000 V for 480Y/277 V
b. 1200 V for 208Y/120 V.
c. 1200 V for 120/240 V delta.

E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.
4. Line to Line: 1200 V.

F. SCCR: Equal or exceed 100 kA.

G. Inominal Rating: 20 kA.1ENCLOSURES

H. Indoor Enclosures: NEMA 250, Type 1.

I. Outdoor Enclosures: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Comply with power and wiring per the project specifications.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Lighting Fixtures.
2. Materials.
3. Finishes.
4. Fixture support.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Refer to the Lighting Fixture Schedule on the drawings for the specified fixtures and options.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.
2. California Title 24 compliant.
3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
5. UL Listing: Listed for damp location.
6. Recessed luminaires shall comply with NEMA LE 4.

C. CRI as indicated on the drawings. CCT as indicated on the drawings.

D. Rated lamp life of minimum 50,000 hours to L80.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.

2.3 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI for all luminaires.

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

B. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

C. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Owner, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls or Attached to a minimum 20 gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with minimum two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
2. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

END OF SECTION 265119

SECTION 265219 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.

1. Include data on features, accessories, and finishes.
2. Include physical description of the unit and dimensions.
3. Battery and charger for light units.
4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.
    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule:

1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Refer to Lighting Fixture Schedule on the drawings for the specified fixtures and options.

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for fluorescent luminaires.

F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.

1. Emergency Connection: Operate lamp(s) continuously full lumen output upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
5. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

G. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.

1. Emergency Connection: Operate LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire.
2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects

from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

3. Charger: Fully automatic, solid-state, constant-current type.
4. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the ballast or emergency power unit manufacturer, whichever is less.
5. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
6. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires: as indicated on the drawings.

C. Emergency Lighting Unit: as indicated on the drawings.

D. Remote Emergency Lighting Units: as indicated on the drawings.

2.4 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LED; 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.5 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Housings:

1. As indicated on the drawings.

D. Conduit: Electrical metallic tubing, minimum 3/4 inch in diameter.

2.6 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

1. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Perform startup service:

1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.5 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
   a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265219

SECTION 270510 - COMMUNICATIONS, GENERAL

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents. This section specifies general wiring requirements for systems provided under 27 Series sections of these specifications.

1.2 SUBMITTALS

A. Refer to particular Specification Sections covering all systems. Submit system test reports as called for.

1.3 GENERAL REQUIREMENTS

A. Provide conduit systems and special systems as called for.

1. Provide conduit, wireway, wire terminations, etc., necessary to provide for system functions.

2. Cross-sectional area of wires installed in a conduit shall not exceed 40% of the cross-sectional area called for in the National Electrical Code.

3. Provide separate circuit power source for each system.

4. Where allowable by Code and contract documents, special systems wiring may be installed without conduit. Installation and wire insulation types shall be as described by NEC, Article 725. All low voltage wiring circuits 50V and under shall:

a. Be adequately supported using bridle rings or other approved method when installed horizontally above accessible ceilings or run exposed in unfinished areas.

b. Be run in wall cavity or surface metal raceway where no access is available to wall cavity, in finished areas.

c. Be installed in conduit when installed vertically in Mechanical Rooms from panels and devices up to ceiling.

d. Be installed in conduit in all cases not specifically covered by the above cases, or where subject to physical damage.

e. Have the proper insulation and meet the requirements of NEC Article 300-22 when installed in plenums or other spaces used for environmental air.

B. Identification:

1. Provide consistent color code wiring and identify with permanently attached number to each end of each wire, except where color coding is prohibited to meet UL burglary protection requirements.

C. Termination:

1. Unless special terminations are required, such as coaxial cable termination, wires shall be terminated on screw type terminal blocks with metal terminal cabinets.

D. Wiring Diagrams:

1. Install systems in accordance with manufacturer's certified correct wiring diagrams.

2. Provide record drawings for each system, with wire identification, numbers and colors, as installed.

PART 2 - PRODUCTS

2.1 MAKE AND SERVICE

A. Provide devices and equipment by an established manufacturer for respective systems. All devices and equipment for which there is a listing shall be UL listed and FM approved.

B. Provide system equipment and devices of one manufacturer who maintains a competent service organization and who shall be prepared to offer a service contract for maintenance of the respective system.

C. Provide three service organization inspections for each system at four-month intervals during the year following final acceptance.

D. Correct defects found in the system at the time of these inspections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide complete installation in a neat and workmanlike manner including all accessories and appurtenances for a complete operating system, including equipment mounting backboards, power supplies, wiring, etc.

B. Each system installation shall be supervised, tested, adjusted and approved by authorized representative of the manufacturer of the system devices and equipment.

C. Provide written statement from the authorized representative of the manufacturer of the system devices and equipment that the completed system has been inspected and tested and is approved.

D. Riser and wiring diagrams are not intended as final installation drawings but only as a guide for bidding. Install system based on final wiring drawings prepared by the manufacturer of the system.

3.2 WIRING

A. Wire sizes shall be as recommended by system manufacturer.

B. #14 AWG wire, minimum unless otherwise called for.

C. #12 AWG wire, minimum for alarm signal circuits and all power supplies.

D. Provide #20/2 copper minimum twisted and shielded with overall jacket for audio frequency circuits. Shield shall be Mylar backed aluminum foil with drain wire, or copper braid. Do not provide spiral wrap shielding.

E. Provide coaxial cable and fiberoptic cable as called for video and RF distribution.

F. Do not install low level lines such as microphone wires in same conduit with high level lines such as speaker wires.

G. All final wire connections and terminations shall be performed by an authorized representative of the equipment manufacturer who is regularly engaged in, and experienced in this type of work. Subcontracting this work to others is not acceptable.

END OF SECTION 270510

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SECTION 272100 - LOCAL AREA NETWORK SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment, services, etc. for a complete functional Local Area Network (LAN) and related work as required in the Contract Documents.

B. The systems to be provided shall be for a switched LAN environment. The system shall hereafter be referred to as the Data Network System.

C. Basic Intent:

1. Located throughout the building as shown on the drawings, are places where computers and associated equipment are intended to be placed and connected to the network for the purposes of utilizing common resources.

2. The telecommunications rooms for the data network in the building(s) are located as shown on the drawings.

3. Located in various other places are additional Telecommunication Rooms. It is intended that these be connected with the Main Telecommunication Room by a fiber optic cable backbone. From each of these locations, data cable is to be run to the data jacks where computer equipment is connected.

4. Patch panels shall be used as termination points for all fiber optic cabling. Provide backbone cabling between telecommunication rooms as indicated.

5. Patch panels shall be used as termination points for all data cables and the individual fiber cables in telecommunication rooms.

D. Description of System:

1. The system shall include the items listed below, as described herein and as indicated on the Contract Documents:

a. Utilityservice to the building(s).

b. Building Main Distribution Frame (MDF) for service entrance and distribution.

c. Intermediate Distribution Frame (IDF) as indicated for cabling distribution.

d. Backbone wiring from entrance facility to the MDF and from MDF to the IDFs.

e. Complete raceway system (cable tray, J hooks, conduit) for cabling distribution.

f. Grounding of all racks, raceway and equipment.

g. Power for the telecommunication rooms.

1.2 TELECOMMUNICATION ROOMS

A. Each telecommunication room shall be furnished with 3/4 in. plywood backboard, floor to ceiling on all walls, with the plywood backboard painted with two (2) coats of fire resistant paint (UL/ASTM Class A), all surfaces.

1. ANSI/TIA/EIA Telecommunications Building Wiring Standards.

2. IEEE Telecommunications Standards.

3. BICSI Methods Manuals.

4. NFPA 70: NEC

1.3 QUALITY ASSURANCE

A. Work shall be as specified herein and it shall be neat and orderly installation. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative.

B. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

C. Installation shall be accordance with NFPA 70 (National Electrical Code), TIA/EIA, IEEE, IEC, state codes, local codes, and requirements of the Authority Having Jurisdiction.

D. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMAIEC, TIA/EIA and IEEE Standards.

E. Each item shall be NRTL tested and listed.

F. The system provider must:

1. Provide equipment from manufacturers for which they maintain a contract, distributorship, are an agent, or other formal arrangement for which documentation can be produced showing authority to sell and service the equipment in this territory.

2. Demonstrate that they have successfully installed these systems, utilizing their standard products, for a period of five (5) years.

3. Maintain a service organization to provide both normal and emergency service. Emergency service must be available 24 hours per day; 365 days per year and staff must be adequate to respond within two (2) hours of an emergency call.

4. Maintain adequate spare parts inventory to provide both normal and emergency service.

5. Employ service technicians who are trained in accordance with the systems manufacturer's recommendations.

6. Own and demonstrate proficiency in the use of the required test equipment, tools, etc. for the proper installation, set-up, testing and maintenance of the system. If requested, must provide a listing of tools and/or equipment and where appropriate, certifications in the proper training and use of the tools and/or equipment.

7. Provide all system programming to deliver a customized system to the Owner ready for use.

    a. All system programming is to be completed to the satisfaction of the Owner. If after preliminary use of the system, and/or training, the increased understanding of the system's features and capabilities necessitates reprogramming to any extent, it is to be performed at no additional cost.

    b. System shall be reprogrammed three months after occupancy/system turn over to incorporate all Owner desired modifications.

G. Contractor Qualifications:

1. This Contractor shall be a certified installer for the proposed equipment/system manufacturer(s) and be BICSI certified ITS Installer 2, Copper and Optical Fiber and shall be certified to terminate indicated fiber connectors.

2. The cable installer shall provide documentation and references from three (3) similar installations installed within the previous two (2) years within a 60 mile radius.

H. Installer Qualifications:

1. Cabling installer must have personnel certified by BICSI on staff.

1.4 SUBMITTALS

A. Provide the following in a single clear and organized submittal. Package shall be submitted as specified in:

1. Manufacturers catalog sheets, specifications and installation instructions for all system components.

2. Detailed description of system operation.

3. Itemized list of all features and functions.

4. Dimensioned drawings of all system control cabinets and layouts for all equipment rooms.

5. Wiring diagrams showing typical connections for equipment.

6. Contractor certification and qualifications.

7. Riser diagrams showing all components, devices and interconnecting cable types.

8. List of three (3) installations of equivalent or larger systems that have been installed within the past two (2) years and have been operating satisfactorily for a minimum of one (1) year.

9. Warranty information.

10. System test reports.

11. Provide scaled elevation and plan drawings indicating walls, data racks, patch panels, wire management, cable trays, power strips, door swing, etc. for each cable closet/room.

1.5 SYSTEM DESCRIPTION

A. Provide a complete and fully operational state of the art Local Area Network (LAN) system as described herein and indicated on the contract documents. Include any and all interface equipment to supply a complete network with complete equipment connections necessary to form a complete "turnkey" network system as outlined in these specifications.

B. The complete system shall include, but is not limited to, the following:

1. Equipment Room build-out.
2. Telecommunications Room build-out.
3. Equipment cabinets and racks.
4. Patch panels and patch cables.
5. Wire management.
6. Fiber optic backbone cabling.
7. Horizontal cabling.
8. Modular jacks, backboxes and faceplates.
9. Terminations and testing.
10. Raceways, pathways, cable tray, sleeves, pull boxes.
11. Firestopping.
12. UPS units.
13. Wireless Network System.
14. Fiber adapters and downlinks.
15. Training and system programming.

C. Owner shall provide the network electronics.

D. The following shall be furnished by the Owner, installed, terminated and tested by this Contractor:

Router, Core Switch, Fringe Switch, Edge Switch, and other network electronics.

1.6 WARRANTY

A. All cable plant parts shall be warranted to the owner for a period of fifteen (15) years as a complete end-to-end system.

B. All network equipment shall be warranted to the owner for a period of one (1) year . Provide technical support at no charge to the customer for a period of one (1) year after system has been commissioned.

C. Make available an extended warranty to the customer.

D. Warranties shall commence upon final acceptance of the system.

PART 2 - PRODUCTS

2.1 BACKBONE WIRING - FIBER OPTIC CABLE

A. All of the fiber optic cable must meet or exceed the following requirements and specifications.

B. Individual fiber optic cables shall consist of:

1. The fiber.
2. Tight buffer.
3. Thermoplastic jacket.
4. Central strength member.
5. Aramid strength member.
6. Second core wrap with ripcord.
7. Polyester barrier.
8. Outer jacket.

C. All backbone fiber optic cable shall be:

1. Installed in plenum rated innerduct labeled on 10 ft. centers - Fiber Optic Cable.

D. Single Mode Fiber (Indoor/Outdoor):

1. Maximum Attenuation per KM:

a. 1310 nM- 0.5

b. 1550 nM - 0.5

2. 1310/1550 nM.

3. Shall be tight buffer, plenum rated, indoor-outdoor breakout style.

4. Core Type: Single Mode.

5. Core Diameter: 8.3 Microns.

6. Clad Diameter: 125 Microns.

7. Minimum bend radius shall be 20 times the diameter.

8. Strength members shall be FGE/Aramid yarn.

9. Shall meet requirements for plenum and vertical tray cable specifications of the NEC.

10. Provide number of fibers/cable as indicated in riser diagram on Drawings.

11. Shall have individual fiber tube colors per TIA/EIA-598 and an overall yellow jacket.

E. Acceptable Manufacturers:

1. Corning
2. Belden
3. OCC
4. TE Connectivity
5. Draka

2.2 HORIZONTAL CABLE

A. Augmented Category 6A UTP Cable:

1. Initially, the manufacturer shall perform qualification tests on each cable. These tests shall be performed in accordance with the latest revision of ANSI/TIA/EIA 568-C.2 standard prior to shipment.

2. Date of Manufacture: Cable shall be a maximum of one (1) year old, from date of manufacture when installed.

3. Cable shall have a ripcord.

4. Cable shall be plenum rated, 4 pair, 100 OHM, 23 AWG.

5. Cable shall meet all requirements of FCC 68, the latest revision of the TIA/EIA 568B-C.2 and Addenda.

6. Cable shall have blue colored thermoplastic jacket with overall diameter not to exceed .215 in. x .290 in.

7. Pulling tension shall be rated for 25 pounds minimum.

8. Cable shall be able to withstand a minimum bend radius of 1.2 in. at -20ºC without insulation cracking.

9. Cable shall be color coded in accordance with the latest revision of the TIA/EIA T568B polarization sequence.

10. Cable shall not exceed maximum length of 90 meters.

11. Provide a printed report documenting testing based on ANSI/TIA 568-C.2 tested at 500 MHz. Testing parameters as follows:

    a. Less than 21.0 ohm per 100 m DC resistance.

    b. Return loss > 10.0 dB/100m at 500 MHz.

    c. Insertion loss < 43.8 dB/100m at 500 MHz.

    d. Near end cross talk (NEXT) > 26.7 dB at 500 MHz.

    e. Power Sum - near end cross talk (PS-NEXT) > 23.8 dB at 500 MHz.

    f. Attenuation to cross talk ration far end (ACRF) > 10.2 dB at 500 MHz.

    g. Power sum - attenuation to cross talk ratio (PS-ACRF) > 7.2 dB at 500 MZz.

    h. DC resistance unbalance between any two (2) conductors of any pair shall not exceed 3%.

    i. The capacitance unbalance of any pair to ground shall not exceed 65.6 pF per 100 meters.

    j. Delay < 490 ns at 100MHz.

    k. Delay skew < 44 ns at 100MHz.

    l. Cable shall be ANSI/TIA/EIA-568-C.2 augmented Category 6 (Cat 6A) compliant. The cable shall be tested and characterized by the manufacture to 500 MHz.

12. Acceptable Manufacturers:

    a. Belden
    b. Berk-Tek
    c. TE Connectivity
    d. General Cable
    e. Comm Scope

2.3 PATCH CABLES

A. Patch Cables - UTP:

1. Provide patch cable for use in the patch panels and field outlets, a minimum of two for each circuit/channel. Quantity of patch cords shall be sufficient to

terminate all outlets indicated on drawings as well as 25% spare outlets of each type. Patch cable type shall correlate to the cable color and type and match or exceed the performance characteristics.

2. Field verify exact length of patch cords for field outlets and patch panel outlets with the Owner. Assume a typical of two (2) meters each.

3. Patch cord shall be stranded with overall jacket and factory made connectors with protective boots.

4. All patch cords shall be third party verified.

5. Acceptable Manufacturers:

a. Belden
b. Berk-Tek
c. TE Connectivity
d. General Cable
e. Comm Scope

B. Patch Cables - Fiber Optic Cable

1. Provide patch cable for use in the patch panels and field outlets, a minimum of two for each circuit/channel. Quantity of patch cords shall be sufficient to terminate all outlets indicated on drawings as well as 25% spare outlets of each type. Patch cable type shall correlate to the cable color and type and match or exceed the performance characteristics.

2. Field verify exact length of patch cords for field outlets and patch panel outlets with the Owner. Assume a typical of two (2) meters each.

3. Patch cord shall meet the specifications for the cable to which it is connected to.

4. All patch cords shall be third party verified.

5. Acceptable Manufacturers:

a. Corning
b. Belden
c. OCC
d. TE Connectivity
e. Draka

2.4 PATCH PANELS

A. UTP Cable Patch Panels:

1. All panels should consist of a faceplate, mounting, hardware, isolation bushings, connector assemblies and labels for all ports.

2. Provide patch panels in each enclosure or rack to which the cable is to be terminated. Patch panels shall be of the type, performance and Category to match the cabling.

3. Patch panels shall be mounted in standard 19 in. racks/cabinets.

   a. Contractor shall provide multiple 48-port patch panels having wiring configuration specified with insulation displacement connectors on the back and 8P8C universal modular jacks on the front.

   b. Contractor shall provide quantity of patch panels to terminate all UTP cable. There shall be a minimum of 25% spare capacity for future installation.

4. Jacks shall be 8P8C, T568 universal and have 110 style termination blocks.

5. Panels shall have factory labels for each port.

6. All cables are to be terminated per EIA/TIA 568B or 568A standards, if applicable, and dressed in a neat workmanship way.

7. Modular jacks shall be mounted on PC boards to offer low insertion and NEXT loss.

8. Provide grounding screw assembly with serrated head screw and manufacturer recommended connection to the associated rack.

9. Shall exceed EIA/TIA-568, UL1863 and FCC Part 68 performance specified.

10. Acceptable Manufacturers:

    a. Ortronics
    b. Panduit
    c. Hubbell
    d. Belden TE Connectivity

B. Fiber Optic Patch Panels

1. Provide fiber optic patch panels in where fiber optic cable is to be terminated.

2. Provide SC to SC style panel base. Provide quantity of ports to terminate all strands of the fiber optic cable with additional 25% spare ports.

3. Shall mount in standard 19 in. rack and be constructed of 16 gauge steel and have gasketed openings and hinged door for easy access.

4. Provide wire management below and in rear of patch panel.

5. Patch panels to have modular ports with 12 minimum ports.

6. Acceptable Manufacturers:

    a. Corning
    b. Panduit
    c. Belden
    d. TE Connectivity

2.5 OUTLETS AND CONNECTORS

A. UTP Outlets/Connectors:

1. Physical Specifications:

    a. Shall be 8 position connector compatible with the cable characteristics.

    b. Shall be modular and snap-in to user configurable faceplates for future retrofits meeting durability requirements specified in the latest revision of the CEI/IEC standard.

    c. Shall be IDC type suitable for eight 22-24 AWG wires with a gas-tight connection.

    d. Each contact surface shall have at a minimum, copper alloy with 50 micro-inches gold over nickel and a minimum contact force of 100g.

    e. Conductors shall be separated and aligned internally by jack comb.

    f. Shall have easy to read 568A/B color scheme to prevent termination errors.

    g. Wired in accordance with TIA/EIA polarization sequence specified in Patch Panel section of this specification.

    h. Transmission characteristics shall meet the requirements for the UTP cabling specified.

    i. Minimum durability shall be 1000 connecting cycles.

2. Acceptable Manufacturers:

    a. Ortronics
    b. Panduit
    c. Belden
    d. Hubbell
    e. TE Connectivity

B. Fiber Optic Multimode Outlets/Connectors

1. Physical Characteristics:

    a. Shall be SC type**.**

b. Shall terminate up to 125 micron fiber.

c. Shall meet dimensional criteria of the latest revision of ANSI/EIA/TIA.

d. Typical outlet box shall be sized to insure minimum bend radius and store 1 meter of two strand fiber cable.

2. Transmission Characteristics:

a. Maximum loss of 0.3 dB per pair.

3. Acceptable Manufacturers:

a. Panduit
b. Belden
c. Hubbell
d. Ortronics
e. TE Connectivity

2.6 COLOR CODING

A. Cable outer jacket shall follow the color-coding scheme as directed by the owner during contractor interviews. Jacket color shall be continuous. Patch cords shall match the cabling.

B. Fiber Optic Cable:

1. Backbone Cabling:

a. Single Mode - Yellow

2.7 DISTRIBUTION ENCLOSURES/RACKS

A. All enclosure/racks shall be properly sized and of the proper quantity to house all of the required components and 25% spare space capacity. Provide grounding stud for each vertical rack.

B. Label each rack/enclosure designating it per the latest TIA/EIA standard:

1. Adhered plastic electronic printed label with 1/2" high lettering minimum.

2. Mount to top and bottom of each rack/enclosure.

C. Open, Floor Mounted Racks:

1. Nominal size shall be 19 in. wide x 7 ft. high x 20 in. (minimum) deep. Rated for 2000 lb. minimum. Depth to match the intended equipment.

2. Rack shall be constructed of 6061-T6 aluminum extrusion, with EIA = 3 in. x 1.265 in. channel, 1/4 in. thick flange.

3. Provide base angles and top cross bars.

4. The back of rack shall have wire management panels and cable tray to wall.

5. Rack shall have baked enamel finish.

D. Floor Mounted Server Racks (Four Post Racks):

1. Racks shall have four vertical posts with top/bottom framing and be as specified above for open, floor mounted racks.

2. Racks shall be provided where shown on the drawings or identified in the equipment schedule.

E. Equipment Shelves:

1. Provide quantity of equipment shelves required by Owner during interviews.

2. Shelves shall be made of .09 in. aluminum and shall support up to 30 lbs. on each side. All mounting hardware shall have baked enamel finish.

F. Acceptable Manufacturers:

1. APC – Design Make
2. Ortronics
3. Homaco
4. Mid-Atlantic
5. Great Lakes

2.8 CABLE MANAGEMENT

A. All racks are to be provided with cable management hardware to insure a neat, functional system when complete. Racks shall as a minimum, include the following:

1. PVC construction; duct fingers to manage cabling; color to match enclosure.

B. All racks shall have 8 in. wide vertical full height cable management, including cover, front and rear, on both sides of the rack.

C. Cabinets shall have 1RU space horizontal panels, front and rear, above and below each patch panel and piece of equipment.

D. All data distribution frame plywood backboards shall be provided with vertical and horizontal wire management with capacities to house all possible future cabling and patch cords for a neat and orderly installation.

E. Acceptable manufacturers:

1. Panduit
2. Ortronics
3. Leviton
4. TE Connectivity

2.9 INNERDUCT

A. Innerduct shall be corrugated HDPE material, plenum rated, flexible, continuous, UV rated with flame/smoke spread in accordance with code and length markings on the outer surface.

B. When in conduit minimum size shall be 3/4 in., otherwise 1 1/2 in. minimum.

C. Acceptable manufacturers:

1. Carlon
2. Maxcell
3. Opti-Com
4. Approved equal

2.10 UPS

A. Provide a rack mounted UPS where indicated on the drawings. UPS shall be sized to accommodate all hubs, edge switches, core switch, routers, file servers and associated equipment in the closet.

B. UPS system shall consist of rectifier/chargers, inverters, AC transfer switches, maintenance switches and batteries. Batteries shall be able to be replaced with new without affecting the continuous power output.

C. In event of normal power failure, system shall maintain battery power to load for 30 minute duration. Upon return of normal power, UPS shall automatically equalize and recharge batteries and return to floating condition.

D. Connections shall be provided on the back of the UPS which shall allow the PDUs to plug directly into.

E. Acceptable Manufacturers:

1. Vertiv Liebert GXT5 – Design Make
2. APC
3. PowerWare
4. Approved equal

2.11 PDU

A. Provide a rack mounted PDU system. PDU shall be a vertical, metered, 30A, 208V, combination C-13/C-19 with a 10ft power cord with NEMA L6-30P. Monitoring system shall be basic level and shall display input and breaker level current monitoring. PDU shall have be upgradable per owner demands overtime.

B. Acceptable Manufacturers:

1. Vertiv Geist rPDU – Design Make

2. Approved equal.

2.12 WIRELESS NETWORK SYSTEM

A. General: Provide a multiple channel, wireless 11 Mbps network, conforming to IEEE 802.11b for 65 simultaneous multiprotocol users (PC and Apple) with coverage for proper operation throughout the building. System shall also support IEEE 802.11a and 802.11g at speeds of 54 Mbps.

B. Layout: Perform system site survey prior to installation. Submit results to Engineer. Provide additional access points at no charge to Owner for complete coverage throughout the construction floors.

C. Access Points: Building mounted transmission - reception devices connected to the data distribution system.

1. Features:

a. IEEE 802.1x authentication.

b. 60-second access point setup

c. Power over Ethernet: powers the access point over Ethernet cable.

d. Clear Channel Select automatically chooses the best available radio channel.

e. Auto Network Connect maintains connection even while roaming across IP subnets.

f. Dynamic Security Link with user-specific, 128-bit encryption keys that change for each networking session and user authentication.

g. Supports 40-bit WEP encryption.

h. Supports up to 65 simultaneous users at distances of 100 m (328 ft.) and speeds up to 11 Mbps for IEEE 802.11b, and 54 Mbps for IEEE 802.11a.

i. Wi-Fi certification of interoperability with other vendor's products.

j. Dual slot for simultaneous operation of radio technologies.

k. Auto sensing 10/100 ethernet uplink.

2. Electrical Characteristics:

a. Wireless LAN Speeds: 1, 2, 5.5 11, 22 and 54 Mbps.

b. Management: Embedded HTTP Web management server (browser must support XML).

c. Media Interface: Wi-Fi, Ethernet.

d. Operating Distance: Up to 100 m (328 ft.).

e. Protocols Supported: TCP/IP, IPX, NetBEUI, DHCP, IEEE 802.11b, IEEE 802.3, IEEE 802.11a, IEEE 02.11g, IEEE 802.11i (security), IEEE 802.11e (QOS), and IEEE 802.11f (multi-vendor).

3. User System Requirements: PC with CD-ROM running Windows 8, Windows 7, Windows XP, or Windows NT 4.0+.

4. Package Contents For Each Access Point:

a. Access point with antenna.

b. Two (2) IEEE 802.11b radio cards.

c. Mezzanine adapter for dual radio card operation.

d. Power supply with power cable and rack mount.

e. Category 6A cable (11 m/35 ft.).

f. Mounting bracket.

g. Software and documentation CD-ROM with PC Card drivers and Site Survey Utility.

h. Network Assistant CD-ROM tutorial.

i. Quick Start guide.

5. Design Make: Enterasys Roamabout R2 #RBTR2-AA with #RBTRC-MZ and #CSIWS-RM.

D. System Design Make: Enterasys Roamabout R2 Series.

2.13 TELECOMMUNICATION EQUIPMENT ROOM SCHEDULES

A. MDF:

1. Provide the following equipment:

a. Four (4) Floor Mounted Racks.

b. Space for network electronics as required by the owner.

c. One (1) wall mounted UPS.

d. Fiber adapters, down link modules and patch cables required to complete connectivity.

e. Provide one (1) port fiber patch panels configured with a number of ports as required by drawing quantities.

f. Provide 48 port UTP patch panels, category to be as specified. Quantity as required by drawings.

2. Configure such that router and edge switches are connected to core switch. Coordinate with owner provided network electronics.

B. IDF-1:

1. Provide the following equipment:

a. One (1) Floor Mounted Racks.

b. Space for network electronics as required by the owner.

c. One (1) UPS.

d. Fiber adapters, down link modules and patch cables required to complete connectivity.

e. Provide one (1) port fiber patch panels configured with a number of ports as required by drawing quantities.

f. Provide 48 port UTP patch panels, category to be as specified. Quantity as required by drawings.

2. Configure such that one edge switch is connected to equipment room core switch. Coordinate with owner provided network electronics.

C. IDF-2:

1. Provide the following equipment:

a. One (1) Floor Mounted Racks.

b. Space for network electronics as required by the owner.

c. One (1) UPS.

d. Fiber adapters, down link modules and patch cables required to complete connectivity.

e. Provide one (1) port fiber patch panels configured with a number of ports as required by drawing quantities.

f. Provide 48 port UTP patch panels, category to be as specified. Quantity as required by drawings.

2. Configure such that one edge switch is connected to equipment room core switch. Coordinate with owner provided network electronics.

D. IDF-3:

1. Provide the following equipment:

a. One (2) Floor Mounted Racks.

b. Space for network electronics as required by the owner.

c. One (1) UPS.

d. Fiber adapters, down link modules and patch cables required to complete connectivity.

e. Provide one (1) port fiber patch panels configured with a number of ports as required by drawing quantities.

f. Provide 48 port UTP patch panels, category to be as specified. Quantity as required by drawings.

2. Configure such that one edge switch is connected to equipment room core switch. Coordinate with owner provided network electronics.

2.14 LABELING

A. General:

1. System labeling shall be in accordance with the latest revision of TIA/EIA 606. System shall provide as built final conditions for each cable, port, panel, rack, etc. and utilize MS Excel or approved equal documentation. Provide hard and electronic copy of labeling documentation to the Owner as part of the O and M process.

2. Each label shall contain the Telecommunication Room designated, the room number and the port number in the room. Verify color of label and size of font prior to completion. Provide samples as requested.

3. Labels shall correspond to the room/names/numbers upon completion of the project. Contractor shall not necessarily utilize existing room/names/numbers or those indicated on the blueprints.

4. Label each rack and patch panel with 1 in. high lettering, black on white, adhered electronically printed plastic type label with labels at top, bottom, front and back.

B. Patch Panel:

1. Individually label all patch panel ports. Port numbers shall match opposite end outlet/port number.

C. Outlets:

1. Individually label all patch panel ports. Labels shall be installed in a workman-like manner and fit completely in the recessed area of the labeled location.

2. Contractor shall utilize adhered labels at poke-thru locations and any other locations that do not have a label location.

D. Cable:

1. Fiber Optic:

a. Individually label fiber optic cables at each termination point indicating destination room, rack number, panel number, port number, strand number and strand color.

b. Each strand color shall match a specific fiber termination number in each closet, i.e. blue - fiber 1, orange - fiber 2, green - fiber 3, etc.

c. Cable label shall be adhered electronically printed plastic type with cable designation fully visible.

2. Copper:

a. Specifically label cables at each termination point indicating the destination room, rack number, panel number and port number.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Cable:

1. Provide a minimum of one horizontal UTP cable to each communication outlet jack from respective equipment/telecommunications room patch panel as called for. Quantity of data jacks equals <u>minimum</u> quantity of UTP cables (typical).

2. Provide a minimum of one (1) pair (2 strands) of multi-mode fiber optic cable to each fiber jack from respective equipment/telecommunications room as called for. Quantity of fiber jacks equals <u>minimum</u> quantity of 2 strand cables (typical).

3. All risers, and wiring concealed in walls or soffits, shall be installed in metal conduits.

4. All cable above accessible ceilings shall be installed in cable tray or J-hook style cable rings 3 ft. O.C.

5. Provide wire management and Velcro cable wraps every 24 in. throughout closets.

6. Wiring/cabling shall be installed in accordance with the manufacturer's recommendations. If the manufacturer recommends larger wire sizes, they shall be provided. However, smaller sizes or lower cable categories are not acceptable.

7. All Contract Documents are schematic. The system supplier shall incorporate their wiring requirements on the system drawings. The Contractor in conjunction with the system manufacturer shall be responsible for complete wiring requirements and conduit sizes.

8. Install UTP cable in accordance with latest revision of TIA/EIA 568 standards.

9. The Contractor shall be responsible for replacing all cables that do not pass required bandwidth and throughput tests.

10. All raceways and closets shall be installed in accordance with latest revision of TIA/EIA-569.

11. All cables shall be labeled in accordance with latest revision of TIA/EIA 606 and these specifications.

12. All horizontal cables shall be terminated in patch panels at the distribution frames, and at the UTP jack at the telecommunications outlet.

13. Maximum length shall be 90 meters.

B. Fiber Optic Cable:

1. Terminate backbone fiber cables in rack mounted patch panels at both ends.

2. Adhere to all manufacturer bend radius recommendations.

C. Terminations:

1. All terminations shall be made by a manufacturer's trained representative.

2. Use termination kits for fiber and UTP that are approved by the manufacturer of the cable.

3. All backbone cable shall be terminated in a patch panel and all connections between horizontal and backbone cables shall be through cross connect cable.

D. Equipment and Devices:

1. Install all devices where shown on drawings. Provide all necessary conduit outlet boxes, junction boxes, supports, etc. Verify all required box sizes with the system supplier and coordinate with bending radius needs. All devices shall be modular for future moves and changes.

2. Install all equipment in specified 19 in. racks/cabinets leaving minimum 30 in. of access space on sides and back of rack and 36 in. in front of rack.

3. Provide all power outlets and plug strips required for system operation but not shown on plans.

E. Raceways:

1. Minimum size raceway shall be 1 in.

2. Minimum backbox size for telecommunications outlet locations shall be two-gang with raised cover; no single-gang boxes allowed.

3. Provide no greater than 180° in bends without pull box in any raceway.

4. All raceways shall stub to above accessible ceiling (if applicable) or be routed to nearest cable tray.

F. Data Network Ground System:

1. Provide grounding system for all equipment rooms and telecommunication rooms as called for in Specification Section 260526.

G. Telecommunications Rooms:

1. Provide 3/4 in. x 4 ft. high continuous plywood backboard with two (2) coats of medium gray fireproof paint in telecommunications rooms.

2. Coordinate with other trades to avoid services being installed above telecommunications racks.

3.2 TESTING

A. Copper Cable: System supplier shall channel test end-to-end each permanent link connection using latest 500 MHz for Cat 6A 1000 Mbps IEEE testing procedure. Tester must conform to the latest standards at the time of testing not time of bid and be Fluke DTX-5000 with latest software version, or approved equal. Testing shall be performed by a technician trained with the specific testing equipment. Testing shall be witnessed by the Owner's Representative.

B. Fiber Optic Cable: Provide an OTDR test for all fiber optic cable and connections per latest IEEE and ANSI accepted procedures. Test shall utilize Fluke Opti Fiber Pro OTDR.

C. Replace any cables and connectors that do not meet or exceed standards referenced and stated herein and then tested. Testing shall be end-to-end / port-to-port for each cable.

D. Test equipment shall be in good condition and working order, calibrated within one year of its use and utilize leads without twisting and kinks. Unit calibration shall be in accordance with Level III Field Tester per ANSI/TIA 1152.

E. A representative of the end-user will select a random sample of 5% of the installed links. The representative (or his authorized delegate) shall test these randomly selected links. The results obtained shall be compared to the data provided by the installation contractor.

If more than 2% of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of the end-user representative shall repeat 100% testing at no additional cost. Cables and connectors that do not pass shall be replaced and retested until acceptable results are obtained.

F. Test Reporting:

1. The field testing shall be accurately documented for submission, inclusion in O&M Manuals and for Owner future use.

2. Test reports shall include data directory table cross-referencing room numbers and cable numbers with the test report. Post copies of directory at telecommunications room location.

3. Report shall utilize electronic Windows based documenting with a hard and electronic copy provided to the Owner.

4. The report documentation for each cable test shall include the following as a minimum:

   a. Project name.

   b. Test equipment manufacturer and model number, and last calibration date.

   c. Date and time of the test.

   d. Patch panel identification.

   e. Cable identification.

   f. Cable type.

   g. Pass/Fail: Pass indicating meeting or exceeding the identified criteria or standard (whichever more stringent) for all parameters. Fail indicating test not meeting identified criteria for one or more parameters.

   h. Test pass criteria.

   i. Cable length.

   j. Propagation delay and attainable bandwidth.

   k. List of tested parameters with test and allowable values. Any failed parameters shall be noted or highlighted.

3.3 TRAINING AND INSTRUCTION

A. Provide eight (8) hours minimum of instruction to Owner personnel regarding system set up configuration and management. Training shall be sufficient for the Owner to understand the system operation, components, configuration, functions, testing and troubleshooting. All Owner questions shall be answered.

B. Training agenda (estimated duration, intent, specifications to be covered) shall be submitted for approval prior to the training. A finalized agenda shall be issued to the Owner and construction representative one (1) week minimum prior to the scheduled training. Owner's comments shall be incorporated and agenda redistributed prior to the training.

C. Two (2) hard copies and one (1) electronic (pdf) copy of the training materials shall be provided.

3.4 WARRANTY

A. All cable plant parts shall be warranted to the owner for a period of fifteen (15) years as a complete end-to-end system.

B. Make available an extended warranty to the customer.

C. Warranties shall commence upon final acceptance of the system.

END OF SECTION 272100

SECTION 273100 - TELEPHONE SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation of a new telephone system and related Work as required in the Contract Documents.

1.2 QUALITY ASSURANCE

A. All methods of construction, details of workmanship that are not specifically described or indicated in the contract documents, shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated in their respective sections of the specifications. The equipment specified is based upon the acceptable manufacturers listed. Equipment types, device ratings, dimensions, etc. correspond to the nomenclature dictated by those manufacturers. All equipment shall be tested at the factory.

B. Unless specified elsewhere, standard factory inspection and operational tests will be acceptable.

C. Installation shall be accordance with NFPA 70 (National Electrical Code), state codes, local codes, and requirements of authority having jurisdiction.

D. Equipment shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA, FCC, REA, EIA and IEEE Standards.

E. Each item shall bear the UL Label.

F. The system provider must:

1. Provide equipment from manufacturers for which they maintain a contract, distributorship, are an agent, or other formal arrangement for which documentation can be produced showing authority to sell and service the equipment in this territory.

2. Demonstrate that they have successfully installed these systems, utilizing their standard products, for a period of five (5) years.

3. Maintain a service organization to provide both normal and emergency service. Emergency service must be available 24 hours per day; 365 days per year and staff must be adequate to respond within 2 hours of an emergency call.

4. Maintain adequate spare parts inventory to provide both normal and emergency service.

5. Employ service technicians who are trained in accordance with the systems manufacturer's recommendations.

6. Own and demonstrate proficiency in the use of the required test equipment, tools, etc. for the proper installation, set-up, testing and maintenance of the system. If requested, must provide a listing of tools and/or equipment and where appropriate, certifications in the proper training and use of the tools and/or equipment.

7. Provide all system programming to deliver a customized system to the Owner ready for use.

   a. All system programming is to be completed to the satisfaction of the Owner. If after preliminary use of the system, and/or training, the increased understanding of the system's features and capabilities necessitates reprogramming to any extent, it is to be performed at no additional cost.

1.3 SHOP DRAWINGS

A. The systems provider shall submit engineering drawings of the complete system with wiring requirements, system operational description and specification sheets covering all component parts for approval prior to installation.

B. Equipment shop drawing submissions must include as a minimum the following information:

1. Provide a complete list of system components, catalog numbers and quantities to be used.

2. Catalog cuts of all components making up the system.

3. Complete description/data indicating UL listing for all system components.

4. Complete sequence of operations of all control functions of the system.

5. Provide an itemized list of all features and functions organized in accordance with these specifications to facilitate item by item comparison to insure full compliance.

1.4 SYSTEMS INCLUDED

A. Networked Private Branch Exchange Telephone System (PBX System).

1.5 GENERAL REQUIREMENTS

A. Furnish and install a complete networked telephone system including all work incidental to the project as shown on the drawings and specified. Include all necessary software, hardware, conduit, communications wire/cable, terminal blocks, and any other equipment, whether specified or not, for a complete and functional system.

PART 2 - PRODUCTS

2.1 GENERAL

A. PBX System - The PBX's in the telephone system shall contain the following capabilities/features:

1. Common equipment shall utilize time division multiplexing switching sequences.

2. The system shall provide self-diagnostics including:

   a. Listing of system activity.

   b. I/O diagnostics of each line and device.

   c. Maintain internal statistics failures, overflows, trunk usage, faults, etc.

3. The system shall be totally non-blocking.

4. The PBX's shall be modular in architecture to allow for the remote installation of cabinets to distribute line connections throughout the project.

   a. Remote cabinets shall be connected to the main cabinet with fiber.

   b. Remote cabinets shall be "back-plane" connected. Networking via T-1 or other means is not acceptable.

   c. The non-blocking feature of the system shall be preserved with the remote cabinets.

5. The system shall be field upgradeable by module replacement or software update.

6. The central processor and other processors and DSP's shall be the products used in the largest configuration of the product family. It shall not be necessary to upgrade or add to the chip set if the system is expanded or if additional software is enabled.

7. The system shall be installed with all system software and firmware provided. When features are added, it shall only require enabling of the software with a soft key.

8. The PBX CPU shall have the capability of no less that 20,000 busy hour call completions.

9. The PBX shall be capable of supporting 700 ports.

10. The PBX shall have a minimum of 800 conversation paths.

11. The PBX shall support both digital and analog telephone sets.

B. Manufacturers:

1. Systems that are considered as meeting the requirements set forth include the following:

a. Nortel Option 11C

b. Avaya Definity ProLogix

c. Siemens Hicom 30EP

C. Features:

1. The PBX shall be provided with a complete set of features.

2. The following features are listed as required enhanced features and those establishing minimum quantities:

a. Account codes - 23
b. Account codes (forced) - 23
c. Centrex reach-through
d. Classes of service - 8
e. DID
f. Internal 9-1-1 notification
g. Least cost routing
h. Malicious call trace
i. Number of trunk groups - 100
j. Speed Dial - 1000 lists
k. Tenant service
l. Traffic management

D. Software:

1. Where multiple software packages are offered, provide the most comprehensive.

2. This should include advanced business applications with networking.

2.2 SYSTEM CONFIGURATION

A. Configuration Requirements are defined as follows:

1. Capacity - The minimum acceptable size that the PBX can expand to.

2. Wired - Card cage, cabinet, etc. shall be provided to accept the required cards for the stated quantities. MDF shall be sized and blocks provided for the stated quantities.

3. Equipped - Circuit cards, modules, licenses, etc. shall be provided for the stated quantities.

B. PBX System:

ITEM	EQUIPPED	WIRED	CAPACITY
Single Line Analog Ports (16/card)	176	240	700
Multi-Line Digital Ports (16/card)	80	112	128
Trunk Ports (CO) (8/card)	40	48	56
Trunk Ports (DID) (8/card)	8	8	8
PRI Trunk Interface (24 Ckts./T1)	2	2	8
"T1" Capacity (24 Ckts./T1)	6	6	8
Auto Attendant/Voice Mail Ports	8	16	96
Voice Mail Storage Hours	16 Hrs	60 Hrs	400 Hrs
Mail Boxes	500	10,000	10,000
Paging/Classroom System Interface Trunk ports (4/card)	4	4	4
Attendant Console (PC Based)	1	4	8
Battery Backup Hours	1 hr.	1 hr.	1 hr.
Power Failure Transfer Circuits	8	12	12

2.3 NETWORKING REQUIREMENTS

A. Digital Networking:

1. Provide PBX Networking over digital (T-1) trunk facilities.

2. The networking shall provide communications and feature characteristics including but not limited to:

a. Route Optimization. Automatic route selection with flexible route assignment by channel and channel assignment flexible as voice and/or data.

b. Called/Calling Line Identity.

c. Callback.

d. Centralized System Voice Mailbox.

e. Centralized System Call Accounting.

f. Messaging Station to Station.

g. Call Forwarding.

h. Hunting.

i. Traffic Reporting Capability.

3. The system design is predicated on a multi-location digitally networked switch environment. All PBX Systems must be equipped with identical software revisions levels.

4. Systems operation shall be such that there is feature transparency across the network. Commands such as "call back" or "message wait" from and to stations in different PBX systems shall be available. The system shall include sufficient software and hardware to deliver these features and "single system" operation to ultimate capacities as specified under this section.

5. The proposed ISDN T-1 network shall provide a 1.544 megabyte 24 channel digital link between the PBX switch locations providing a private voice and data network. The T-1 network shall provide twenty-four (24), 64Kbps clear channels, including 64Kbps out of band signaling channel (23B + D). Each individual channel must be capable of handling CO, FX, WATS, DID, TIE, E&M and 4-wire type trunk circuits. The signaling must accommodate loop start, ground start, E&M, DTMF and Dial Pulse.

6. Synchronization must be Stratum 3 compatible (accuracy, jitter, pull-in range) master or slave type service.

7. The voice transmission must meet EIA digital PBX draft standard PN-1429.

8. The hub PBX shall be capable of supporting all T-1's without blockage. Configurations other than a star out of the hub PBX because of the proposed hub PBX limitations will not be acceptable.

9. A caller at one building must have the capability of calling another extension at another building over the T-1 network. This call shall not require more than one (1) channel on the T-1 circuit per extension call.

10. Once the auto attendant has answered a call, it will have the capability of transferring that call to an extension number located across the network. This call shall not take more than a total of one (1) channel on the T-1 network. Should this call be redirected or transferred to an extension back across the network, again, it will not require more than one (1) T-1 channel. The intent of this specification is that the proposed system will have the ability to transfer calls back and forth across the network, while only utilizing one (1) channel in the process.

11. Call Accounting information from all PBX switches shall be passed over the T-1 network to the Call Accounting system located at the hub PBX.

12. The network system shall select a digital T-1 as a first choice for call routing. Should the T-1 digital circuit encounter technical difficulties such as a partial or complete outage, the system will be required to redirect calls over the public network. This changeover must be done on an automatic basis; manual switches or customer intervention will not be acceptable.

2.4 TELEPHONE SET REQUIREMENTS

A. Provide a full complement of station features and capabilities to all telephone sets.

B. Provide a 6 ft. long coiled handset cord for each telephone set furnished.

C. Digital Telephone Sets:

1. Digital Single-Line Telephone Set:

a. Fixed Hold/Flash Key.

b. Message waiting indicator.

c. Volume control for handset, ringer and on-hook dialing.

d. Feature Key.

e. Desk or wall mounted as indicated on drawings.

f. Acceptable Manufacturers:

1) Nortel - M3901
2) AVAYA
3) Siemens

2. Digital Multi-Line Telephone Set:

a. Twelve (12) programmable line/feature keys with LCD indicators and four (4) softkeys for feature access.

b. Fixed Hold.

c. Fixed Feature Keys.

d. Full Speakerphone operation.

e. Message Waiting Indicator.

f. Volume control or Handset, Ringer and On-Hook Dialing.

g. Minimum 5 Line x 24 Character Display.

h. Power Requirements:

1) Loop power for voice communication, display and hands free.

i. Acceptable Manufacturers:

1) Nortel - M3904

2) AVAYA -
3) Siemens -

3. Central Answering Positions (CAP):

a. The telephone set used for the CAP locations shall be the same as the digital, multi-line telephone.

b. Provide CAP software to modify the functionality of the standard digital telephone.

c. Each CAP set shall be provided with DSS add-on modules. Provide enough modules so that each telephone extension can be shown.

d. Power Requirements:

1) Loop powered.

4. Attendant Console - PC Based:

a. Fully integrated CRT-based Attendant/Administrative Console.

b. Screen Based.

c. Software Controlled.

d. Functional "Window" Display Areas.

e. Number and Source Display for both Incoming and Internal Calls.

f. Extension Status Indication.

g. Number of Calls Waiting Indication.

h. Context-Dependent, Interactive Softkeys to provide multiple feature/function access dependent on telephone set status.

i. Trunk Group Labels.

j. Integrated Telephone Directory, with Dial by Name, Transfer by Name.

k. CDE (Customer Data Entry). (English Language, menu driven).

l. Headset/Handset compatible.

m. Keyboard including:

1) 10 Softkeys
2) 3 Programmable Firmkeys
3) 8 Attendant Function Keys

4) Hold Key
5) Function Key
6) Cancel Key
7) Release Key
8) Page Key
9) Call Block Key
10) Answer Key

n. Fully functional PC Mode.

D. Analog Telephone Sets:

1. Analog Single-Line Telephone Set:

a. Tone alerter.

b. Flash key.

c. Message waiting/visual ringing indicator.

d. Desk or wall mounted as indicated on drawings.

e. Manufacturer: Industry standard analog 2500 type with Flash and Message Waiting indicator.

2. Weatherproof, Special Purpose Telephone Set:

a. Analog, single line, touch tone, fully modular.

b. Covered touch pads with protective seals to keep out dust, dirt and moisture.

c. Handset cradle incorporating a proximity switch for hookswitch function. Switch will have no moving parts and shall allow for front panel seal to prevent contaminants and other foreign material from damaging the internal electronics.

d. Enclosure shall be high-impact, anti-corrosive material with hinged, swing-open door.

e. Wall mounted.

f. Manufacturer: GAI-Tronics - Model 246.

2.5 APPLICATIONS

A. Automated Attendant/Voice Mail:

1. Automated Attendant System:

a. Answer inbound calls made on main number.

b. Answer overflow calls from the Attendant.

c. Answer "Night Service" calls on main number.

2. Automated Attendant must be capable of routing calls as follows:

a. Caller dials extension/voice mailbox of called party.

b. Menu-driven direct-dial options for callers attempting to reach specific departments or services.

c. Callers without DTMF Capability are transferred to an Attendant.

3. Automated Attendant configuration as follows:

B. Voice Mail System:

1. The Integrated Voice Mail System shall serve all users connected to the PBX Network.

2. The voice mail system shall be fully integrated to the PBX network system. Integration is defined in the following manner: when an outside caller reaches an extension number that is either hunting, forward no answering, or manually call forwarded to the voice mail system, it must be able to be answered with a personalized greeting of the extension number being called. Once a caller has received the personalized greeting, they will have the option of leaving a detailed message without the intervention of dialing additional codes or dialing other extension numbers. Should the caller wish not to leave a message, the proposed systems must allow a caller to dial an extension number or "0" and be transferred either to the system operator or a designated extension number such as a secretary.

3. The system shall be online 24 hours a day, for either internal or external locations. When a caller leaves a voice mail message for a system user, the system user will receive a lamp indication on their telephone. (Interrupted dial tone must be available for sets not having a message waiting lamp.) Any internal extension, whether dialed internally or externally, will have the ability to have their call redirected to voice mail via the following conditions: on a forward no answer, on a hunt (or busy while the user is utilizing the telephone), or if the user manually call forwards their telephone to the voice mail system. Rotary dial telephones must also be able to leave a message for any voice mail user on the system. Voice mail users in one location must be able to leave a message for a

voice mail user located at another location from within their own respective mailbox. Therefore, should a voice mail user at the one location wish to transfer a message to a voice mail user at the other location, the proposed system shall have the capability to transfer that message across the network.

4. System must be AMIS compatible for potential future networking needs. If requested, submit documentation certifying that the System meets AMIS Standards.

5. Provide with battery backup (UPS) for 20 minutes with charger.

6. Provide 4 ft. x 2 ft. table for mounting all equipment.

C. Internal 911 Notification:

1. The system shall provide for in-building notification of any extension dialing 911 or 9-911.

2. At the same time the PBX processes the 911 call to the local PSAP through the local CO, the system shall provide audible and visual notification to a designated location of an emergency 911 call having been placed. This shall be annunciated and displayed via the display located on the designated telephone.

3. The system shall determine the exact station location that dialed 911 identified by extension number, user name, time of call and trunk line accessed to dial the call.

4. Upon termination of the call, the system shall mark and log the following information in a CDR packet with a stamp to include:

a. Day, Month, Year.

b. Time of day.

c. Extension and party name initializing "9-1-1" feature.

d. Calling line identification, if provided by Telco.

e. Telco trunk line.

f. There shall be a security mechanism that will allow only authorized personnel access to the CDR packets. Every access attempt whether successful or denied shall be logged. It shall be possible to run reports from the log.

g. The system shall be capable of transporting above information to the operating telephone company for identification at the local PSAP via 10/20 digit ANI. The 10/20 digit ANI on 911 calls shall handle any number of valid Numbering Plan Areas within a single PSAP through 10 digit ANI, and identifies the physical location of caller dialing 9-1-1 by using 20 digit ANI.

D. Public Address System Interface:

1. The telephone systems shall interface with the new paging/classroom communication equipment located in each building.

2. The existing new equipment is specified elsewhere.

3. Interface to this equipment shall allow the following functions to occur:

a. Allow night answer ringing over paging speakers.

b. Allow the PBX system telephone stations to access the paging equipment and make voice announcements over speakers throughout the facility.

4. Provide appropriate paging/classroom system interface equipment with the PBX Telephone System.

E. Call Detail Reporting:

1. Call detail reporting is intended to query the PBX CDR data base and provide user friendly reports.

2. The system shall log all incoming and outgoing calls and sort by user.

3. The system shall organize all data into a variety of report formats selected by the operator and print on the management terminal printer. The reports shall include at least the following reports:

a. Extension by extension call details.

b. Department summary.

c. Area code and trunk usage summaries.

d. Exception report for excessive usage, longest calls, most frequently dialed numbers and most expensive call.

e. Identity of city and state for all calls.

f. The software and hardware shall be capable of providing call data by: extension, department, cost center, call type, dialed number, etc. System reports must be available based on requested information listed above.

g. The system must be capable of storing at least 10,000 call records.

h. The system shall be capable of collecting call records from all types of trunks including C/O, FX, WATS, 4-wire E&M, 2-wire E&M, Paging, and all trunks provided through the T1 links.

i. The system management terminal shall be an IBM compatible personal computer and laser printer. The PC and printer shall be located in an office selected by Owner and interfaced to the telephone system using a RS232C to twisted pair converter at both switch side and system side.

j. Provide UPS backup for 20 minutes.

k. Provide with 4 ft. x 2 ft. table for mounting equipment.

F. Record A Call:

1. The system shall provide the following for recording a call from any multi-line digital set on the PBX:

   a. Upon user depressing a single "RECORD" button on multi-line digital set, the system shall audibly record and store the entire two-way conversation as an industry standard wave file accessible by the District system administrator.

2. Upon termination of the call, the system shall mark and log the following information in a recorded packet with a stamp to include:

   a. Day, Month, Year.
   b. Time of day.
   c. Extension and party name initializing "RECORD" feature.
   d. Calling line identification, if provided by Telco.
   e. Telco trunk line.
   f. Length of call in seconds.

3. Upon termination of the call, the system shall provide all of the following post-recording access methods:

   a. Via an industry standard WEB browser for full multimedia playback of recorded conversation and display of the recorded data packet.

   b. Via any authorized telephone internal or external to the PBX. Numeric information from the data packet such as the trunk number and extension number shall be communicated via a spoken phrase.

   c. Be able to automatically generate and forward an e-mail message containing the recorded conversation and data packet to recipients contained within a distribution list.

4. There shall be a security mechanism that will allow only authorized personnel access to the recorded conversation and data packets. Every access attempt whether successful or denied shall be logged. It shall be possible to run reports from the log.

G. Malicious Call Trace:

1. The system shall provide the following for tracing a call from any telephone set on the PBX:

   a. Upon user initializing the "TRACE" feature on any telephone set, the PBX shall initiate Call Detail Recording to mark the call in the system to be accessible by the District System Administrator.

2. Upon termination of the call, the system shall mark and log the following information in a CDR packet with a stamp to include:

   a. Day, Month, Year.
   b. Time of day.
   c. Extension and party name initializing "TRACE" feature.
   d. Calling line identification, if provided by Telco.
   e. Telco trunk line.

3. Upon termination of call, the system shall provide all of the following post-trace access methods:

   a. Via an industry standard WEB browser for full display of the CDR packet.

   b. Via any authorized telephone internal or external to the PBX. Numeric information from the data packet such as the trunk number and extension number shall be communicated via a spoken phrase.

   c. Be able to automatically generate and forward an E-Mail message containing the CDR packet to recipients contained within a distribution list.

   d. There shall be a security mechanism that will allow only authorized personnel access to the CDR packets. Every access attempt whether successful or denied shall be logged. It shall be possible to run reports from the log.

H. Enhanced Internal 911 Notification:

1. The system shall provide all the capabilities of the standard 911 notification system plus the following features:

   a. Provide 911 notification at locations as identified on the drawings and/or as specified by the owner.

   b. Provide notification on color monitors at the locations selected above, in addition to notification on the telephone.

2. Upon termination of call, the system shall provide all of the following post-911 access methods:

   a. Via an industry standard WEB browser for full display of the CDR packet.

   b. Via any authorized telephone internal or external to the PBX. Numeric information from the data packet such as the trunk number and extension number shall be communicated via a spoken phrase.

   c. Be able to automatically generate and forward an E-Mail message containing the CDR packet to recipients contained within a distribution list.

3. There shall be a security mechanism that will allow only authorized personnel access to the CDR packets. Every access attempt whether successful or denied shall be logged. It shall be possible to run reports from the log.

I. Auto Diagnostics:

1. In addition to the standard PBX diagnostics, the following enhanced diagnostics shall be provided:

   a. Check activity within the system.

   b. Schedule automatic test routines with reporting via e-mail and automated origination of telephone calls to configured numbers and report on the following:

2. System on line and tested acceptable.

3. System parameters unacceptable.

   a. Diagnostics shall include loop back and disarrangement tests.

4. The system shall be capable of being monitored and tested remotely by equipment PBX vendor.

5. The system shall have the capability of checking each link and have the ability to remotely block a link from the system if found defective.

6. The system shall obtain results of statistics maintained internally by the system to include:

   a. Service requests.
   b. Links in use at any time.
   c. Processor faults.
   d. Data faults.
   e. Interface resets.
   f. Initiation of Record-a-call function.

g. Initiation of Malicious Call Trace function.
h. Initiation of Internal 9-1-1 Notification function.

J. E-Mail/Website Integration:

1. System shall be equipped with all hardware and software to allow the system's multimedia mailbox to receive messages from, and send messages to other VPIM locations, and be accessible through a standard WEB browser.

2. System shall include a number of PC based management tools to support the system.

3. System shall comply with industry standards to smoothly integrate with existing customer information technology and telecom environments.

4. Caller name and Calling Line ID shall be displayed in the message header, and messages can be retrieved in any order.

5. The system administrator can reply to and forward messages using standard e-mail commands.

6. Voice messages can be created and addressed using standard e-mail commands and a System Address Book.

7. The system shall use IMAP for WEB-based message access protocols. Other acceptable protocols shall be Post office Protocol (POP).

K. Unified Messaging Voice Mail Enhancement:

1. System shall provide a single mailbox for voice and fax messages, and supports conventional touch-tone commands as well as a convenient and easy-to-use speech recognition interface. The system's multimedia mailbox can receive messages from, and send messages to, a fax machine, receive messages from a fax auto attendant and from desktop applications, and can receive messages from, and send messages to, other VPIM locations.

2. The system shall have fax handling capabilities, so that users can receive faxes whether they are in or out of the office, store faxes on their PC's with the desktop messaging option, retrieve faxes using the telephone user interface and forward the fax to other users. Users can also forward faxes in e-mail, with or without scheduled delivery and cut and paste faxes into documents and presentations. All these features shall be available with the system even though no analog line to the desktop is required. Moreover, the broadcast fax feature offers flexible directory addressing for "by name" faxing, and personal and group distribution lists.

3. Caller name and Calling Line ID are displayed in the message header, and messages can be retrieved in any order. Users can reply to and forward messages using standard e-mail commands.

4. Voice messages can be played back over the telephone or PC speaker. FAX messages can be displayed on the user's PC screen and printed on a network printer.

5. Voice messages can be created and addressed using standard e-mail commands and a System Address Book. Voice messages can be recorded using a telephone handset or a PC microphone. Fax messages can be created using the "Print" command from within any Windows application. A TIF file can be attached to an outgoing message and sent as a Fax message.

6. Notify to either a telephone or pager, based on the type of message left, i.e., urgent or standard.

7. System shall support the following groupware clients: Microsoft Outlook Express, Microsoft Outlook (97, 98, and 2000) Lotus Notes 4.5, Lotus Notes R5, Novell GroupWise 5.5, and others.

8. System shall support the following Internet clients: Microsoft Outlook 98 (Internet mode), Microsoft Outlook Express, Qualcomm Eudora Pro eMail 4.0, and Netscape Communicator. System supports the following web clients: Microsoft Internet Explorer and Netscape Navigator.

9. The system shall include an application builder. The Application Builder shall use a graphical user interface for application creation of voice and fax applications. This tool shall allow Owner to build applications in a fraction of the time normally required. The Drag and Drop interface allows creation of shared voice menus to standardize voice menus across your network; this reduces administrative costs.

L. Voice Recognition:

1. Provide integrated Interactive Voice Recognition system with sufficient ports and storage to provide the following features and functions:

2. Recognize voices based on natural, continuous and phonetic basis.

3. System shall recite recognized statements to insure understanding if the confidence level of the recognition is not above a programmable level, or ask the speaker to repeat if the response is not recognizable.

4. The system shall pass touch-tones.

5. A programmable timeout shall prompt speaker that the system is waiting for a response.

6. The system shall be grammar independent thus ignoring extraneous words.

7. The system shall be programmable through a graphical user interface.

8. The system shall be configured by the supplier.

M. Computer Telephone Integration (CTI):

1. The PBX shall be capable of integrating with the District computers.

2. The PBX shall be TAPI compliant.

3. Provide custom programming to recognize calling party identification and initiate "screen pops" with related data from the management system.

4. The relationships may be as follows: Calls into the guidance office would pop student grades. Calls into the attendance office would pop attendance records. Calls into the health office would pop medical records, etc. Calls to sales would pop order status, etc.

N. Automated Out-Dialing:

1. Provide an out-dial system that is optimized for the needs of the District as a whole, and also for the needs of individual teachers and staff members.

2. One process shall be for large lists with standardized message subject and language codes.

3. One process shall be for staff and faculty to send personal outside mail messages from their mailboxes.

4. Provide ability to deliver multiple messages in a single call.

5. After out-dial message delivery, the following programmable options shall be available for the called party:

   a. Provide the called party with ability to stay in the system to request more information.

   b. Provide the called party with ability to be connected to a teacher's mailbox to leave a response

   c. Provide called party with ability to be connected to a phone extension to talk to a live person.

6. Students shall be grouped for out-dialing. The system shall support both a phone book database with attribute tags and teacher maintained ID lists.

7. Provide message delivery acknowledgment. Voice or tone called party response and complete/partial message delivery results shall be shown on reports.

8. Answering machine handling. System shall detect answering machines using highly reliable interactive audio technique. System shall wait until answering machine stops talking to begin playback of outgoing message. Delivery to answering machines shall be reported on printed reports.

9. Staff Out-Dial:

   a. Mailbox owners can send outside mail messages by out-dial to individual student ID numbers or lists of student IDs (such as class roster). Phone numbers shall be automatically retrieved from the phone book database. Teachers can maintain their own student ID lists.

   b. Staff Log report shall show all outside messages sent and the result.

   c. Staff can ask called party for a voice response, which automatically goes into the staff person's voice mailbox. The called party shall be automatically connected to the sender's mailbox after message delivery, or to the sender's phone extension for a live response.

10. Database:

    a. System shall support "ExPRESS" Standards in ANSI format for electronic transfer of student records between Districts and from Districts to post secondary institutions.

11. Teacher Services:

    a. Provide ability for a teacher to have any number of bulletin board messages assigned to him/her. It can be one homework message or it can be multiple messages, one for each class with a personal directory for callers who don't know the teacher's classes.

2.6 SYSTEM ACCESSORIES

A. The following items are major components that are required to complete the system. It is not intended that this list be totally comprehensive as there are many small items that are required for a complete system. If additional items are necessary that are not detailed here, they shall be provided as part of the complete working system

B. Channel Service Units (CSU):

   1. Provide a Channel Service Unit (CSU) for each T-1 link having the capability of local and remote loop back testing. The unit shall provide a complete T-1 diagnostics and network protection for the links between PBX switches and the local Central Office equipment. It shall have external testing capability. CSU's shall meet standard Bellcore specifications for connection to 1.54 mbs (North American Standard) T-1 in a D4 or extended super frame (ESF) format.

   2. CSU's shall be capable of supplying clocking or free run from external clocking source.

   3. CSU's shall be capable of supporting ISDN type signaling 23 B+D for future Data/Voice Application.

4. CSU's banks shall be independently powered from a 120 VAC outlet. If special electrical requirements such as separate grounding is necessary, Contractor shall furnish all equipment as required.

5. Channel service units must:

6. Be equipped for and provide line ringing, i.e., ring generators.

7. Self enclosed with locking case.

8. Be capable of software configures.

9. Be equipped with DTE/DCE maintenance ports.

10. Be equipped with alarm status indicators.

11. Be equipped with local and remote loopback.

12. Operate in an environment of 32 degrees to 100 degrees Fahrenheit and up to 95% humidity, non-condensing.

13. U.L. listed.

14. Equipment to be supplied: Kentrox or approved equal.

15. System Surge Suppression

    a. Provide new surge protection devices for all cable runs between buildings and between Telephone Company service entrance and the telephone PBX.

    b. The surge protection devices shall be designed to prevent injuries and fires on the customer's site due to lightning or power line crosses. It should work by limiting or "clamping" excess energy coming in contact with the lines.

    c. Surge protectors shall protect the equipment from high frequency transients, which can damage communication equipment. The surge suppressant devices must operate in the 100 kHz frequency range and above. The lowest clamping voltage must operate in or about 27 volts for transience around the 1MHz range. Protectors shall provide a transient edge smoothing, turning fast edged transience into low ripples. All gas tube strike and re-strike transience must be filtered out. No "clamping" or filtering will take place below 25 volts at any frequency. All useful signal information shall be left unchanged with no imbalance introduced into normal lines.

    d. Connect a #6 ground conductor to each block of protectors and route them back to a solid ground point.

e. Provide surge protection to all pairs required to operate the specific number of stations at each building, and an additional 50% more pairs to accommodate future growth. The remaining pairs at the vendor's discretion may be either protected or shunt modules may be installed.

C. Loud Ringing Bells:

1. Double gong type, surface mounted on single gang outlet box.

2. Manufacturer: Danmac No. 1-F-5900FL Series or approved equal.

D. Maintenance Terminal:

1. The maintenance terminal shall be located in the switch room and is intended for use by the maintenance technician for diagnostics and repair of the system.

2. The system terminal interface into the switch utilizing a dedicated port intended specifically for this function. This terminal or a similar terminal shall be able to access the maintenance functions on a dial-up basis through a secondary port. Password security to access the system shall have no less than two levels prior to entry.

3. The terminal shall include as a minimum:

a. A high resolution monitor.

b. A keyboard for command input.

c. A printer for monitoring of alarms, error messages and other hard copy material necessary for maintenance of the system.

d. Other functions that shall be capable of being performed at this terminal includes:

e. System back-up.

f. Monitor system traffic performance.

g. Day to day management of the system.

h. Maintenance and modification of system security.

i. Moves and changes for sets, networking and trunks.

E. Uninterruptible Power Supplies:

1. The PBX system shall operate at full capacity on separately mounted batteries provided as an integral part of the system for a minimum of one (1) hour with no degradation of service.

2. All required associated equipment including but not limited to remote cabinets, CSU's, DSU's, modems, converters, etc. shall also be provided with one (1) hour of battery (ups) backup power.

3. Uninterruptible power supplies shall be provided for any component or sub-system of the telephone system that does not operate on batteries.

4. The UPS systems shall be line interactive.

5. UPS systems shall have batteries sized to provide one (1) hour of complete operation as specified above.

F. Fiber Modems:

1. Fiber modems shall be provided to connect the networked PBX's on the Owners fiber network.

2. The modems shall convert copper to fiber for each T-1 network link. There shall be a modem at each end of each fiber link.

3. Multi-Mode modems shall be used with multi-mode fiber and single-mode modems shall be used with single-mode fiber.

a. Modems shall be Transition Networks model T1E1-CF-01.

4. Where remote cabinets are connected to PBX's with single mode fiber, provide single to multi-mode converters. These converters shall interface the multi-mode connections on the PBX and remote cabinets to the single-mode fiber.

a. Converters shall be Allied Telesyn model AT-MC104.

2.7 MAIN AND INTERMEDIATE DISTRIBUTION FRAMES

A. Main Distribution Frames (MDF):

1. Provide an MDF at each PBX and remote cabinet location.

2. Each MDF shall include the following:

a. 4 ft. x 8 ft. (minimum) 3/4 in. plywood board painted gray.

b. Two (2) double duplex, surge suppression receptacles on two (2) emergency circuits.

c. Ground bar.

3. The MDF shall have areas segregated as follows with cross connection between the areas:

a. One section of the board identified for Telco connections.

b. One section for PBX connections (extension and trunk).

c. One section for distribution (house) cables.

d. One section for extensions.

B. Intermediate Distribution Frame (IDF):

1. Provide IDF's where shown on the drawings and elsewhere as requested by the Contractor to assist in his construction of the system, subject to approval by the Engineer, at no additional cost.

2. Each IDF shall include the following:

a. 4 ft. x 4 ft. (minimum) 3/4 in. plywood board painted gray.

b. One (1) double duplex, surge suppression receptacles on one (1) emergency circuit.

c. Ground bar.

d. The IDF shall have areas segregated as follows with cross connection between the areas:

1) One section of the board identified for Telco connections (if required).

2) One section for multi-pair distribution (house) cables (from MDF).

3) One section for extensions.

C. Terminal Blocks:

1. The terminal blocks on each MDF and IDF shall be high intensity punch down blocks - BIX Type A0284798.

2.8 CABLE

A. New Cabling:

1. New cabling shall be installed under this contract

2. A separate cable shall be provided for each device.

B. Interior Premise Cable:

1. All premise cables shall be 4 pair twisted in one teflon coated fire retardant sheathing. Cable shall be data grade, category 5e media.

2. 24 AWG, solid copper conductors.

3. U.L. listed plenum cable in accordance with NEC Article 800, Type CMP.

C. Interior Telephone Distribution (House) Cable:

1. All telephone distribution cables shall contain twisted pairs in one teflon coated fire retardant sheathing.

2. 24 AWG, solid copper conductors.

3. Quantity of pairs shall be as follows:

a. Provide 100 pair for IDF's serving 50 telephones or less.

b. Provide 150 pair for IDF's serving 51 to 100 telephones.

c. Provide 200 pair for IDF's serving 101 to 150 telephones.

4. U.L. listed plenum cable in accordance with NEC Article 800, Type CMP.

D. Exterior Cable:

1. All exterior cable shall be REA listed PE-89 gel-filled, 22 AWG. Cable shall be direct buried or installed in conduit as indicated on the drawings. Provide a yellow tear tape over cables in the duct bank. Install 12" below surface.

2.1 TELEPHONE OUTLETS

A. Desk Type: Provided by Data Spec

1. Voice outlet shall be provided by the Contractor responsible for Specification Section 272100.

2. This Contractor shall be responsible for terminating the cable on the jack and installing the telephone.

B. Wall Type:

1. Single modular outlet assembly shall consist of one (1) 8 conductor modular jack with screw type terminal box. Face plate shall be stainless steel with mounting lugs for installing modular wall telephone sets.

2. Flush mounted on single gang outlet box.

3. Manufacturer: Suttle, Hubbell, Leviton or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Survey the site prior to submission of bid to ascertain all conditions and impediments that would affect the ease and cost of the installation of this system.

B. Precautions must be taken to assure that the existing telephone system remains in operation, unhampered until the cutover date of the new system covered by these specifications.

C. Areas in which ceiling tiles are removed and replaced shall be carefully and completely cleaned after the tiles are replaced. Any tiles damaged during the installation of the system shall be replaced with new, matching tiles provided and installed at the Contractor's expense.

D. Any other finished surfaces damaged during the installation of the system, shall be restored to match the existing surrounding finish at no additional cost to the Owner. The determination of whether the repaired finish matches the surrounding finish will rest solely with the Owner's representative. Areas that are damaged as they presently exist, shall be reviewed with the Owner's representative prior to starting work in these areas. Once work has begun in an area, damage to existing surfaces will be considered to have been caused by this Contractor.

3.2 CABLE INSTALLATION

A. The system wiring shall be all new.

B. Various ceiling locations are utilized as an air plenum. All cabling will be done with a CMP, fire retardant sheathing approved for use in plenums.

C. Provide adequate equipment for installation of cable. Pull all cables in such a manner as not to overstress or stretch any cable, and use precautions as not to score, cut, twist or damage the protective covering of insulation. Cabling shall be installed following data cable standards as identified in EIA 56B.

D. Cables shall be handled and placed in such a manner as to avoid kinks and other sheath deformities. Minimum bending radius of all cables shall be ten (10) times the diameter of the cable. Cable kinked or flattened shall not be used. Lead sleeves or duct splices shall not be permitted.

E. Cables shall be installed parallel or perpendicular to the building lines.

F. No splices shall be made in any cable run except when approved and using Type 20D1 cast aluminum splice closure manufactured by Reliable Electric/Utility Products. Transition from one cable to another shall be at an IDF, MDF or auxiliary frames using BIX blocks.

G. Cable shall not be more than 300 cable ft. from the MDF (Main Distribution Frame), or IDF (Intermediate Distribution Frame) from which it is served.

H. In general, all wiring will be fully concealed in all facilities. All wiring will be run through conduit raceway, surface raceway, cable tray or in ring run above suspended ceilings. Refer to drawings for specific instructions.

I. Install cables in conduit raceways for the following applications:

1. From all telephone outlets up to the accessible ceiling. Methods utilized shall be in the following order as available at each outlet location: via new or existing recessed outlet box and conduit; via recessed outlet box with cable fished in existing walls where possible; or via surface outlet box with surface raceway on existing walls.

2. In conduit sleeves through floors. Conduit shall be stubbed 6 in. below the floor slab and extended 6'-0" above the floor slab, unless noted otherwise.

3. In conduit sleeves through walls and fire and smoke partitions. Seal conduits after installation of cables, cap spare sleeves.

J. Wire and cable not in conduit should be installed with cables supported at a maximum of 8 ft. centers with a multiple tie plate, Panduit Company MTP Series or approved equal.

K. Wire and cable shall not be supported from electrical conduits or mechanical piping.

L. All cables shall be installed in existing conduits where possible. In cases where local Telephone Company cabling is to be removed the cable installation shall be coordinated with the telephone company so as to minimize out of service time. (It may be necessary for the Contractor to provide temporary telephone service as required by the Owner, in order to meet this requirement.)

M. The Contractor shall furnish and install 3/4 in. plywood backboard, painted light gray, where indicated on drawings.

N. The Contractor shall furnish and install nylon fish line in all empty conduits.

O. Wall outlets shall be mounted with centerline of box 18 in. above floor for desk telephones and 58 in. above floor for wall telephones.

P. All equipment shall be properly mounted and anchored. All holes or voids caused by the Contractor shall be patched.

Q. Prior to installation, the successful bidder shall be responsible for the complete system layout and configuration based upon meetings with the Owner's designated personnel and the contract drawings. Requirements for this are specified below.

R. Remove all abandoned telephone cable.

3.3 TELEPHONE SET QUANTITIES AND LOCATIONS

A. Telephone stations are shown and located on the drawings included with these specifications. Actual locations within designated rooms will be as directed by the Owner during system installation.

3.4 POWER FAILURE TRANSFER CIRCUIT LOCATIONS

A. The following locations shall be served by power failure transfer circuits.

B. Each location listed shall be provided with one modular telephone jack for this use. This jack will be in addition to any other outlet(s) installed in the same location. Provide label on outlet faceplate "FOR EMERGENCY PHONE".

C. Provide a cable for each outlet location back to the MDF or IDF serving the area. Ultimately, this outlet shall be connected to the telephone switch transfer ports.

D. For each location listed, provide one analog single-line telephone set for use when telephone switch is in failure transfer mode.

3.5 PREMISE CABLE TERMINATIONS - AT OUTLETS

A. Premise cables shall be terminated at each telephone outlet.

B. The cable shall be terminated to the modular jack.

C. All faceplates shall be provided with permanent marking which shall correspond to the associated punch down block label card and patch panel port number. Block labels and port numbers shall be designated by the Contractor.

D. The Contractor shall provide a cable termination log book listing each room installed with an outlet including its corresponding block label and port number designations.

3.6 PREMISE CABLE TERMINATIONS - AT EQUIPMENT BACKBOARDS

A. All cables shall be terminated on BIX blocks mounted on the plywood backboards.

B. All punch down blocks are to have label cards with each pair labeled.

C. The Contractor shall attach all wiring to mounting boards to insure a secure and organized installation.

3.7 "T-1" CARRIER CIRCUIT INSTALLATION

A. Provide silicon diode or better lightning protectors designed to protect T-1 circuits. The quantity of protectors should be adequate for the T-1 circuits installed.

B. The Contractor shall coordinate with the Telephone Company on the installation of their equipment at each location. The Contractor shall provide a plywood backboard for mounting Telephone Company equipment. Location and size of board as required by

Telephone Company. Furnish isolated ground type duplex receptacles for Telephone Company equipment. Receptacles shall be circuited to the nearest emergency system panelboard if available. If emergency panelboards are not available, circuit to nearest normal power panelboard and provide "lock-on" device for the circuit breaker.

3.8 CABLE TAGGING

A. Plastic tie-wrap cable tags shall be placed on all distribution cables including stub cables and branch cables. Each tag shall be stamped to indicate the cable size, gauge, cable number and number of first and last pair of each group of consecutive pairs which is in the main cable, stub cable or branch cable to which the tag is attached. The number of dead pairs, if any, shall also be designated.

3.9 SYSTEM GROUNDING

A. Provide a #6 bare grounding conductor from the telephone switch and each equipment backboard to the main building service ground. Each gas tube protector shall also be connected to ground with a #6 insulated copper conductor.

3.10 REMOVALS

A. This Contractor shall arrange for removal of the existing telephone system equipment and associated cables.

3.11 SYSTEM CONFIGURATION AND LAYOUT

A. Meeting with the Owner:

1. To accurately design and program the manufacturer's system in accordance with the specification, the layout, programming and training representative shall meet with the owner's representative, with all communications documented, for the Engineer's review. Meeting shall include, but be limited to, the following:

a. Introduction of all parties involved, determination of Owner's primary contact.

b. Brief description of system as specified.

c. Samples and/or descriptive literature of telephone sets.

d. Review of schedule of layout, programming, cutover and training.

e. Review floor plans and/or actual site walk-through, including equipment room. Identify each location with a cable number, include fax, modem, and answering machines, where applicable. Locate loud bells, central answering positions and PC for special applications (ACD, CDR, Voicemail), where applicable. If assigning new extension numbers with cable reuse, indicate old extension in programming for cross reference.

f. Review Telephone Company Service Provider service.

g. Review system features such as system speed call, call park, dial intercom, authorization codes, class of service and BARS routing, call answering scenarios and call coverage.

h. Review number plan and dial plan structure, with considerations for existing numbering plans and/or centrex.

2. Obtain directory of users with proper name spelling.

a. Identify/review night assignment.

b. Identify proper departments and/or cost centers for call accounting reporting.

c. Review Automated Attendant and Voicemail, including configuration and scripts, if applicable.

d. Discuss training issues.

B. Order Service:

1. The layout, programming and training representative shall act as the agent of the Owner in dealings with the local, long distance telephone line supplier and/or T-1 provider, with all communications documented, for Owner's/Engineer's review if required. The representative shall execute a minimum, but not limited to, the following:

a. Identify hunt group and carrier.

b. Determine if RJ21x is sufficient, verify with service provider.

c. Identify signaling, CO switch type and T-1 channelization.

d. Coordinate order for any additional services.

C. Input and Program Custom Database:

1. System program database shall be unique and custom designed for this particular application, based on the capabilities of the PBX and the specification herein. The program shall include, but not be limited to, the following:

a. Sets; according to the schedule, each set shall include last name, first name (maximum 16 letters), abbreviated logically if needed, to provide for a customer directory, a readable name display and call accounting information. Compare to cable list and schedule. Format each set with specific class of service, restriction(s) (access to 800, 900 calls, etc.), along with speed call list.

b. Trunks; identify and coordinate trunks with service provider for trunk configuration, i.e.: input groups, hunt groups, private lines, night answer, power failure units, etc.

c. BARS (Basic Automatic Route Selection); as determined by conversations with service provider and owner, and as specified herein, program database accordingly.

d. Security; as specified, and as capabilities of the system allow, program security measures including anti-toll fraud, etc.

e. Program voicemail mailbox numbers, menu ID's, and type scripts for easy recording.

f. Download database electronically into system hard drive locally off-premise from owner's site, and test system prior to delivery. Database shall have the ability to automatically and electronically provide custom labels for each individual phone set and customized user guides for training. Samples shall be submitted to Owner/Engineer in advance of cutover for approval. System supplier shall maintain this database on electronic media for owner's use for a disaster recovery program.

D. Customized Programming Manual:

1. The system supplier shall provide to the Owner/Engineer for approval in advance of cutover, a customized programming manual clearly identifying the project/job name and number, Owner name, Engineer name and supplier name. Upon signed approval by the Engineer, provide a minimum of two (2) copies to the Owner; one to be left with the system, and one for the Owner's system administrator. The manual shall also include, but not be limited to the following:

a. Service provider information; any and all correspondence with local and long distance telephone line suppliers, etc.

b. Inventory; list of equipment, including:

1) Trunks.

2) Analog sets.

3) Digital sets.

4) Voicemail and other applications

5) Custom equipment; including long coil cords, etc.

a) Trunk configuration; detailed breakdown of lines and trunk configuration on the PBX, as well as those that are not part of the system. Identification of RJ21x and all services from service provider.

b) System Configuration; count of ports, including:

6) T1 trunk(s).

7) Universal/analog trunk ports (specify as CO or DID).

8) Analog sets.

9) Digital sets.

a) Cable Extensions; list of cable runs by:

(1) Type of phone.
(2) Name.
(3) Extension #.
(4) Peripherals (i.e.; loud bells).

10) Phantom Numbers; list and breakdown of directory numbers (DN) on system.

11) Power Failure Transfer; detailed list by:

a) Route.
b) Trunk.
c) Name.
d) Extension #.
e) Cable #.

12) Call Pickup Group; summary breakdown of groups by:

a) Name.
b) Extension #.

13) Speed Call Lists; detailed list of all station speed dial number, shown as:

a) Name.
b) Extension #.
c) Quantity.

14) Dial Group Intercom; list of all intercom groups by:

a) Name.
b) Extension #.

15) Directory; list of user group by:

a) Extension #.
b) Intercom number.
c) Voice/ring.

d) Name.
e) Call forward to extension "x".

16) Program Information Sheets; complete details of telephone sets features and functions, in two formats:

a) Switch mnemonics.

b) Customer readable format (English).

17) Night Answer; description of how it operates and what extensions/device ring.

18) Program Data; all database loads of software, including but not limited to the following:

a) Routes data block.
b) Trunks data block.
c) Customer data blocks.
d) Authorization codes.
e) T1 configurations, if applicable.
f) User names.
g) Flex feature codes.

19) BARS; detail description of the basic automatic route selection, in a customer readable format (English), by:

a) NXX (exchanges).
b) NPA (area codes).
c) SPN (special).

20) Security Access; detailed list of any/all options/application that are security sensitive and any/all features activated or not activated.

3.12 TRAINING

A. The layout, programming and training representative shall perform professional, organized and controlled training sessions on the Owner's premises. These training sessions shall be coordinated and scheduled with the Owner's representative, and communicated to participating parties, and documented for the Engineer's review if required. The trainer shall provide an adequate supply of customized user guides one (1) for each user, plus fifteen (15) spares. These training sessions shall allow the owner/users to operate the system and develop questions and/or problems which can be satisfied during the next sessions. The system shall be functional during on-site training. If the system is not operational, training shall be performed at the system supplier's premise. The training sessions shall not exceed twenty-five users, and shall be a minimum of one (1) hour in length for each function, including but not limited to the following:

1. User training; include features and functions of station apparatus (i.e.; analog and digital sets).

2. Administration training; include expanded feature and functions of station apparatus, if applicable.

3. Voicemail; include setting up mailboxes, leaving and retrieving messages, etc., if applicable.

B. Presence at Cutover:

1. The layout, programming and training representative shall be present at cutover to provide personal assistance to all users. If the users group at one location is larger than 200 and/or the Owners campus is expansive, a help desk shall set up with direct inward intercom connection to all users for assistance. The need of a help desk shall be at the discretion of Engineer, with input from the layout, programming and training representative. All issues and/or trouble with station apparatus and/or system shall be documented and reported in writing with resolution to Owner, with all communications documented, for Engineer's review if required.

C. After Cutover Follow-Up:

1. The layout, programming and training representative shall be available for additional user assistance, on either a personal basis or in the form of a help desk. This need shall be at the discretion of Engineer, with input from the Owner/users.

3.13 TESTING

A. All pairs in each cable shall be tested and certified as usable. This includes new and existing reused cable (if applicable).

3.14 PROJECT CLOSEOUT/FINAL ACCEPTANCE

A. The project shall be considered complete and ready to be turned over to the Owner after the completion of the following items:

1. Submission and approval of the certified test report.

2. Certification of the completion of training of all employees available during the training period.

3. Submission of the Owner's operation and maintenance manual complete with all cable and other instructions.

4. Submission and approval of the cable termination log book.

5. Submission of all written warranties.

3.15 GUARANTEE

A. The entire system shall be guaranteed for a period of one (1) year from date of acceptance as determined by the Engineer.

B. Upon final acceptance of the system, furnish a separate proposal giving fixed costs for continuing the same level of service for the system for each of the next five (5) years following the warranty year.

3.16 UNIT PRICES

A. Furnish Unit Prices for the items enumerated hereunder.

B. Any work not included under the Base Contract shall be performed in any quantity as directed at the Unit Prices set forth below. Such work shall be performed upon request at any time until final acceptance of all work under this contract. All such additional work shall be performed in accordance with the terms and conditions of this contract. In the event that the Owner shall direct the elimination of any work under this contract, the Contractor shall credit to the Owner the cost of said eliminated work at the Unit Prices set forth below.

C. The Unit Prices set forth hereunder shall include all materials required for the complete installation and operation of each item.

D. The Contractor shall complete each column and submit with Bid Form.

Item No.	Description	Pre-Cutover	Post Cutover
1.	Two-Way Trunk Card (8 port)		
2.	Analog Line Card (16 port)		
3.	Digital Multi-Line Card (16 Port)		
4.	Digital Multi-Line Telephone		
5.	Digital Single Line Telephone		
6.	CAP Telephone		
7.	Analog Telephone		
8.	Pre-wired Telephone Outlet with 100 ft. of interior premise cable (Installed)		
9.	12 ft. long coiled handset cord		
10.	25 ft. long coiled handset cord		

END OF SECTION 273100

SECTION 275113 – PUBLIC ADDRESS SYSTEM (PA)

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. The conditions of the General Contract (General, Supplementary, and Other Conditions) and the General Requirements are hereby made a part of this Section.

B. All bids shall be based on the equipment as specified herein. The catalog numbers and model designations are those of the CH2000IP Life Safety Communication Platform.

C. Contractors who want to submit alternate equipment shall provide the specifying authority with the appropriate documentation at least 15 business days before bid opening. The submitted documentation must provide a feature-by-feature comparison identifying how the proposed equipment meets the operation and functionality of the system described in this specification. The contractor shall provide adequate and complete submittal information beforethe bid date. Submittal documentation shall include but is not limited to, specification sheets, working drawings, shop drawings, and system demonstrations. The alternate supplier-contractor must also provide a list of six installations identical to the system proposed.

D. Final approval of the alternate system shall be determined at the time of job completion. Failure to provide the "precise functional equivalent" shall result in the removal of the alternate system at the contractor’s expense.

E. The contractor for this work shall be held to have read all bidding requirements, the general requirements of Division 1 and contract proposal forms and complete the execution of this work. The contractor shall be bound by all conditions and requirements therein.

F. The contractor shall be responsible for providing a complete functional system including all necessary components whether included in this specification or not.

G. In preparing the bid, the contractor should consider that no claim will be made against the owner for any costs incurred by the contractor for any equipment demonstrations that the owner requests.

1.2 SCOPE OF WORK

A. Furnish and install all equipment, accessories, and materials per these specifications and drawings to provide a complete and operating school communications system including, but not limited to:

1. Administrative Console with a color touchscreen display and intuitive GUI.

2. An Administrative Display Application able to receive call-ins and establish two-way audio communication between call-signaling audio endpoints. Capable of calling and receiving calls from other network-connected administrative consoles, consisting of a map-based GUI (Graphical User Interface) and capable of running on a 22” (or larger) LCD touchscreen computer.

3. Call initiation switches capable of placing normal and emergency calls.

4. Built-in calendar with configurable time zone (including Daylight Saving Time), unlimited events and supporting a minimum of 80 schedules.

5. IP-based system software with LAN/WAN access for Voice over IP (VoIP) communications and remote management.

6. Public Switched Telephone Network (PSTN) or VOIP switch can be connected to the system via an inbound SIP Trunk.

1.3 SUBMITTALS

A. Specification sheets on all items including cable types.

B. Shop drawings that detail the integrated electronic communications network system.

C. Wiring diagrams showing typical connections for all equipment.

D. Numbered Certificate of Completion for installation, programming, and service training, which identifies the installing technician(s) as having successfully completed the technical training course(s) provided by the system manufacturer.

1.4 QUALITY ASSURANCE

A. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

B. The contractor shall be an established communications and electronics contractor who currently maintains and for at least fifteen years has had a locally run and operated business. The contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.

C. The contractor shall show satisfactory evidence, upon request, that he or she maintains a fully equipped service organization that can furnish adequate inspection and service to the system. The contractor shall maintain at his or her facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied. Upon request, the contractor shall show satisfactory evidence that he or she maintains a fully equipped service organization.

1.5 SINGLE SOURCE RESPONSIBILITY

A. Except where specifically noted otherwise, all PA equipment supplied shall be the standard product of a single manufacturer of known reputation and with a minimum of 10 years' experience in the industry. The supplying contractor shall have attended the manufacturer's installation and service school. A certificate of this training shall be provided with the contractor's submittal.

1.6 SAFETY/COMPLIANCE TESTING

A. The mains-powered communications system shall bear the label of a Nationally Recognized Testing Laboratory (NRTL), such as TUV or UL, and shall be listed by their re-examination service. All work must be completed in accordance with all applicable electrical codes under the direction of a qualified and factory-approved distributor with the owner's approval.

B. The system is to be designed and configured for ease of service and repair.

1.7 IN-SERVICE TRAINING

A. The contractor shall provide at least eight (8) hours of in-service training with this system. These sessions shall be broken into up to four (4) segments that facilitate the training of individuals in the operation of this system. Operator manuals and user guides shall be provided at the time of this training.

1.8 WIRING

A. System wiring and equipment installation shall be in accordance with good engineering practices as established by the EIA and the NEC/CSA. Wiring shall meet all local electrical codes. All wiring shall be tested and verified to meet the requirements.

B. All communication system wiring shall be labelled at both ends of the cable. All labelling shall be based on the designators indicated in the architectural graphics package.

1.9 PROTECTION

A. The contractor shall provide all necessary transient protection on the AC power feed and all port lines leaving or entering the building.

B. The contractor shall note in the system drawings the type and location of these protection devices and all wiring information. Such devices are not to be installed above the ceiling.

1.10 SERVICE AND MAINTENANCE

A. The contractor shall provide a one-year equipment hardware warranty for the installed system against defects in material and workmanship. All materials subject to warranty repair/replacement shall be provided at no expense to the owner during normal working hours. The warranty period shall begin on the date of acceptance by the owner/engineer.

B. The contractor shall, at the owner's request, make available a maintenance contract offering continuing factory-authorized service of this system after the initial warranty period.

C. The system manufacturer shall maintain engineering and service departments that are capable of rendering advice regarding the installation and final adjustment of the system.

1.11 USER ROLES AND ACCESS

A. The system shall include the ability to configure user roles and access for permission-based functionality.

1.12 DATA AND COMMUNICATION ENCRYPTION

A. The system shall include a minimum of AES-128 encryption for communications and data transfers.

1.13 QUALIFICATIONS

A. The equipment furnished and major work described herein must be provided and performed by an established audio contracting firm, which must document its ability to execute the contract in a timely, competent, and acceptable manner. All bids must contain proof that the proposed firm:

1. Has been in the business of this specific type of work (school inter-communications and clock systems) for at least 15 continuous years.

2. Operates from an office within 20 miles of Newburgh Enlarged Central School District, and is equipped with a dedicated repair shop.

3. Is not a private residence. Parties who operate from private residences will not be considered qualified as prospective bidders for this project.

4. Has satisfactorily performed intercommunication and clock system work of the type specified herein, at a minimum of 10 similar projects.

5. Operates from an office that is fully equipped with test equipment, spare parts, a dedicated service and repair facility and service vehicles to render proper service. The Engineer/Owner reserves the right to inspect Bidder's facilities to verify these criteria.

6. Has a factory-trained service department on call 24 hours a day, 365 days a year, to service the specified product.

7. Is capable of being bonded to ensure the owner of performance and satisfactory service during the guarantee period.

B. The authorized PA vendor for the Newburgh Enlarged Central School District is:
Dutchess Tel-Audio, Inc.
10 Steele Road, New Windsor, NY 12553
Tel: (845) 462-1700
Email: info@dutchesstelaudio.com

PART 2 - EQUIPMENT SPECIFICATION

2.1 MANUFACTURERS

A. Subject to compliance with requirements specifications, provide the following system:

1. CH2000IP manufactured by CareHawk Inc.

B. This specification is intended to establish a standard of quality, function, and features.It is the bidder's responsibility to ensure that the proposed product meets or exceeds every standard outlined in these specifications.

C. The functions and features specified are vital to the operation of this facility; therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with this specification's requirements.

2.2 EQUIPMENT

A. SYSTEM EQUIPMENT

1. CH2000IP Life Safety Communication Platform Server.

a. Intel I5 or higher processor.
b. 99 simultaneous tasks capable of 200 call-ins in the queue.
c. Linux OS
d. CH2000IP software.

2. PoE+ Switch(es).

3. GW2WIP1/GW2WIP2 SIP Enabled POE Gateway.

4. Program Sources:

a. External audio source interfaced through a 3.5mm connection.

5. Administrative Equipment:

a. Spotlight Administrative Display Application with map-based user interface
b. ADMIN7 Administrative Console

6. Optional Equipment:

a. CLKMSL10(D) Messaging display POE
b. CLKMSL10(D)-SPK Messaging display with SIP speakerPOE+
c. CLKMSL22A Messaging display (12V, 35W)
d. DAF100-25/70 100-Watt remote Class D amplifier 25V or 70V (For use with GW2WIP1/GW2WIP2)
e. DAF300-25/70 300-Watt remote Class D amplifier 25V or 70V(For use with GW2WIP1/GW2WIP2)
f. VCall+ Mobile application
g. AS-3B-LWE Alert Station
h. CS2-C(-FR), CS2-CE(-FR), CS55, CS-D30-IP Call Stations
i. GPIO-8I-8O Integration Hub (General Purpose Inputs and Outputs)

2.3 COMPONENTS AND DESCRIPTIONS

A. The system must support analog speakers with IP-based cable infrastructure.

B. Central Equipment:

1. The system shall have a maximum of 256 SIP audio endpoints and 16 administrative devices.

2. The system shall be capable of expanding capacity using additional systems.

3. The software shall be upgraded via web interface. After rebooting the system, the software upgrade is complete. The system shall allow for a manual revert to the previous working software.

4. The system shall facilitate the playing of pre-recorded audio files.

5. The system shall facilitate the live recording, naming, and storage of user-generated audio files.

6. The built-in calendar shall facilitate automatic control of class changesand other events.

7. The system shall be capable of retrieving ("pulling") calendars from other connected systems as well as sending ("pushing") a calendar or day schedule from one or more designated systems to a single or multiple connected systems (Mass Calendar Update).

8. The system shall be capable of displaying active calendars from connected systems.

9. Network Time Synchronization. The system shall be capable of synchronizing the time with a Network Time Server running NTP via the school's LAN network. Systems that cannot provide Network Time Synchronization will not be deemed equivalent.

10. The system shall have user management with configurable permission-based roles and access to system functionality.

C. Spotlight Administrative Display Application:

1. The system shall show the time of day and date.

2. The system shall display a facility map(s)/floorplan(s).

3. The system shall include a tool to create and update facility maps.

4. The system shall highlight, with distinct colors, system communications on the map including intercom, paging, tones, and music distribution.

5. The system shall have the ability to provide Lockdown Acknowledgement per endpoint. This is to be highlighted on the map as the endpoints report back to the system as secure.

6. The system will use a GUI to activate intercoms, security alerts, zone pages, external functions, select program sources, and distribute or cancel the source to any or all endpoints or zones.

7. The system shall allow for the generation of user-created zones and dynamic zone creation.

8. The system shall display call-in extensions/room numbers and the call-in priority of calls placed.

9. The system shall allow for the management of users, roles, and permissions.

10. The system shall allow for the management of user-defined tones and preannounce tones.

11. The system shall facilitate the distribution of configurable email alerts based on triggered tones/events.

12. The system shall be accessible on supported browser-based devices connected to the local network.

13. The system shall enable bi-directional communication with system audio endpoints, Spotlight, and Administrative Consoles.

D. ADMIN7 Administrative Console:

1. The console shall clearly distinguish between normal and emergency call-ins.

2. The console shall use a priority-based call-in display queue, where critical call-ins are placed at the top of the call queue.

3. The console shall allow the user to select call-ins out of queue order.

4. The console shall display active critical alert badges such as Lockdown.

5. The console shall facilitate quick access to color-coded emergency tones and alerts, including Lockdown and All Clear.

6. The console shall facilitate two-way intercom calls, phone-to-phone calls, paging to zones, tones to zones, and music distribution to zones.

7. The console shall display its IP address and other system information and connectivity status.

8. The console shall include a minimum display size of 7” with a color touch-screen display.

9. The console shall not require the use of phone codes for the operation of daily or emergency communications.

E. Spotlight Calendar:

1. The system shall include a browser-based Calendar interface.

2. The calendar shall have unlimited events that may be programmed into any of the unlimited day schedules.

3. The schedules shall be calendar-based and allow for programming years in advance.

4. The calendar shall facilitate on-the-fly day schedule changes in a calendar-based interface.

5. The calendar shall facilitate the use of exclusion dates for holidays and other special circumstances.

6. The calendar interface shall have options for import, export, and schedule editing.

7. Users shall have configurable role-based access to Calendar with all scheduling functions.

F. External Phones:

1. External phones shall be integrated with the system through an inbound SIP trunk.

G. Call Stations:

1. Call Stations shall be CareHawk Model:

   a. CS55 Rocker Style Call-in Switch
   b. CS2-C Push button Call-In Switch
   c. CS2-CE Push button Call-in/Emergency switch
   d. CS-D30-IP Silicone Button Call-in switch

2. Shall be capable of Normal and Emergency Calls.

3. The system must have Emergency Call escalation.

   a. If the emergency call is unanswered by the designated extension and the emergency call escalation is programmed, the emergency call shall be forwarded to all the other administrative extensions. Systems that do not provide Emergency call escalation will not be considered equal.

4. The stations shall be able to provide Lockdown Acknowledgement.

   a. This shall be provided through the pressing of any button on the station following the initiation of a Lockdown.
   b. After acknowledgement, the buttons revert to the default functionality.

H. Alert Stations

1. Alert stations shall be CareHawk Model:

   a. AS-3B-LWE.

2. Alert stations shall be capable of triggering a Lockdown, Weather/Tornado or Evacuate critical tones.

3. Alert stations shall include a minimum of two software-programmable buttons.

I. VCall+

1. The mobile application will initiate normal and emergency call-ins to Spotlight and ADMIN7 consoles from the selectable classroom endpoints.
2. Call-ins initiated by the mobile application will be displayed on the Spotlight and ADMIN7 consoles as VCall+ triggered (with mobile device callback number if configured).

3. This system shall not provide direct audio communication to the mobile application.

4. The system shall initiate Lockdown and up to 10 custom tones from the mobile application.

5. The mobile application will initiate Lockdown Acknowledgement from the selectable classroom endpoints.

6. The system shall allow for the configuration of users, roles and permissions based on login credentials.

7. The mobile application will indicate any active alerts through a graphical display and vibration.

J. GPIO-8I-8O Integration Hub

1. The system shall include 8 contact closure inputs and 8 relay outputs.

2. The system shall allow for a combined 16 contact closure inputs and 16 relay outputs(2 x GPIO-8I-8).

3. The GPIO-8I-8O Hub shall be powered by POE or an optional external 12V power supply.

4. The GPIO-8I-8O Hub shall support LLMNR addressing.

5. The GPIO-8I-8O Hub shall include runtime communication with AES-128 encryption.

6. The GPIO-8I-8O Hub shall allow for remote browser-based firmware updates.

7. The GPIO-8I-8O Hub shall allow for supervision and firmware fatal error reporting and logging.

8. The GPIO-8I-8O Hub shall allow additional criteria configuration for event processing.

2.4 SYSTEM PARAMETERS

A. The communication system shall provide an IP-based communication network between administrative areas and indoor and outdoor locations throughout the facility over VLANs.

B. The system shall provide integrated criteria-based contact closure inputs and relay outputs for communication with third-party systems. Systems that do not contain event-processing communication ports shall not be considered.

C. The system shall provide no less than the following features and functions:

1. IP Based communication between the SS32IP, Spotlight, and ADMIN7 Consoles. Each SS32IP port shall be capable of supporting 32 Watts, 3 Call in buttons, and duplex communication.

2. Paging only speaker locations such as hallways or common areas shall be homerun to the SS32IP or to a Class D amplifier integrated with the SS32IP.

3. System amplifiers shall be Class D only.

4. ADMIN7 IP Administrative Console.

5. Spotlight Administrative Display.

6. Classroom and hallway locations needing visual displays shall use CLKMSL10(D)-(SPK) messaging displays. The SPK version shall support a 4" 4-watt speaker and microphone with echo suppression. Use of a remote call switch shall be supported (applicable to -SPK versions only). 10-inch LCDs shall show visual graphics for emergency and non-emergency events. Four integrated RGB multicolor strobe LEDsper display shall be available to enhance any visual alert.

7. Communal areas (Cafeterias/Gymnasiums) needing visual displays shall use CLKMSL22A messaging displays. The display shall support 15W(@4ohms) or 9W (@8ohms) external speakers with the internal amplifier. This unit shall provide AGC based on ambient audio levels. The unit shall provide a line out for use with external amplifiers and a configurable dry contact closure.

D. The Emergency Page All-Call function shall have the highest system priority that will suspend security alert audio for additional announcements.

1. Systems that do not treat Emergency Page All-Call page with the highest priority shall not be deemed as equal.

E. There shall be at least 100 user tone slots available for pre-recorded tones/announcements. Any of these can be dedicated Emergency Alarm Tones. Each shall be accessed from the Spotlight Administrative Display, ADMIN7 console, or any authorized PBX. Systems using external alarm generators or having less than 100pre-recorded tones/announcements shall not be acceptable.

F. The system shall provide for three-, four-, five-, or six-digit architectural room numbers with description.

G. There shall be an automatic level control for return speech during amplified voice communications.

H. Each room's loudspeaker shall be assigned to any single, any combination, or all of 64 multi-purpose zones per facility. Systems with less than 64 multi-purpose zones shall not be acceptable.

I. There shall be unlimited Time-Signaling Schedules with unlimited user-programmed events per facility. Each event shall trigger one of the user-selected tones or program sources. It shall be possible to assign each schedule to a day in an unlimited calendar or to manually change schedules from the Spotlight Administrative Display. Systems that do not provide unlimited time-signaling schedules or a choice of 100-time tones and external audio shall not be acceptable.

J. There shall be a zone-page/all-page feature that is accessible by Spotlight Administrative Display, ADMIN7 console, and authorized PBX:

1. There shall be a preannounce tone signal at any loudspeaker selected for voice paging.

K. There shall be a voice intercom feature that is accessible by Spotlight Administrative Display, ADMIN7 console and authorized PBX.

1. There shall be a privacy tone every 15 seconds to signal that any loudspeaker selected for amplified-voice intercom is active.

2. There shall be a preannounce tone signal at any loudspeaker selected for voice intercom communication.

3. Privacy and pre-announce tone signals shall be capable of being disabled during system initialization.

L. Each Classroom call station shall support two call-in types, as follows:

1. Normal.

2. Emergency.

3. Emergency Call-ins from Classroom Call Switch Stations shall jump to the top of the call-in queue and alert the Spotlight Administrative Display via a distinctive ring and the map location flashing red. If the Spotlight Administrative Display is busy, the user shall be alerted via a tone. Systems which interrupt calls shall not be acceptable.

4. Normal calls shall be logged into a queue for the designated Spotlight Administrative Display.

5. Each queue shall first be sorted by call priority (emergency calls, and then normal calls). Calls are sorted within each priority level on a first-in, first-out basis. When a call is answered, it shall automatically be removed from the queue. Systems that do not sort calls according to priority and order received shall not be acceptable.

6. It shall be possible to answer any incoming call simply by clicking the map location while it is ringing. It shall not be necessary to hit any buttons to answer a call unless the call has dropped into the queue.

M. Spotlight Administrative Display:

1. Incoming calls can be directed to the desired administrative console via call groups.

2. The display shall, by default, show the time of day, day of the week, the current time, and the locations of all stations calling with the call-in status of each station (normal or emergency).

3. When dialing from Spotlight, the console shall indicate the room number being dialed.

4. The display shall provide user-friendly menu selections to assist the operator when paging and distributing program material. Systems that require the operator to memorize long lists of operating symbols or control codes shall not be acceptable.

5. Program selection and its distribution or cancellation shall be accomplished from a designated Spotlight Administrative Displaywith the assistance of the menu display system. Distribution and cancellation shall be to any one or combination of speakers, any zone(s), or all zones. It shall be possible to provide multiple program channels at the same time.

6. It shall be possible, via a Spotlight Administrative Display, to manually initiate any of 100 tones. The tones shall be separate and distinct.

7. Each Spotlight Administrative Display shall maintain a unique queue of all stations calling that phone.

8. Provide the ability to mass update calendars across multiple servers including IP and Analog based systems.

9. Provide the system status of the various IP and analog-based systems.

10. Provide custom configurable instant access buttons to initiate alerts.

N. System programming shall be from the CH2000IP browser-based interface. All system programming data shall be stored in nonvolatile memory.

1. Diagnostics shall be built into the system and be accessible via a web browser and only by authorized personnel. Diagnostics shall show all activity with a 30-day log of all events. Logs shall be exportable for in-depth system analysis. Systems that do not provide a summary of the activity shall not be deemed equal.

2. All programming and data access shall be through an Ethernet connection. Systems that do not have a built-in Ethernet port shall not be deemed equal.

O. IP Endpoint Supervision:

1. The system shall include supervision of IP endpoints including:

a. GW2WIP1/GW2WIP2 Gateways
b. CLKMSL Messaging Displays
c. GPIO-8I-8O Integration Hubs
d. ADMIN7Administrative Consoles
e. Spotlight Administrative Display

2. The system shall attempt automatic active recovery of IP endpoints should a malfunction or error occur.

3. The system shall include the ability to alert end users via software and/or automated emails if an IP endpoint is offline.

P. Each IP system shall be capable of integrating with a minimum of 20 existing analog systems from the same manufacturer. IP system shall be capable of detecting the online status of each analog system, receiving call-ins from, and initiating all audio activity types to (intercom, page, emergency page, tone, emergency tone and music distribution) each connected analog system. IP system shall be capable of global page and tone operations encompassing all endpoints on the IP system and all endpoints on all connected analog systems.

1. Functionality includes:

a. ADMIN7 administrative consoles can be contacted anywhere in the multisystem network (IP-based systems)
b. Intercom to any IP-controlled endpoint (analog endpoints are controlled through a connected IP system)
c. Initiate critical alerts (i.e. Lockdown, Weather, Evacuate, etc.) on multiple systems automatically based on a configuredgrouping.
d. Initiate Global Page, Zone Page, Emergency Page, and Music distribution across the multisystem network.

Q. Software License:

1. All software shall be perpetual with no recurring license fees for any of the equipment provided, central equipment or endpoint devices, or for any of the future expansion equipment.

2.5 PERIPHERY EQUIPMENT & DEVICES

A. Standard constant voltage speakers for paging in hallways, communal areas, and outside paging. Groups of speakers are connected via the SS32IP. These speakers do not support intercom/talkback communication, only one-way paging.

B. Standard constant voltage speakers for intercom/talkback communication in classrooms and other areas requiring intercom with talkback. Groups of speakers are connected via the SS32IP.

1. Ceiling speakers shall be an 8-inch seamless cone type, with an additional cone mounted in the apex of the large cone to extend the high frequency response. The ceramic magnet shall weigh at least 10 ounces. The normal wattage rating shall be 15 watts with a program rating of 25 watts. The loudspeaker shall be equipped with a universal matching transformer suitable for use on a 25-volt or a 70-volt output line with taps at ¼, ½, 1, 2, or 5 watts.

a. The flush speaker baffle shall be 12-7/8 inches in diameter, and the circular design shall match the surrounding motif. It shall be constructed of 22 gauge cold-rolled steel and finished in solid white. The surface shall be coated with a baked on powdered epoxy that is highly resists to scratches and other surface blemishes. It shall be pre-drilled to accept an 8” loudspeaker. The baffle weight shall not exceed 20 ounces.
b. The speaker support truss shall be constructed of 28 gauge or heavier hot dipped non-corrosive cold rolled steel. It shall be punched to accept 8” speaker grilles if 9-1/8”, 11-1/4” or 12-1/2” in diameter. The truss shall provide attachment for 9-1/8” square enclosure. The truss shall have integral slots to accommodate torsion spring type baffles. Length of truss shall be 23-1/2” size to fit standard 24” tile

suspension grids. The speaker support truss shall have convenient holes for support wires where required for safety. The weight of the truss shall be a slight as 15 ounces with breakdown strength of over 100 pounds when suspended as in a typical T-Bar suspended ceiling.

c. The metal protective enclosure shall have four 8-32 J-Clips installed in the mounting flange. The enclosures shall have 4 combination knock-outs 1⁄2" – 3⁄4" (13mm -19mm) spaced 90° apart and shall be of one piece construction. Interior of enclosure shall be undercoated to prevent mechanical and acoustical resonances. Enclosure shall be finished in textured epoxy.

2. Wall speakers shall be an 8-inch seamless cone type, with an additional cone mounted in the apex of the large cone to extend the high frequency response. The ceramic magnet shall weigh at least 10 ounces. The normal wattage rating shall be 15 watts with a program rating of 25 watts. The loudspeaker shall be equipped with a universal matching transformer suitable for use on a 25-volt or a 70-volt output line with taps at ¼, ½, 1, 2, or 5 watts.

a. The speaker baffle shall be fabricated of ½ inch particle board, 60 pound density, overlaid with a ¼ inch photo etched, walnut grained finish. The faceplate shall slope at an angle of 15degrees with the assembly measuring be 10-12 inches high, 13-1/2 inches wide and 6-5/8 inches deep at the top and 4 inches deep at the bottom. It shall have a volume of 594 cubic inches. The assembly shall weigh 6 pounds, 4-1/2 ounces.

3. Horns shall have a continuous power rating of 15 watts. The frequency range shall be 400Hz to 14,000Hz. The trumpet shall have a screwdriver adjustable switch that can be set externally to select 15, 7.5, 3.8, 2, 1 watts on a 70 volt line or 15, 7.8, 1.8, .94, .48 watts on a 25 volt line. Available impedances shall be 5000, 2500, 1300, 666, 333, 89 and 45ohms. The sound pressure level shall be 116dB at 3.3feet on axis with 15 watts input. Sound dispersion shall be 115 degrees (-6dB, 1000Hz), 70 degrees (-6dB, 2000Hz) and 40 degrees (-6dB, 4000Hz) octave band.

a. The trumpet shall be 7-7/8 inches wide, 8-3/4 inches high and 9-5/16 inches deep. The finish shall be beige baked epoxy. External connections shall be to screw terminals. The terminal housing and transparent cover shall function together as a cable strain relief. The trumpet shall be provided with a three way adjustable mounting bracket. The assembly weight shall not exceed 4 pounds.

b. Horns should be shockproof and weatherproof.

C. Call-Station shall be a momentary normally open call-in button that provides a method to initiate a normal call-in or an emergency call-in. Call-Station shall consist of a rocker type push button mounted to a brushed stainless steel plate for durability.

D. VCall+ Software shall provide the customer with the ability to place normal or emergency calls to the administrator via the classroom PC and answer via the classroom speaker. The software must provide redundancy to the traditional wired call points and an easy to use one click interface.

E. A CareHawk model ADMIN7 IP Administrative Console(s) shall be furnished and installed to initiate intercom calls to the classroom, play tones to zones, perform and respond to emergency communications. The ADMIN7 IP shall be the control center for communications, paging, program distribution, and signaling. The ADMIN7 IP shall feature (but not limited to):

1. Priority-based call queue.
2. Two-way intercom to the classroom.
3. Broadcast pages or tones to zones.
4. HD audio on speakerphone and handset.
5. 7-inch capacitive touchscreen display.
6. Built-in Bluetooth for connecting Bluetooth headset or use the wired headset/mic jack.
7. Dual Gigabit ports.
8. Integrated PoE.
9. Stand with two adjustable angles of 40 and 50 degrees.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions with the installer present for compliance with requirements and other conditions affecting the performance of the Integrated Telecommunications/Time/Audio/Media System.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Installation shall conform to local electrical requirements and be sized and installed in accordance with the manufacturer’s approved shop drawings.

B. Low-voltage wiring may be run exposed above ceiling areas where easily accessible but must be installed and supported in compliance with current codes and standards.

C. All Administrative Consoles shall be desk- or counter-mounted.

1. Verify the exact location with the Architect.

D. System Configuration:

1. All configuration parameters need to be gathered from the facility administration for the system configuration.

3.3 GROUNDING

A. Provide equipment grounding connections for Integrated Telecommunications/Time/Audio/Media System as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to ensure permanent and effective grounds.

B. Ground equipment, conductor, and cable shields to eliminate shock hazards and to minimize to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.

C. Provide all necessary transient protection on the AC power feed and all audio lines leaving or entering the building.

D. Note in the drawing the type and locations of these protection devices as well as all wiring information.

E. Furnish and install a dedicated, isolated earth ground from the central equipment rack and bond to the incoming electrical service ground bus bar.

PART 4 - EXECUTION

4.1 DIVISION OF WORK

A. While all work included under this specification is the complete responsibility of the contractor, the following division of actual work listed shall occur.

1. The conduit, outlets, terminal cabinets, etc., which form part of the rough-in work shall be furnished and installed completely by the electrical contractor. The balance of the system, including installation of speakers and equipment, making all connections, etc., shall be performed by the manufacturer's authorized representative. The entire responsibility of the system, its operation, function, testing, and complete maintenance for one year after final acceptance of the project by the owner shall also be the responsibility of the manufacturer's authorized representative.

4.2 EQUIPMENT MANUFACTURER'S REPRESENTATIVE

A. All work described herein to be done by the manufacturer's authorized representative shall be provided by a documented factory-authorized representative of the basic line of equipment to be used.

B. The manufacturer's representative shall provide a letter with submittals from the manufacturer of all major equipment stating that the manufacturer's representative is an authorized distributor. This letter shall also state that the manufacturer guarantees service performance for the life of the equipment and that there will always be an authorized distributor assigned to service the area in which the system has been installed.

C. The contractor shall furnish a letter from the manufacturer of the equipment that certifies that the equipment has been installed according to factory-intended practices, that all the components used in the system are compatible, and that all new portions of the systems are operating satisfactorily.

4.3 INSTALLATION

A. Plug disconnect: All major equipment components shall be fully pluggable using multi-pin receptacles and matching plugs to provide ease of maintenance and service.

B. Protection of cables: Cables within terminal cabinets, equipment racks, etc.

C. Cable identification: Cable conductors shall be color-coded, and each cable shall be individually identified. Each cable identification shall have a unique number located about 1 1/2" from the cable connections at both ends. Numbers shall be approximately 1/4" in height. These unique numbers shall appear on the As-Built Drawings.

D. Instructions: Provide complete "in service" instructions of system operation to school personnel.

4.4 DOCUMENTATION

A. Provide the following directly to the Supervisor of Technology Service:

1. A printed copy of all field programming for all system components

2. One copy of all diagnostic software with a copy of field program for each unit

3. One copy of all service manuals, parts list, and internal wiring diagrams of each system component

4. One copy of all field wiring runs, location, and end designation of the system

END OF SECTION 275113

SECTION 275313 CLOCK SYSTEMS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

B. Include FCC registrations and any other fees and licenses for not less than 10 years.

1.2 SECTION INCLUDES

A. Clock system requirements.

B. Wireless clock systems and associated components:

1. Master clock unit.

2. Wireless secondary indicating clocks.

C. Accessories.

1.3 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices current edition.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.

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

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of clocks with potential conflicts and/or view obstructions installed under other sections or by others.

2. Coordinate the work with other installers to provide power for clocks and equipment atrequired locations.

3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each system component. Include ratings, configurations, standard wiring diagrams, dimensions, finishes, service condition requirements, and installed features.

B. Maintenance contracts, if applicable.

C. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

a. Dutchess Tel-Audio, Inc. 10 Steele Rd. New Windsor, NY (845) 462-1700.

D. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

E. Project Record Documents: Record actual locations of system components and installed wiring arrangements and routing.

F. Software: One copy of software, if applicable.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70.

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

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company with minimum three years documented experience with similar clock systems and providing contract maintenance service as a regular part of their business; manufacturer's authorized installer.

1. Contract maintenance office located within 25 miles of project site.

E. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.7 DELIVERY, STORAGE, AND HANDLING

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

B. Store products in manufacturer's unopened packaging, keep dry and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 CLOCK SYSTEM REQUIREMENTS

A. Provide new wireless clock system consisting of all required equipment, battery powered clocks, transmitter(s), hardware, accessories, software, system programming, etc. as necessary for a complete operating wireless system that provides the functional intent indicated.

B. Interface with Other Systems:

1. Provide products compatible with other systems requiring interface with clock system, if required.

C. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.

2.2 WIRELESS CLOCK SYSTEMS

A. Manufacturers:

1. Wireless Clock System:

a. Primex 72MHz OneVue™ Sync Wireless Clock System https://www.primexinc.com/en/

1) Broadcast at 72 MHz/FCC-licensed frequency.
2) Compatible with existing Newburgh ECSD district wide 72mhz FCC license.

b. Acceptable product, approved as equal.

2. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer.

3. Source Limitations: Furnish system components and accessories produced by a single manufacturer and obtained from a single supplier.

B. Master Clock Unit:

1. Description: Microprocessor-based controller and associated accessories for maintaining time reference and correcting connected wireless secondary indicating clocks.

   a. Product(s):

      1) Primex, Sync OneVue Transmitter 1 Watt with NTP capability (with GPS)
      2) Primex, Sync Transmitter Accessory Pack - Transmitter Rack and UPS.

2. Acceptable Time Reference Source(s): Based on Network Time Protocol (NTP) server time data obtained via local area network (LAN).

   a. Optional GPS antenna time source.

3. Wireless Time Correction Signal Transmitter/Antenna: Compatible with wireless secondary clocks.

4. Master Clock and Repeater Placement:

   a. Installation location to be reviewed by manufacture.

      1) Prior to installation, Primex to confirm the proper location of the transmitter and repeater to ensure facility wide time correction signal coverage.

5. Features:

   a. Battery backup for timekeeping and settings; rated for 10 years.
   b. Supports security access control for system programming functions.
   c. Supports remote interface via web browser or software.
   d. Supports automatic daylight savings time adjustment.

C. Analog Wireless Secondary Indicating Clocks:

1. Power Source: Two (2) D cell batteries, to be included.

2. Time Reference Source: Synchronized with master clock unit wireless time correction signal.

3. Clock Movements: Microprocessor-controlled.

4. Clock Face:

   a. Shape: Round.

   b. Size: 12inch and 16inch nominal.

   c. Color: White face with black numerals and markings, unless otherwise indicated or approved by Architect.

   d. Hands: For indicating hour, minute, and second.

5. Clock Crystal/Lens: Shatter-resistant plastic.

6. Case Material/Color/Finish: Black.

7. Mounting:

   a. Single-Face Clocks: Surface mount.
   b. Double-Face Clocks: Dual Clock 12.5” Mounting Kit.

8. Product(s):

   a. Primex Sync 72Mhz Analog Clock, 12.5” Black.
   b. Primex Sync 72Mhz Analog Clock, 16” Black.
   c. Primex Sync 12.5” Dual Mounting Kit.

D. Provide components as indicated or as required for extension of wireless time correction signal between master clock unit and wireless secondary indicating clocks.

1. Product(s):

   a. Wireless Repeater: Primex, Sync OneVue Transceiver 1 Watt Repeater.

2.3 ACCESSORIES

A. Provide components and wiring as indicated or as required for connection to auxiliary devices and other systems indicated.

1. Product(s):

   a. 100’ GPS Extension Cable for Sync OneVue Transmitter.

B. Auxiliary Devices:

1. Product(s):

a. Tone/Audio Generator to existing pa system, if required.

C. Protective Covers/Guards for Clocks: Where indicated.

1. Product(s):

a. Primex Sync 18”x18” Analog Wire Guard (for 12.5” and 16” clocks).

D. Racks/Cabinets: Provide as indicated or as required for equipment mounting.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that characteristics of system components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive system components.

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

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

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

C. All installations shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.

D. Provide on 20 ampere, 120 volt power circuit to the master clock and program controller; provide 20A – 1P circuit breaker at panelboard and identify on panel directory.

A. All surface mounted devices shall be mounted on a special box furnished by clock equipment manufacturer. Total assembly shall be secure, smooth contour and have no protrusions.

3.3 FIELD QUALITY CONTROL

A. Prepare and start system in accordance with manufacturer's instructions.

B. Program system parameters according to requirements of Owner.

C. Test for proper interface with other systems.

D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.

3. Location: At project site.

3.6 PROTECTION

A. Protect installed system components from subsequent construction operations.

3.7 MAINTENANCE

A. Vendor to provide an initial quantity of spare clocks, see SPARES 3.08.

B. Provide trouble call-back service upon notification by Owner:

1. Vendor to provide first year warranty support during normal working hours at no extra cost to Owner.

2. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on then current prevailing product and service rates.

3. Post warranty support will be provided to the Owner at then current prevailing product and service rates.

3.8 SPARES

A. Analog clock spares, provide 5% of each model (12.5” and 16”).

END OF SECTION 275313

SECTION 281300 - DOOR ACCESS/CONTROL SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for the complete installation and related Work as required in Contract Documents.

1.2 GENERAL DESCRIPTION

A. The card reading system shall match the district’s existing system at other buildings or be of equal design and make..

B. The systems shall include all programming wiring, connections and accessories to provide card access and alarms for the doors indicating utilizing the District’s standard employee identification card.

C. The system shall be listed with UL for power limited circuit use, shall monitor the integrity of all alarm initiating circuits, and shall be provided with automatically charged standby batteries.

D. Location of the control panel, alarm initiating devices, alarm indicating devices shall be as shown on plans:

1. System Operation:

a. The systems shall report to the existing head end. Include all connections programming and accessories to allow communication, control and documentation.

1.3 SHOP DRAWINGS

A. Shop drawings for systems provided under this section of the specification shall contain, but not be limited to the following:

1. Specification data sheets on each individual system component.

2. Wiring diagrams indicating all system components, number and size required conductors, interconnecting components and conduit size required to house conductors.

B. Wiring diagrams shall be point-to-point wiring diagrams prepared for this project. Typical wiring diagrams will not be accepted.

PART 2 - PRODUCTS

2.1 CONTROL PANEL

A. Each panel shall have the following features:

1. Three (3) serial RS485 ports.

2. Full, operational battery backup for six (6) hours.

3. Memory backup for thirty (30) days.

4. Remote I/O board with separate battery backup.

2.2 DOOR CONTROL

A. Each door controlled shall have the following:

1. Proximitycard reader.

2. Request to exit sensor.

3. Door status switch.

4. Electric door strike.

5. Fire alarm system interface (unlock upon signal from fire alarm system).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all equipment, wiring, conduit, and outlet boxes required for the installation of a complete and operating system in accordance with applicable local, state and national codes, the manufacturer's recommendations, these plans and specifications. All circuits not in conduit shall be wired with UL listed power limited cable under NEC 725 Class II wiring. Plenum cable shall be utilized in all return air plenum ceilings. All other types of wiring must be in a separate conduit system. Color coded wires shall be used through out. Wiring shall conform to the National Electrical Code Article 725.

B. The manufacturer's authorized representative shall provide supervision of final system panel connections, perform a complete functional test of the system and submit a written report to the Contractor attesting to the proper operation of the system. He shall also provide four (4) hours of training for the districts personnel.

C. All equipment and wiring shall be guaranteed against defects in materials and workmanship for a one (1) year period from the start-up and the beneficial use of the system. Warranty service for the equipment shall be provided by the system supplier's factory-trained representative.

END OF SECTION 281300

SECTION 281301 - AUDIO/VISUAL ENTRY SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Work of this section shall be performed in accordance with the requirements of the Contract Documents, including but not limited to Instruction to Bidders, Agreement and General Conditions, Supplementary General Conditions, General Requirements and Basic Mechanical/Electrical Requirements.

B. Provide labor materials, equipment and services to perform work and related work required by Contract Documents for a complete operating system.

1.2 SUBMITTALS

A. Submit manufacturer's data for approval in accordance with Basic Mechanical/Electrical Requirements and Section 013300, "Submittals". Obtain approval prior to ordering materials.

B. Provide submittals for entire system including, but not limited to:

1. All items required, including relays and cable types.

2. Submit outline drawing of system control cabinets showing relative positions of major components.

3. Submit wiring diagrams showing typical connections for equipment.

4. Audio/Video Control Consoles.

5. Audio/Video Door Stations.

6. High Impedance Circuit Adapter.

7. Electric Door Strike.

8. Miscellaneous Equipment.

1.3 STANDARDS AND TEST

A. Equipment and material covered by these Specifications shall be designed, manufactured, assembled, and tested in accordance with the latest revisions of applicable published ANSI, NEMA, and IEEE Standards, and requirements of UL and NEC.

1.4 GENERAL REQUIREMENTS

A. Equipment furnished under this Specification shall be the standard product of one manufacturer having at least ten (10) years experience in this field.

B. Equipment shall be designed by the manufacturer to operate as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing interconnections.

C. Equipment shall meet or exceed the manufacturer's published specifications.

D. Equipment shall be solid state design.

E. Manufacturer must make available to the Owner, within a 75 mile radius and 48 hour period, a local service department of a duly authorized distributor which is to stock the manufacturer's standard parts.

F. On-the-premises maintenance is to be provided during normal working hours at no cost to the purchaser for a period of twelve (12) months from the date of acceptance by the Owner of the system unless damage is caused by misuse, abuse, or accident.

G. On-the-premises service furnished at other than normal working hours must also be available and may be charged for by the manufacturer's distributor at current labor rates.

1.5 DESCRIPTION OF SYSTEM

A. Provide separate audible call-in annunciation from each audio-video (AV) door station to AV control console. Annunciation shall prompt video signal from particular AV door station unless AV control console is in communication with another AV door station.

B. Provide separate one-way video signal from each door station to AV control console.

C. Provide separate two-way audio signal from each AV door station to AV control console. Provide console initiated communication from AV control console to AV door stations to maintain console privacy.

D. Provide separate remote door release for each monitored room from control console. Remote door release shall only operate particular AV door station in which AV control console communication is selected.

E. Provide AV console controls to select desired AV door station, and operate AV door station features.

F. Provide vandal resistant and weatherproof enclosures to protect exterior portions of system.

PART 2 - PRODUCTS

2.1 AUDIO/VISUAL CONTROL CONSOLES

A. Wall mounted door station with integral speaker and camera for two (2) way communication.

B. Software integration into desktop computer station in reception office.

C. Features and functions outlined in system description.

D. Communication and control capacities:

1. Two (2) AV door stations.
2. Two (2) door releases.
3. Integration into desktop computer station.

E. Additional Features:

1. Speaker phone with chime tone and volume control.

2. LED visual indicator.

3. System reset and system impedance controls.

4. AV door station selection control.

5. AV door station pan-tilt video control.

6. Door release control.

7. Dual door release module for selecting door release control between two doors.

F. Power Supply:

1. Power Over Ethernet (PoE) supply.
2. Circuit protection with reset.

G. Acceptable Manufacturers:

1. AIPHONE IX series or manufacturer to match districts existing systems at other buildings (confirm manufacturer and model with district).
2. Approved equal.

2.2 AUDIO-VIDEO DOOR STATIONS

A. Flush mounted metal unit with:

1. Polycarbonate camera shield.
2. High impact call button.
3. Stainless steel surface mount box.
4. Weatherproof.

B. Rigid anodized aluminum cover.

C. Vandal resistant enclosure.

D. Video:

1. 1/3” CMOS 1.23 Megapixel
2. 5 Lux illumination
3. -40ºF-140ºF operating temperature.

E. Video Mount:

1. Integral within AV door station.
2. Adjustable field of view 6 ft. - 0 in.W x 3 ft. - 0 in. H at 1 foot.

F. Audio:

1. Speaker-microphone.
2. Integral with AV door station.

G. Acceptable Manufacturer:

1. Airphone IX DVF or manufacturer to match districts existing systems at other buildings (confirm manufacturer and model with district).
2. Approved equal.

2.3 ELECTRIC DOOR STRIKE

A. Electrical activation shall react strike jaw, releasing latch-bolt so door can be opened without operating the latch itself.

B. When the door strike is in the located position, it shall be possible to gain access to the building through use of mechanical key lock.

C. Rated for use with conventional mortise latch locks, cylindrical locks, unit locks and mortise panic exit devices.

D. Capable of being continuously energized with silent operation.

E. 24 volt AC with remote mounted individually enclosed step-down transformer with in-line fusing.

F. Verify electric strike is compatible with existing door frame and hardware prior to pricing.

G. Acceptable Manufacturers:

1. Adams Rite.
2. Folger Adams.
3. Approved equal.

2.4 MISCELLANEOUS EQUIPMENT

A. Control Console Conduit Access Box:

1. Size as required to house adapters, relays and power supplies; minimum 18 in. x 18 in.

2. 4 in. deep flush-mounted box with split cover.

3. One part of box shall have bushed holes for cable.

PART 3 - EXECUTION

3.1 INSTALLATION, EQUIPMENT

A. Install and test in accordance with requirements listed in Section 270510, "Communications General" of these specifications.

B. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work.

C. Mount power supplies, adapters, relays etc. inside conduit access box.

D. Provide three (3) sets of keys for all panels, stations and devices, and turn over to Owner's Representative; obtain receipt.

3.2 WIRING

A. Install all wiring conduit unless noted otherwise.

B. Where open wiring is permitted in open ceilings and above corridors where lift out ceiling tiles provide access after completion of the buildings (refer to 270510), provide conduit runouts from all outlets into accessible ceiling. Provide bushings on all conduit ends. Support wiring closely to structural members, using bridle rings spaced not more than 4 ft. apart. Cable laid on ceiling panels is not acceptable. Support cable from building structure as required by NEC. Provide cable, UL listed for plenum use where cable is installed in air plenums, and UL listed for riser plenum or use for cables used in risers.

C. After the system has been completely tested, neatly bundle the cables with either nylon lacing cord or nylon cable clamping devices similar to Thomas & Betts "Ty-Rap". More than one cable bundle may be used if one would be too large to be workable. Provide sufficient loop in the cable bundle to allow moving equipment for servicing. Cabling within the access box shall similarly be bundled, and routed in such a manner as to permit easy access to internal equipment and connections.

D. Wiring shall be in accordance with the recommendations of the system manufacturer.

E. Maintain minimum 20 in. separation between cable runs and any AC power to prevent interference.

F. Where equipment has a pullout feature, provide sufficient loop of cable to prevent binding.

G. All wiring shall be copper.

H. Minimum #18 AWG shielded for AV door station circuits, larger as recommended by equipment supplier. Each AV door station shall be circuited individually back to each AV control console location. If distance id greater than 330 feet, provide high impedance adapters to extend circuits up to 980 feet.

I. Provide a 120 volt, 20 ampere circuit in 1/2 in. raceway to AV control console power supply and to door strike remote transformer.

J. All 120 volt wiring shall be installed in separate conduit.

K. Ground AV control console conduit access boxes using #12 AWG insulated conductor run in conduit to the building water service or building steel or ground rod.

3.3 WALL MOUNTED EQUIPMENT

A. Modify wall for surface mounting.

B. Provide suitable back box and hardware.

C. Provide cutting, patching and painting to match existing surface.

D. Provide equipment.

3.4 ELECTRIC DOOR STRIKE

A. Remove existing latch hardware. Modify existing door frame.

B. Provide electric door strike.

C. Provide branch circuiting inside door frame.

D. Coordinate with other trades.

E. Verify compatibility with existing door frame and hardware prior to pricing.

3.5 MANUFACTURER'S SERVICE REPRESENTATIVE

A. Provide services of an authorized representative of the manufacturer to supervise the installation in order to insure a complete operating and trouble-free system.

3.6 TESTING

A. Submit a written test report from an authorized service representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner and shall be performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to request for final payment.

B. Provide at least one half day of instruction to the Owner for use and operation system.

END OF SECTION 281301

SECTION 281600 - INTRUSION DETECTION SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide all labor, materials and equipment and services to perform operations required for the complete installation and related work as required in Contract Documents.

1.2 GENERAL DESCRIPTION

A. Provide all equipment, accessories, programming, etc. for a complete electrically supervised intrusion detection system as described herein and as shown on the Contract Documents. Overall system engineering, layout and equipment installation shall be provided by an authorized representative of the equipment manufacturer. These specifications and associated drawings are intended to be used as a guideline.

B. Equipment and accessories furnished under the terms of this Specification shall be the standard products of a single manufacturer where possible. The names of manufacturers and attendant model numbers are given to establish a standard of quality and performance.

C. The main control panel shall be a microprocessor-based universal burglar, fire, hold-up supervisory control digital communicator.

D. The systems shall be approved by Factory Mutual, and shall be UL listed as follows:

E. NFPA 71 Central Station Signaling Systems.

F. NFPA 72 National Fire Alarm Code.

1.3 SYSTEM DESCRIPTION

A. Actuation of any intrusion detection alarm initiating device shall cause the following to happen:

1. Annunciation shall take place at the command center and the remote receiver located in the main office via modem if so programmed.

2. The alarm shall be tied into the districts existing security system and talk to the existing command center for the district.

3. The attendant shall manually reset the system at the conclusion of an alarm condition.

4. The command center shall provide the following functions:

    a. Audible alarm silencing
    b. Trouble buzzer silencing
    c. System test

d. Ability to view 500-event memory.

B. All initiating, signal and annunciator circuits shall be supervised.

C. Power supply shall be 120 volts, 60 Hz. 12 volt DC power for all system supervisory and control functions shall be provided by the control panel master power supply. Provide auxiliary power supplies and wiring for all sensing devices, alarm horns, etc., as required for a complete, operating system.

D. Standby power shall be furnished for 4 hours of system supervisory functions followed by 10 minutes of system control functions by 12 volt DC batteries with automatic charger. Provide uninterruptible power supply (UPS) for input voltage for a minimum 15 minute ride-through of loss of utility power to allow for short duration power interruptions. Locate at IDCP1.

E. Provide communications link via modem to the district's existingcentral alarm CPU such that the existing central alarm CPU displays the individual point designation and type on the CRT until the alarm condition has been corrected. The central alarm CPU shall print the assigned message with the date and time for the particular point.

1. Provide programming of central alarm CPU so that the alarms and trouble conditions are annunciated by printout and visual display on the existing printer and CRT's. Refer to contract documents for zoning. Provide zone descriptions as directed by Owner.

1.4 SUBMITTALS

A. Complete equipment list including quantities. Catalog descriptive literature for all equipment. Riser Wiring Diagram showing all devices, wire quantities and sizes. Typical Terminal Wiring Diagrams for each type of device. Terminal Wiring Diagram for the control panel. Calculations, including actual equipment loads used to derive battery backup ampere-hour rating. Submittals that fail to comply with the requirements described will be rejected.

PART 2 - PRODUCTS

2.1 INTRUSION DETECTION CONTROL PANEL

A. Control panel shall be microprocessor-based universal burglar, fire, hold-up supervisory control digital communicator, UL listed for commercial fire alarm and burglar alarm application, and shall be FM approved. The control panel shall comply with the applicable NFPA Standards (NFPA 71 and/or NFPA 72).

B. The control panel shall have an integral modem for remote accessibility for the purposes of programming, diagnostics and remote control of functions. The unit shall come equipped with a minimum of eight (8) protective zones and shall have a 1.4-AMP power output capability for alarm signals. Provide additional power supplies as required for additional capacity.

C. The control panel shall also provide a minimum of 1-AMP power for auxiliary devices, real-time clock and test timer, battery charging circuit, on-board diagnostic LED's, automatic resetting circuit breakers, a transformer cover, and RFI protection.

1. Programmable features shall include the capability to independently control zones through separate area keypads, and the ability for one panel-wide keypad to have control over the entire system, four telephone number dial up for primary and secondary remote receivers, automatic test reports, selective zone shunting, and custom text on the associated command centers. System shall provide 14 authority levels designating the authorization levels of the areas. Forty-nine (49) user passcodes shall be available to identify the user while alarming and disarming. The system shall also have the ability to add, change or delete user passcodes. The panel shall have the capability of creating a software "mask" by the user with a maximum of 32 keystrokes, providing a program which can be enabled with two keystrokes. The user shall have the ability to view arm/disarm status of other areas on the panel-wide command center. The area-wide command centers shall have the capability to provide custom arm and disarm text to allow user-defined identification of location.

2. Zone expansion: The eight programmable areas of the control panel shall be expanded to up to 134 individually annunciated points of protection through the addition of a two-wire multiplex zone expansion system. Points of protection shall be annunciated with custom text at the command centers and shall be reported to the district’s existingreceiver via modem.

3. Fire Test Mode: The fire test mode shall suppress reports to the central station while fire tests are conducted. The fire test mode shall be activated by entering a code at the command center. When the fire test mode is initiated, the panel shall send a signal to the central station to indicate the beginning of the test. Test events than become "local only" events. Each time a device initiates an alarm, the indicating appliances shall sound briefly. The automatic sensor reset feature of the fire test mode shall allow the inspector to continue testing additional devices without time consuming trips to manually reset the sensor.

4. After the automatic sensor resets, the command center shall display the number of alarms which have been initiated since testing began. When the test is completed, a signal indicating the completion of the test shall be sent to the central station. Tripping each master zone shall then transmit each point to the central station in one call of recording and documentation (accelerated test and verification).

5. Logger: Events programmed for transmission to the central station shall be stored in the control panel's memory (up to 500 events). The panel shall remember the time, date, event, account number, point number, user ID and point text. Events which are shored shall include: alarms, restorals, troubles and openings and closing by user. Another programming option shall allow the logger to record certain functions entered at command centers. The 500 events in memory shall be retrievable with a remote programmer or through the keypad.

6. Skeds: The control panel shall be controlled by an internal clock which remembers time and date. Each control panel shall operate up to 17 individual skeds (scheduled events). Each sked shall be programmed to do any one of over 100 different functions, such as arm/disarm, relay control, point bypassing, etc. Each sked shall be programmed for time and either a day of the week schedule (i.e. Monday, Tuesday, etc.) or a date of the year schedule (i.e. July 4, December 25, etc.). A sked shall be programmed so that it repeats automatically. The user shall be able to change the time for a sked if the sked is programmed for user time editing.

7. A service reminder function shall re-sound and annunciate existing trouble conditions daily until silenced at the command center. The sked shall cause the command center to re-sound daily until the trouble condition is corrected.

8. User Pass Codes: Ninety-nine (99) user pass codes shall be available to identify the User when arming/disarming the System. The system shall have the ability to limit use of a valid passcode to specific days and times on a weekly schedule.

9. Report Groups: The control panel shall sort events into one of 12 report groups: fire alarm, fire trouble, non-fire alarm trouble, open/close, test report, diagnostic, relays, skeds, RAM, phone/power supervision, and service. The control panel shall be programmable to route reports from each group tone or more of four receiver phone numbers. Phone numbers shall be selectable as to primary and backup for the report group. Each master zone represents a protective circuit and shall accommodate normally opened and close devices with end-of-line resistor supervision.

10. Each of the eight master zones are programmable as to whether they are controlled versus 24 hours; interior versus perimeter; instant versus delayed; silent versus audible (and if audible, pulsed or steady) and local or reporting.

11. Additional programmable parameters for each master zone shall include the ability to suppress trouble or restoral reports, designate it as a priority zone (system cannot be armed if this zone is off-normal), report two separate telephone numbers and provide for automatic shunting of master zone from the system in the event that the detection device malfunctions and creates numerous false alarms. Each master zone shall be dividable into 16 points of identification (except for zone 8, which can only be subdivided into 14 points of identification) by utilizing Point-of-Protection-Interface-Transponders (POPITs). Each POPIT shall accommodate normally opened and normal closed devices with end-of-line resistor supervisor.

12. Refer to Contract Documents for system layout.

D. Entry/Exit Delays:

1. Shall be independently programmable from 10 to 600 seconds. A pre-warn audible shall be coincident with the entry delay. During exit delays, <u>instant burglary</u> zones shall be defaulted <u>first</u>; <u>instant</u> burglary zones shall have the ability to be converted to <u>delay</u> zones.

E. Programming:

1. Programming of all system functions shall be achievable at system site or remotely via the use of the dial-up telephone network. Minimum programmable functions shall include: user pass codes, entry/exit delays times, master zone personality, day/date/time, telephone numbers, point of protection text labels, and bell time. A programmable system pass code shall be used to prevent unauthorized remote programming attempts. Remote programming capacity shall be automatic or require user enabling at the discretion of the user. Provide all programming required, including that of the district's existing receiver, as required for a complete operating system.

F. Remote Control:

1. Via the use of remote programming on the dial-up telephone network shall include: System arming, reset of audible signals, activation/deactivation of eight relay contacts, interrogation of battery, zone and armed status and enable/disable of reporting functions and removing reporting devices for servicing while the remainder of the system is operative.

G. Recognitions:

1. Fire: Underwriters Laboratories: NFPA 71 Central Station, NFPA 72 Chapter 6 Local, NFPA 72 Chapter 8 Remote Station, NFPA 74, Household Fire Warning.

2. Burglary: Underwriters Laboratories: Central Station, Local, Police contact and Household Systems.

H. Miscellaneous Built-in Features:

1. Shall include: A real-time clock, interrogator, auto-answer modem phone line monitor, loop start/ground start telephone interface, auto bell test, plug-in terminal strips and user controlled zone bypass. The system shall have the ability to bypass a single point in the system, and shall have a swinger shunt capability where multiple troubles or alarms may be shunted after four alarms.

I. Modules and Accessories:

1. Provide all modules and accessories required to perform the specified functions.

J. Make: Shall be compatible with the owner's existing intrusion monitoring system.

2.2 COMMAND CENTER

A. Shall be microprocessor-based, UL listed, with built-in 16 character alpha-numeric display, burglary and fire sounders, backlighted 15-key touchpad, and pre-warn tone. The Command Center shall display in English language, system status, area status, and point status (custom text). Arm/disarm status: System diagnostics; time/day/date; and user prompts. Additional features shall include local system test, sensor reset, panic and/or medical and/or duress alarm initiation, independent master zone bypass with automatic restoral to a normal status to next system arming, perimeter watch mode, user changeable pass codes, remote programming initiation and system/monitoring service test. Provide panel-wide and area-wide command centers as indicated on the drawings.

B. Make: Shall be compatible with the district's existing intrusion monitoring system.

2.3 SUB-ZONE CONTROL

A. Shall allow a single zone of the Intrusion Detection Control Panel to be armed and disarmed separately from the rest of the system. It shall incorporate a user-programmable passcode for arming and disarming, and built-in panic buttons. Entry and exit delay times shall allow it to be located inside the protected area. Unit shall provide individual annunciation of delayed and instant loops, and shall provide a form C relay output upon alarm. Keypad shall backlight when any key is pressed, and shall be mounted in a low-profile surface-mount enclosure.

B. Make: Shall be compatible with the district's existing intrusion monitoring system.

2.4 POINT OF PROTECTION INTERFACE TRANSPONDER

A. Provide Point of Protection Interface Transponders (POPITS) and Point of Protection Expansion modules (POPEX) as required to provide the specified functions. One POPEX module shall supervise up to 63 POPIT modules. Over one two-conductor one expansion loop, up to 63 POPITs shall communicate back to the Control Panel with the POPEX module. Each POPIT shall have it's own sensor loop which may monitor normally open and/or normally closed detection devices. POPIT sensor loops shall be supervised. The POPIT shall communicate it's sensor loop status indicating open circuit, short circuit, normal circuit and other system conditions. A DIP switch on each POPIT shall be used to assign the POPIT to a master zone of the Control Panel.

B. Make: Shall be compatible with the district's existing intrusion monitoring system.

2.5 MISCELLANEOUS DEVICES

A. Provide initiation circuit modules, bell circuit supervision modules, transformer enclosures, attack resistant enclosures, release modules, and other devices required to provided specified functions and meet the requirements of Underwriters Laboratories and referenced NFPA publications.

2.6 SENSING DEVICES

A. Type 1 shall be a low profile ceiling mount Passive Infrared Intrusion Detector which shall use alternate polarity pulse count technology. Unit shall incorporate a pointable fresnel lens to provide coverage of 360° by 24 ft. (when mounted at 12 ft.). Unit shall be semi-flush mounted directly on ceiling or octagonal electrical box. Alarm output shall be field selectable form "A" to "B" reed relay. Unit shall incorporate form "A" cover activated tamper switch with separate terminals, and radio frequency interference immunity. Make: Detection Systems DS936 or approved equivalent.

B. Type 2 shall be a microprocessor-based Dual Technology Passive Infrared/Microwave Intrusion Detector which shall use passive infrared and microwave technologies to provide an alarm condition upon simultaneous activation of both fields of protection. Unit shall provide barrier coverage of 50 ft. x 6 ft. Unit shall be surface or bracket mounted. Alarm output shall be form "A" reed relay, and shall incorporate form "A" normally closed tamper switch, and radio frequency interference immunity. Make: Detection Systems DS707 Barrier Coverage or approved equivalent.

C. Type 3 shall be similar to type 2, above, except providing broad coverage of 30 ft. x 35 ft. Make: Detection Systems DS706 Broad Coverage or approved equivalent.

2.7 MAGNETIC DOOR CONTACTS

A. Type 1 shall be a nominal 3/4 in. diameter concealed magnetic contact intended primarily for use in steel doors. Both switch and magnet shall be isolated from surrounding steel. Contacts shall be plated to prevent sticking and cold welding and to ensure reliability. Contacts shall be SPDT rated 3 watts maximum at 28VDC. Make: Sentrol Model No. 1076CW or approved equivalent:

B. Type 2 shall be overhead door type for mounting at top of door. Contacts shall be SPDT, and a range of gap distances shall be provided. Switch and magnet case shall be enclosed in an aluminum housing. Wiring shall be enclosed in armored cable. Make: Sentrol Model No. 2507A or approved equivalent.

C. Type 3 shall be the same as Type 2, above, except installed on exterior hinged doors with heavy steel frames. Make: Sentrol Model No. 2507A or approved equivalent.

2.8 SEISMIC SHOCK SENSOR

A. Sensor shall include a highly accurate piezoceramic microphone, electronic processing circuitry, and an alarm output stage. Each signal shall be classified to three criteria: amplitude, frequency and duration. Sensor shall be insensitive to environmental interference, UL listed, and shall be tamperproof. Unit shall permanently mount on safe and have a minimum 10 ft. radius coverage. Make: Arrowhead S3800 Series or approved equivalent.

2.9 SAFE DOOR CONTACT

A. Contact shall be the same as Type 3 magnetic door contact as specified above.

2.10 VAULT DOOR THERMOSTAT

A. Provide a heat detector that will alarm to indicate forced entry into a safe door when a torch or similar device is used. A stainless steel shell shall conduct heat to the thermal element which is hermetically sealed and mounts off the shell. The shell shall contain a terminal board for wiring and shall mount to the baseplate by two screws. The baseplate shall fasten to the ceiling of the safe. If the ambient air reaches 140°F, normally closed contacts will open, causing an alarm. When the temperature falls below 140°F, the contacts shall close. Make: Mosler Model VT-3 or approved equivalent.

2.11 AUTOMATED TELLER MACHINE TAMPER ALARM

A. Provide POPIT and connection to tamper alarm contacts furnished with Automated Teller Machine (ATM). Provide connections to all ATM internal tamper alarms and connect to monitor all points on one POPIT.

2.12 ALARM HORN/BEACON

A. Alarm horn/beacon shall be a horn and beacon combination and shall meet the requirements of UL 681. Provide auxiliary power supply as required for proper horn and strobe function. The horn portion shall be s self-contained two channel (yelp and steady) siren/speaker in housing. 6-13.8 VDC operation. Up to 106dB output at 10 ft. UL listed. Make: Aritech MPI-36 or approved equivalent. The beacon portion shall be 6 watt Xenon strobe providing an effective intensity of 120 candela. Flush mounted. UL listed. 75 flashes per minute. Make: Whelen VSA Series or approved equivalent. Submit proposed mounting arrangement for approval.

B. Building exterior alarm horn/beacon shall be a horn and beacon combination and shall meet the requirements of UL 681. Provide auxiliary power supply as required for proper horn and strobe function. The horn portion shall be a heavy-duty industrial, tone-selectable, stand-alone signaling device capable of producing volume-controlled, high-decibel tones, and shall use a microprocessor circuit to create 13 distinctive tones. Unit shall be fully enclosed, weatherproof design, 24 VDC. Tone shall be selectable by Owner. Make: Edwards Cat. No. 5530D-GR or approved equivalent. The beacon portion shall be a rotating signal providing maximum brilliance through the use of a parabolic reflector. Weatherproof construction, amber lens, 24 VDC. Make: Edwards 53A-G1 or approved equivalent. Submit proposed mounting arrangement for approval.

2.13 REFRIGERATION EQUIPMENT COMMON ALARM CONTACT

A. Provide POPIT and connection to refrigeration equipment common alarm contact furnished by building HVAC Contractor.

2.14 EMERGENCY GENERATOR STATUS ALARMS

A. Provide POPITS and connection to generator derangement signal contacts furnished with generator controls. EG1 is for Emergency Generator Running, and EG2 is for Emergency Generator Testing.

2.15 ELECTRIC SERVICE PHASE FAILURE CONTACT

A. Provide POPIT and connection to building electric service phase failure alarm contacts furnished with electric switchgear.

2.16 ACCESS CONTROL SYSTEM EMERGENCY DOOR RELEASE PUSHBUTTON

A. Provide POPIT and connection to dry contacts on pushbutton furnished under Specification Section 17728.

PART 3 - EXECUTION

3.1 INSTALLATION - EQUIPMENT

A. Installation shall be accomplished in a professional manner by qualified personnel regularly engaged in and experienced in this type of work. Installation shall conform to UL and FM requirements, and shall be in strict accordance with manufacturer's installation manuals.

B. Install all wiring in accordance with manufacturer's recommendations. No ground loops can be tolerated. Ground only at one point as recommended by equipment manufacturer. Safes will be predrilled for wiring entrances.

C. All wiring shall be stranded copper and installed as a separate and segregated system. No "tee-taps" are allowed.

D. Minimum #18 AWG for initiating circuits, larger as recommended by equipment supplier. Minimum #14 AWG for signaling circuits. Utilize twisted shielded pair cables where recommended by equipment manufacturer.

E. Arrange for a 120 volt, 20 ampere circuit to be brought to the Intrusion Detection Control Panel and other locations where required for proper system operation. Coordinate with Building Electrical Contractor.

F. All 120 volt wiring shall be installed in separate conduit.

G. Adjust the protection range or all sensing device so that an unprotected area from the floor level up to 6 in. above floor level is maintained. Also aim sensing devices to provide area coverage as required by Owner in the field.

H. Detection and initiating equipment shall be listed by UL or FM.

I. Intrusion Detection System equipment supplier shall provide complete wiring diagrams as part of the shop drawing submittal. An authorized representative of the manufacturer shall supervise the installation in order to insure a complete operating and trouble-free system.

J. Provide three (3) sets of all keys for all panels, stations, and devices.

3.2 PROGRAMMING

A. Include in bid the cost to cover all system programming, including items particular to this project (such as custom zone descriptions, time delay settings, sensitivity settings, etc.) such that entire system is 100% complete and operating to the Owner's satisfaction. Coordinate all system programming with the Owner. Also, provide remote programming of the system a minimum of once during the guarantee period to allow for holiday schedule whereby all points will report to the D6500 receiver for a predetermined time period, and to provide changes requested by the Owner.

3.3 TESTING

A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Intrusion Detection Systems Contractor and performed by equipment supplier. Final test report must be received and acknowledged by the Owner prior to request for final payment.

B. Provide a minimum of four hours of instruction to the Owner with regard to use and operation of system.

C. Provide quarterly inspections during warranty period.

3.4 WARRANTY

A. Entire system shall be warranted against equipment failure and installation defects for a period of one (1) year from the date of acknowledged Owner acceptance of final test.

3.5 RECORD DRAWINGS.

A. Provide record drawings as specified in Section 260500.

END OF SECTION 281600

SECTION 282300 - CLOSED CIRCUIT TELEVISION SURVEILLANCE SYSTEM

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Provide labor, materials, equipment and services to perform operations required for a complete system and related Work as shown in Contract Documents.

1.2 GENERAL DESCRIPTION

A. Provide all equipment and accessories for a complete Closed Circuit Television Surveillance System (CCTV) as described herein and as shown on Contract Documents. The names of manufacturers and attendant model numbers are given to establish a standard of quality and performance. Overall system engineering, layout and supervision of installation shall be provided by an authorized representative of the equipment manufacturer.

1.3 SYSTEM STRUCTURE

A. The video surveillance system shall include cameras, lenses, zoom lenses, pan and tilt units, camera mounts, camera housings, cabling, recording devices, switching devices, etc. for a complete video surveillance system.

1.4 SUBMITTALS

A. Contractor shall submit all items in accordance with the requirements of Division 1, Submittals, and shall include, but not be limited to the following:

1. Model numbers of all components furnished on the job.

2. Manufacturer’s catalog data sheets for all components.

3. Complete engineered drawings indicating:

    a. Point-to-point wiring diagrams for all devices.

    b. Termination details for all devices.

    c. Single-line system architecture drawings representing the entire system.

    d. Layout plans and elevations of all equipment.

    e. Camera view submittal binder.

4. Digital storage calculations indicating frames/second, resolution, number of cameras, length of storage, storage needed and system storage capability.

5. Operation Data: Include operating instructions.

6. Maintenance Data: Include maintenance and repair procedures.

7. Training Syllabus: Include course outlines for each of the end user training programs. The course outlines shall include the course duration, location, prerequisites, and a brief description of the subject matter.

8. Installer certification from the system manufacturer that they have been trained in the installation and operation of the intended system.

1.5 OWNER COORDINATION

A. Prior to shop drawing approval, perform interviews with the Owner to obtain exact locations of all devices. Submit layout drawings with "Agreed" locations for review and approval.

B. Perform on-site demonstration for each camera location using proposed equipment and mobile monitor in order to verify views with Owner and Engineer.

C. Submit a camera view submittal binder showing the actual view ranges and resolution of each camera position. Obtain Owner sign-off prior to ordering equipment and roughing locations.

D. Make any lens revisions required to provide views satisfactory to Owner and Engineer.

1.6 WARRANTY

A. Period: The Contractor shall warrant all labor, workmanship and materials for a duration as specified in Division 1/General Conditions or two (2) years from the date of final acceptance whichever is longer. Should a failure occur during the warranty period to the CCTV system, the Contractor shall provide all labor and materials necessary to restore the system to a complete operating condition, at no cost to the Owner.

1.7 SYSTEM DESCRIPTION & CAPABILITIES

A. Primary Function: The CCTV system's primary function shall be to record and send video to the Owner's LAN.

1. The CCTV system shall allow the configuration of an alarm and display workstation. The system workstation shall be connected through the Owners LAN.

B. Capabilities and Features:

1. Activity detection: Network Video Recorder (NVR) shall be configured to record video only while activity is occurring in the camera's view. Users define the NVR's level of motion sensitivity and configure NVR to ignore subtle changes in light level. Motion masks eliminate areas of the camera view where motion events should not trigger recording.

2. Alarm I/O: Capability of alarms connected to and from the NVR through encoders and device servers.

3. Recording Options: NVR can record in four modes: Motion mode (records activity only); Alarm mode (records alarm events only); Both mode (records activity and alarm events only); and Free mode (records continually).

4. Video Information: NVR shall record information about the time, date, and source of all video for easy search and retrieval. The status of all alarm inputs is recorded with each stored image.

5. Live Video Display. Live video can be viewed in various modes from single view to all camera view utilizing IP video servers and or video walls during recording.

6. Control of all camera features and functions including pan, tilt, zoom, etc.

C. Video Review and Retrieval:

1. Video Search: NVR shall allow searches based on a time frame, one or more video sources, defined “fenced” areas or objects, and types of events (motion, alarm, etc.).Video Search Results: Search results are listed with the following information: source camera; time and date captured; whether motion or alarm events occurred; number of frames in the segment; and storage location (. Results shall be sortable.

2. User Interface: Search results are played back with full control (play, fast forward, rewind, pause, step forward, etc.).

3. Image Export: Individual images can be exported to multiple formats compatible with standard workstations. Formatted messages are sent with the original time/date stamps and a self-executable player for ease of viewing by the e-mail receiver.

4. Video Authentication: Performs checksum algorithm on the video image, time stamp and date stamp and reports any deviations from original recording state of image.

5. Snapshot Image Print: Print function prints image to system compatible printer.

6. Alarm Search: Searches by network alarms (type, name, event, date, time, etc.) from peripheral systems attached to the CCTV through the LAN.

7. Recordable Drive: Allows the transfer of video files to CDs, DVDs, USB drives, disks, SD cards, mobile devices and remote storage for archival and distribution purposes.

D. Remote Review of Video:

1. Network Configuration: Live and recorded video on a NVR system can be viewed remotely through software (automatically installed in a standard NVR implementation). NVR shall operate as a server, allowing users to download recorded video over a network connection.

2. Remote Review of Recorded Video: Recorded video can be downloaded from NVR through any remote client provided the client can access the NVR via a network connection and has remote viewing software installed. Software shall permit an unlimited number of simultaneous connections for the purposes of downloading recorded video.

3. Remote Viewing of Live Video: Live video can be downloaded from NVR through a remote client. NVR can transfer live images across a network as they are recorded.

4. Remote Viewing Server Application: NVR shall operate as a server for live and recorded video. It requires the remote server application software to be running on the NVR platform.

5. Multiple Remote Viewing Server Application: Software enables this particular NVR to be one of many NVR's accessible and viewable simultaneously by a remote view client.

6. Live Tile Viewing: Live tile viewing of one or multiple live video streams.

E. Administrator Application:

1. User Interface: The system graphical user interface (GUI) shall allow full control of video viewing, alarm configuration, scheduling, search and playback, hardware setup, and user administration. System GUI shall be controlled using a workstation, tablet, and other mobile devices, and shall be compatible all Windows, Android and Apple iOS platforms. The System GUI main screen includes indicators for the current date and time, the recording status of each camera input, disk usage, and the amount of recording time available at the current hardware settings

2. Camera Configuration: The user interface shall allow control of the contrast, brightness, sharpness, hue, and saturation of video. Each camera to be individually configurable.

3. Camera Schedule: The Schedule page is a graphical representation of the NVR recording schedule. Recording modes are color-coded. System GUI shall allow scheduling of all cameras to record in the same mode for 24 hours a day. More complex schedules require recording segments to be drawn on a timeline. One schedule can be designated as the weekday default while another schedule is designated the weekend default. An unlimited number of special days can run on other schedules. A schedule for one day can also be copied and "pasted" to another day. Each camera can be scheduled to record in unlimited combinations of recording modes and schedules. Each recording segment can be as short as 15 minutes.

4. Monitor Tours: System GUI shall allow the user to view live video configured in various user defined formats. The user decides which camera is displayed in which window. In all modes, motion and alarm events trigger a visual feedback mechanism, calling attention to the appropriate view screen with a brightly colored border.

5. Alarm Configuration: System GUI shall allow the user to control which cameras should record video during an alarm event. Unlimited number of alarms can be connected to NVR. Each alarm can trigger any camera on the network, and each camera can be triggered by any number of alarms. Alarms are individually configurable as normally open or normally closed. NVR can also record all alarm events. Time of day/week schedule allows programming of alarm activations and off-hours recording parameters.

6. Security: System GUI shall allow complete control of user access. Users must enter a password to use the NVR and are granted one of three levels of permissions. Non-administrators can be prevented from accessing other portions of NVR. System GUI also provides contingencies for improper shutdown that automatically resume recording without user intervention.

7. Image Size Configuration: System GUI shall allow full control of video compression. Each camera can be configured independently.

8. Storage Space Management: System GUI shall allow complete storage management by authorized personnel. Storage location and file size limits shall be configurable. The user determines which location video is stored on and limits the amount of video each disk can hold (each hard drive used must be configured the same). The Circular option causes System GUI to record over the oldest video on the disk when it reaches the user-defined limit. The Purge feature allows the user to delete video based on the date it was captured.

9. Frame Rate Configuration: System GUI allows the reduction of frame rate for each camera. By default, video is captured at eight frames per second per camera, unless noted otherwise on Contract Documents or during Owner Interviews.

10. Storage Drive Configuration: System GUI shall allow the archiving of video data.

11. Archive Configuration: By default, archiving shall occur once per day at a preset time.

12. Activity Mask Configuration: System GUI uses motion masks to eliminate areas of a camera's view from activity detection. Masks can be created in any detailed pattern to prevent the unwanted recording of anticipated activity.

13. User Log: Allows administrator to track start-ups, log-on attempts, exits, and changes in recording status, errors, and remote activity.

PART 2 – PRODUCTS

2.1 CCTV SYSTEM SOFTWARE

A. The system shall include the manufacturer's current client management software for system operation and control.

B. A minimum of six (6) complete licenses shall be included.

C. Manufacturer software upgrades shall be provided to the Owner for five years from system acceptance at no additional cost to the Owner.

D. System shall be compatible with the District's existing system.

2.2 NETWORK VIDEO RECORDER AND STORAGE ARRAY

A. Network Video Recorder (NVR)

1. Hardware Specifications

a. Processors: Two (2) Intel Xeon processor E5-2400 and E5-2400 v2 product families.

b. Chipset: Intel C602

c. Memory: 16 GB DDR3RAM

d. Storage: Eight RAID 5, hot swappable, 1 TB hard drives.

e. SCSI controller card for use with external storage devices.

f. I/O Slots: Four (4) x16 PCIe slots.

g. Digital I/O Card: Dry contact use.

h. Dimensions: 2 RU

2. Software Specifications:

a. Shall be enterprise level or better.

b. Shall be capable of recording a minimum of 64 cameras at 30FPS on a single server.

c. Additional Features:

1) Remote administration, monitoring and management of video and audio data

2) Archive utility

3) Network health and event monitoring

4) Logical camera grouping

5) Quick review

d. Recording rate configurable per camera system requirements:

1) Windows 10 professional or Owner approved OS.

3. Provide client software at no charge for remote viewing and management. Install on Owner provided workstations. Coordinate with Owner for exact number of client software installations required.

4. Design Make: Hanwha Vision

B. Storage Array

1. Provide a SCSI connected storage array for each network video recorder system with enough storage to store 90 days of recorded video with all cameras (new and existing) recording at 8-10 fps.

2. Estimated array sizes are shown below. Submit calculations as part of submittal:

a. Storage shall be a minimum of 60TB

3. Design Make: Hanwha Vision

2.3 CAMERAS

A. Refer to the Contract Drawings for locations, types and mounting requirements. The following is a general description.

B. TYPE S - Interior fixed, tamper-resistant, network IP camera shall meet or exceed the following specifications:

1. General:

a. Casing: Polycarbonate smoked cover, aluminum inner camera module with encapsulated electronics, white finish, tamper resistant polycarbonate casing.

b. Power: Power over Ethernet (PoE) IEEE 802.3af, Class 3

c. Connectors:

1) RJ-45 10BASE-T/100BASE-TX PoE

2) 3.5 mm mic/line in, 3.5 mm line out

d. Operating Conditions: -10°C to 40°C (14°F to 122°F), humidity 20-80% RH (non-condensing).

e. Included Accessories: Mounting and connector kits, Installation Guide CD with installation tools, recording software and User Manual, Windows decoder 1-user license.

2. Camera:

a. Signal-to-Noise Ratio: >60 dB

b. Wide Dynamic Range:

1) Up to 120 Db.

2) Performed at pixel level to prevent "blooming" image.

c. Image sensor: Progressive scan RGB CMOS 1/3".

d. Lens:

1) Auto Focus Varifocal Megapixel Lens.

2) Focal Length: 2.8 mm.

3) Horizontal Angle of View: 104.4°

4) Iris Control: DC-iris.

e. Minimum Illumination:

1) Color: 0.15 lux.

f. Shutter Time: 1/5 sec to 1/12,000sec.

g. Pan/Tilt/Zoom: Manual adjustment.

h. Camera Angle Adjustment: Pan 350°, Tilt 69°, Rotation 355°

3. Video:

a. Video Compression: H.265/H.264: Main/High, MJPEG.

b. Resolution: 2592 x 1944 (5 MP).

c. Frame Rate:

1) H.264: Up to 30 fps (dependent upon coding, resolution, and stream configuration).

2) Motion JPEG: Up to 15 fps (dependent upon coding, resolution, and stream configuration).

d. Video Streaming: Multiple, individually configurable streams with controllable frame rate and bandwidth, VBR/CBR H.264.

e. Multi-view Streaming: Up to 16 individually cropped out view areas, preset positions, guard tour.

4. Network:

    a. Security: Password protection, IP address filtering, digest authentication, user access log, IEEE 802.1X network access control, HTTPS encryption.

5. System Integration:

    a. Intelligent Video: Video motion detection, active tampering alarm, audio detection.

    b. Events: Intelligent video, external input.

    c. Alarm Actions:

        1) File upload via FTP, HTTP & email.

        2) Notification via email, HTTP & TCP.

        3) External output activation.

        4) Video and audio recording to edge storage.

        5) Pre- and post-alarm video buffering.

6. Design Make: Wisenet Q Series.

C. TYPE B - the same parameters as for Type A except bi-directional.

1. Design Make: Wisenet P Series.

D. TYPE T – the same parameters as for Type A except three-way directional camera.

1. Design Make: Wisenet P Series.

E. TYPE F - Interior fixed, tamper-resistant, network IP fisheye camera shall meet or exceed the following specifications:

1. General:

    a. Casing: Polycarbonate smoked cover, aluminum inner camera module with encapsulated electronics, white finish, tamper resistant polycarbonate casing.

    b. Power: Power over Ethernet (PoE) IEEE 802.3af, Class 3.

    c. Connectors:

        1) RJ-45 10BASE-T/100BASE-TX PoE.

        2) 3.5 mm mic/line in, 3.5 mm line out.

d. Operating Conditions: -10°C to 40°C (14°F to 122°F), humidity 20-80% RH (non-condensing).

e. Included Accessories: Mounting and connector kits, Installation Guide CD with installation tools, recording software and User Manual, Windows decoder 1-user license.

2. Camera:

a. Signal-to-Noise Ratio: >60 dB

b. Wide Dynamic Range:

1) Up to 120 dB.

2) Performed at pixel level to prevent "blooming" image.

c. Image sensor: Progressive scan RGB CMOS 1/3"

d. Lens:

1) Auto Focus Varifocal Megapixel Lens.

2) Focal Length: 1.08 mm.

3) Horizontal Angle of View: 187°.

4) Iris Control: DC-iris.

e. Minimum Illumination:

1) Color: 0.39 lux.

f. Shutter Time: 2 sec to 1/12,000sec.

3. Video:

a. Video Compression: H.265/H.264: Main/Baseline/High, MJPEG.

b. Resolution: 2592 x 1944 (5 MP).

c. Frame Rate:

1) H.264: Up to 30 fps (dependent upon coding, resolution, and stream configuration).

2) Motion JPEG: Up to 15 fps (dependent upon coding, resolution, and stream configuration).

d. Video Streaming: Multiple, individually configurable streams with controllable frame rate and bandwidth, VBR/CBR H.264.

e. Multi-view Streaming: Up to 16 individually cropped out view areas, preset positions, guard tour.

4. Network:

a. Security: Password protection, IP address filtering, digest authentication, user access log, IEEE 802.1X network access control, HTTPS encryption.

5. System Integration:

a. Intelligent Video: Video motion detection, active tampering alarm, audio detection.

b. Events: Intelligent video, external input.

c. Alarm Actions:

1) File upload via FTP, HTTP & email.

2) Notification via email, HTTP & TCP.

3) External output activation.

4) Video and audio recording to edge storage.

5) Pre- and post-alarm video buffering.

6. Design Make: Wisenet Q Series.

F. TYPE O/V - Exterior fixed, vandal-resistant, network IP camera shall meet or exceed the following specifications:

1. General:

a. Day/Night Compatibility.

b. Casing: Polycarbonate transparent cover, aluminum inner camera module with encapsulated electronics, white finish, tamper resistant polycarbonate casing, thermostatically controlled heater.

c. Power: Power over Ethernet (PoE) IEEE 802.3af, Class 3.

d. Connectors:

1) RJ-45 10BASE-T/100BASE-TX PoE.

2) 3.5 mm mic/line in, 3.5 mm line out.

e. Operating Conditions: -50°C to 60°C (-22°F to 122°F); PoE operates between 0°C to 50°C (32°F to 122°F), 12 VAC power is required for heater operation below 0°C (32°F); humidity 20-80% RH (non-condensing).

f. Included Accessories: Mounting and connector kits, Installation Guide CD with installation tools, recording software and User Manual, Windows decoder 1-user license.

2. Camera:

a. Signal-to-Noise Ratio: 50 dB

b. Image sensor: Progressive scan RGB CMOS 1/3.2"

c. Lens:

1) Auto Focus Varifocal Megapixel Lens.

2) Focal Length: 3-9 mm.

3) Horizontal Angle of View: 180° (Type O) - 270º (Type V).

4) Iris Control: DC-iris.

d. Minimum Illumination:

1) Color: 0.04 lux.

2) Mono: 0.004 lux.

e. Shutter Time: 2 sec to 1/12,000 sec.

f. Pan/Tilt/Zoom: Manual adjustment.

3. Video:

a. Video Compression: H.264 (MPEG-4 Part 10/AVC) & Motion JPEG.

b. Resolution: 2592 x 1944 (5 MP).

c. Frame Rate:

1) H.264: Up to 30 fps (dependent upon coding, resolution, and stream configuration).

2) Motion JPEG: Up to 30 fps (dependent upon coding, resolution, and stream configuration).

d. Video Streaming: Multiple, individually configurable streams with controllable frame rate and bandwidth, VBR/CBR H.264.

e. Multi-view Streaming: Up to 16 individually cropped out view areas, preset positions, guard tour.

4. Network:

a. Security: Password protection, IP address filtering, digest authentication, user access log, IEEE 802.1X network access control, HTTPS encryption.

5. System Integration:

a. Intelligent Video: Video motion detection, active tampering alarm, audio detection.

b. Events: Intelligent video, external input

c. Alarm Actions:

1) File upload via FTP, HTTP & email

2) Notification via email, HTTP & TCP

3) External output activation

4) Video and audio recording to edge storage

5) Pre- and post-alarm video buffering.

6. Design Make: Wisenet X Series

2.4 MOUNTING

A. Provide indoor and outdoor, custom camera mounting hardware as indicated on the Contract Drawings. Note that all camera locations shall be field verified with the Owner's Representative prior to roughing. This contractor shall be responsible for locating the camera for optimum viewing of the scene. Refer to Section 3.2 of this specification.

B. Provide equipment rack accessories for mounting of all IP video surveillance equipment into existing equipment racks located in IDF and MDF locations.

2.5 CLOSED CIRCUIT TELEVISION SURVEILLANCE SYSTEM CABLE

A. Low voltage (24 VAC) video control cable shall be minimum of #18 AWG between the controls at the console and the relay boxes located at the cameras for the equipment specified.

B. Power branch circuiting for power supplies, etc. shall be minimum #10 AWG conductors in minimum 1/2 in. conduit.

C. Camera cabling shall be Category 6A. Provide one (1) dedicated cable for each camera. Camera cabling shall match Owner's color coding standard listed in LAN specifications. Refer to Specification Section 272100 for installation and testing requirements.

2.6 SURVEILLANCE MONITOR

A. The monitor shall meet the final minimum specifications:

1. Slim, LED Flat-Panel

2. Physical: 40-inch: 36-7/8"W x 21-5/8"H x 2"D (40" Diagonal)

3. Resolution: 1080p

4. Refresh Rate: 120Hz

5. Sound Output (RMS): 10W x 2

6. Speaker Type: Down Firing + Full Range

7. Dual Core Processor

8. Video and Audio Inputs:

a. HDMI
b. USB
c. Ethernet
d. Component
e. Composite
f. RF In
g. DVI Audio In (Mini Jack)
h. Digital Audio Out (Optical)
i. Audio Out (Mini Jack)
j. IR Out
k. RS232 (AV Control)

9. Power:

a. Energy Star 6.0 Compliant
b. Power Supply: 110-120V, 60Hz
c. Typical Power Consumption: 40-inch: 51W
d. Standby Power Consumption: < 0.3W

10. DTV Tuner/Digital Cable Tuner/Analog Tuner

11. Clock & On/Off Timer

12. Universal Remote

13. Design Make: 40-inch: Samsung 40" Class, LED 6300 Series TV or Approved Equal

2.7 MONITOR MOUNT

A. The monitor mount shall meet the final minimum specifications:

1. Slim, Full-motion Wall Mount

2. Weight Capacity (Do not exceed): 100 lbs

3. Swivel: +/- 90°

4. Tilt: 0° to -13.5°

5. Level: +/- 3°

6. Extension: 15.01 inches

7. Design Make: 40-inch: Sanus VLF515 or Approved Equal

2.8 REMOTE MINI-VIDEO DRIVER

A. Provide small form factor PC loaded with CCTV system surveillance monitoring software that allows the CCTV system camera images to be displayed on surveillance monitor.

B. Design Make: Intel NUC or approved equal.

2.9 ETHERNET MEDIA CONVERTERS

A. Provide Ethernet media converters designed to transmit and receive 10/100 Mbps or 10/100/1000 Mbps data over optical fiber through small form-factor fiber modules. Converter shall also support IEEE 802.3at Class 1-4 as Power Sourcing Equipment (PSE) with up to 30W at 48 VDC.

B. Provide weatherproof enclosure when converters are mounted outside.

C. Design Make: Pelco FMCI-PoE Series Media Converters

2.10 ANALOG VIDEO ENCODER

A. Video Features:

1. Encodes 4 analog video channels into 1 OP Ethernet stream.

2. Maximum resolution 720 x 480 (NTSC) or 720 x 576 (PAL).

3. 30 images per second from each port.

4. H.264 and Motion jpeg compression.

5. ONVIF compliant API.

6. Motion adaptive 3D deinterlacing.

7. Motion detection selectable sensitivity and threshold.

8. Up to 4 privacy zones available per channel.

9. 4 BNC IN, 1 RJ-45 OUT.

B. Controls: Support for PTZ and dome cameras via RS-485 interface.

C. Audio Support: 4 audio input channels, 4 audio output channels.

D. External I/O terminals: 4 alarm IN, 4 alarm OUT.

E. Power over Ethernet: IEEE 902.3af (PoE), 15W per channel, 24 VAC or 12 VDC 8W power input.

F. Compatibility: Shall automatically connect to NVR video management system.

G. Accessories: Provide multiple rack mount kits to mount all encoders. Maximum of 3 encoders per 1U of rack space.

H. Design Make: Hanwha

PART 3 - EXECUTION

3.1 WIRING

A. Low voltage control relay boxes shall be provided as required. Camera and relay box power shall be derived from the nearest available 120VAC unswitched power source or as called for. Provide circuit breakers to match existing panelboards. Particular attention should be directed to the proper installation of the camera mounting hardware. Video distribution coaxial cable shall not be installed in the same conduit with any AC power wiring. All camera locations shall be as directed by the Owner’s Representative in the field.

B. Verify prior to roughing. Field locate cameras and provide lenses required for optimum viewing of the scenes listed in the CCTV camera schedule on the Contract Documents and to the Owner’s satisfaction. Coordinate all control equipment locations with the Owner’s Representative.

C. Provide wiring between the cameras, control equipment and monitors. All wiring shall be in accordance with Specification Sections 260501 and 272100 of these project specifications.

3.2 INSTALLATION

A. Installation of the CCTV shall include the appropriate equipment and shall be performed by a factory-trained Contractor Installer. The installation shall be completed to meet the requirements of this specification and the project drawings. The installation shall include the following:

1. Site planning and system configuration of field hardware and CCTV.
2. Complete system diagnostics verification.
3. Complete system operation verification.
4. Problem reporting and tracking.
5. Project specific installation log.
6. Completion of specific customer acceptance test plans.
7. Formal turnover of the specific project installation documentation to Maintenance Service Organization.

3.3 PROGRAMMING

A. Include in bid the cost to cover all system programming, including items particular to his project (such as custom zone descriptions, time delay settings, sensitivity settings, etc.) such that entire system is 100% complete and operating to the Owner's satisfaction. Coordinate all system programming with the Owner. Re-number all cameras to meet Owner's requirements in the fields.

B. Provide three (3) additional site visits for programming and device relocations after system has been accepted.

3.4 TESTING

A. Submit a written test report from an authorized representative of the equipment manufacturer that the system has been 100% tested and approved. Final test shall be witnessed by Owner, Engineer, Contractor and performed by the equipment supplier. Final test report must be received and acknowledged by the Owner prior to request for final payment.

B. Provide three (3) 4-hour sessions of instruction to the staff with regard to use and operation of the system.

C. Provide quarterly inspections during warranty period of the operation of all cameras, video/audio quality, recording capability and all functions.

3.5 RECORD DRAWINGS

A. Provide record drawings as specified other sections.

3.6 SYSTEM DOCUMENTATION

A. Complete documentation shall be provided with the system. The documentation shall completely describe all operations, each program, data sets and the hardware and peripherals. All updates, addendum and adjustments to the documentation shall be provided at no additional charge, in the same quantities as originally required. Each Division shall define the initial quantities.

1. System Administrator Manual: Overview and step-by-step guide and instructions detailing all System Administrator responsibility and authority.

2. User Manual: Step by step guide and instructions detailing all system user functions and responsibilities.

3. Alarm Monitoring Manual: Step by step guide and instructions detailing all alarm monitoring system user functions and responsibilities.

4. Technical Maintenance Manual: Shall be a comprehensive and detailed document providing all maintenance action, system testing schedules, troubleshooting flowcharts, functional system layout and block diagrams and schematic diagrams of all system wiring.

3.7 SYSTEM TRAINING

A. Proposal shall include four (4) 4-hour sessions of system maintenance and training on-site by a representative of the CCTV manufacturer. Training shall take place before the system is operational. A detailed description of the training material shall be included in the submittal package. All training courses shall enable the attendees to be capable of all normal system operations within their respective positions.

1. System Administrators shall receive a course detailing the system functions and operations. Course shall offer configuration training on all aspects of the system including data import-export, reports, cardholder management, system workstations, peripherals and field hardware.

2. Alarm Monitoring Users shall receive a course detailing the operation of all aspects of alarm monitoring functions, reports, error messages, alarm handling, output relay control and general overview of field hardware.

3.8 POST-BID UNIT PRICES

A. Furnish Unit Prices for the items enumerated hereunder.

B. Any work not included under the Base Contract shall be performed in any quantity as directed at the Unit Prices set forth below. Such work shall be performed upon request at any time until final acceptance of all work under this contract. All such additional work shall be performed in accordance with the terms and conditions of this contract. In the event that the Owner shall direct the elimination of any work under this contract, the Contractor shall credit to the Owner the cost of said eliminated work at the Unit Prices set forth below.

C. The Unit Prices set forth hereunder shall include all materials required for the complete installation and operation of each item.

D. The Contractor shall complete each column and submit Post-Bid, prior to submittals.

Item No.	**Description**	**Pre-Startup**	**Post Startup**

1.	Type B, Interior Network IP Camera		
2.	Type F, Interior Network IP Camera		
3.	Type O, Exterior Network IP Camera		
4.	Type S, Interior Network IP Camera		
5.	Type T, Interior Network IP Camera		
6.	Type V, Exterior Network IP Camera		

END OF SECTION

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SECTION 283100 – FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Fire-alarm control panel (FACP).
2. Manual fire alarm pull stations.
3. System smoke detectors.
4. Carbon Monoxide detectors.
5. Heat detectors.
6. Notification appliances.
7. Fire Alarm Annunciator Panel (FAAP).
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. Network communications.
11. Device Guards.

1.2 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.3 SUBMITTALS

A. Product Data: For each type of product, including finished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire alarm system:

1. Floor plans (minimum 1/8-inch scale) with room names and numbers, showing device locations and interconnecting conduit and wire. Include location of fire/smoke rated or barrier walls.
2. Drawings shall show proposed layout and anchorage of equipment and appurtenances and equipment relationship to other parts of the work, including clearances for maintenance and operation.
3. Scaled detail drawings of FACP and FAAP panel fronts.
4. Wiring diagram for each device. Include connection details to auxiliary equipment.
5. Customize the second sentence of Clause F. to suit project-specific requirements.
6. Riser diagram showing devices, equipment, and interconnecting conduit and wire. Indicate points of connection to other equipment such as, damper actuators, kitchen hood fire protection systems, pre-action fire protection systems, clean agent fire protection systems, elevator machine rooms and shafts, electric door locking hardware, fire door releases, magnetic door holders, and other related devices and equipment.
7. Complete narrative of the sequence of operation.
8. Sequence of operation matrix table including a complete line-by-line listing of fire alarm initiating devices, corresponding device address, and input/output matrix.
9. Voltage drop calculations.
10. Battery sizing calculations.
11. Visual alarm power supply sizing calculations.
12. Power supply calculations for magnetic door holders, and electric door locking hardware.
13. Wire identification schedule.
14. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this specification and in NFPA 72.All

drawings must be stamped and signed by a Professional Engineer registered in New York State, for approval by the Fire Marshal and NYSED.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. Include the following:

1. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
3. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
4. Riser diagram.
5. Device addresses.
6. Record copy of site-specific software. This software shall also be in an electronic format to allow an alternate Authorized Distributor to add , change , or modify in any way, the existing system data base.
7. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
   a. Equipment tested.
   b. Frequency of testing of installed components.
   c. Frequency of inspection of installed components.
   d. Requirements and recommendations related to results of maintenance.
   e. Manufacturer's user training manuals.
8. Manufacturer's required maintenance related to system warranty requirements.
9. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire alarm Level III technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

D. Manufacturer and equipment supplier shall have a minimum of ten years' prior experience in New York State. Equipment supplier shall have 24-hour parts and labor service available with a maximum 4-hour response time. There shall be a minimum of 2 Independent Authorized Distributors within a 50 mile radius of project. Proprietary equipment shall not be acceptable.

1.6 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.7 SYSTEM ZONING

A. Alarm Initiating Devices:

1. Provide a separate, individual zone for each manual pull station, area smoke detector, duct smoke detector, and area heat detector, and water flow switch.

B. Fire Audible and Visual Alarm Strobes:

1. Each floor of the building (above and below grade) shall be a separate, individual zone.

2. Each stairwell shall be a separate, individual zone.

3. Each exterior area shall be a separate individual zone.

C. Fire Alarm Control zones:

1. Air Handling Fan systems: Provide one (1) shutdown contact for each air handling fan systems. Contacts shall initiate the shutdown of fan system and closing of dampers on associated floor.

2. Provide two (2) open/close contact for each floor's/zones's dampers grouped as a function of being in the supply or return air streams.
3. Provide one (1) recall contact for each elevator control panel to recall elevator to ground floor.
4. Provide one (1) release control contact for all door lock systems.

D. Initiating and signaling device wiring circuits/loops/channels shall be loaded to no more than 80 percent (80%) capacity to allow for the installation of future devices.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.

B. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. All new fire detection and alarm system components shall be of the same manufacturer, and must meet all requirements of the contract documents.

B. Acceptable manufacturers:

1. Edwards

C. Products for this project shall be of the latest design that has been in service for at least two (2) years, and no more than 4 years. Obsolete or discontinued models are not acceptable.

2.2 DESCRIPTION

A. Fire alarm system infrastructure including conduit, wiring, backboxes, etc. and all associated labor and installation is in the scope of this contract.

B. Shop drawings and submittal review/approval, testing and programming, project management and closeout documentation shall be by the fire alarm system manufacturer's authorized representative.

C. Provide a microprocessor-controlled, electrically supervised fire alarm system in accordance with the Contract Documents. Provide detailed system design, all equipment, tools, drawings, labor, materials, accessories, and approvals from governing agencies required to furnish, install, start up, and test a complete operating fire alarm system. Systems shall be provided and placed into operation in accordance with the requirements of the Authority Having Jurisdiction (AHJ).

D. Labor, materials including conduit and wiring, and accessories not specifically called for in the Contract Documents but required to provide complete, operating, and approved systems, shall be provided within the scope of this contract.

E. Determine, coordinate, and incorporate the design and construction requirements of the architectural, structural, fire protection and mechanical systems, and auxiliary systems including food service, fire doors and windows, elevators, and other related systems, to fully meet all code requirements.

F. The fire alarm system manufacturer and Contractor shall provide all required documentation, obtain all required permits and approvals, and shall provide all devices and accessories in the quantities and locations necessary for a fully functional and code-compliant system.

G. Programming of system shall be based on final room names and numbers, which may not necessarily be the same as those used on the construction documents.

H. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

I. The Fire Alarm Control Panel (FACP) and Fire Alarm Annunciator Panel (FAAP) shall be connected in a network configuration to become components for a distributed intelligence system.

J. The fire detection and alarm system shall be the fully addressable type. Each fire alarm initiating device shall be a separate, individual zone. Provide interface modules to connect non-addressable devices to addressable wiring channels.

K. All components provided shall be listed for use with the selected system.

L. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual pull stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Waterflow Switch.

B. Fire alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances, including voice evacuation notices.
2. Identify alarm and specific initiating device at FACP, connected network control panels, off-premises network control panels, and remote annunciators.
3. Indicate device in alarm on the graphic annunciator
4. Transmit an alarm signal to the remote alarm receiving station.
5. Unlock electric door locks in designated egress paths.
6. Release fire and smoke doors held open by magnetic door holders.
7. Activate voice/alarm communication system.
8. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
9. Close smoke dampers in air ducts of designated air conditioning duct systems.
10. Activate emergency shutoffs for gas and fuel supplies.
11. Record events in the system memory.

C. Detection of carbon monoxide by a carbon monoxide detector shall:

1. Activate a distinct carbon monoxide alarm at the FACP.
   a. Carbon monoxide signal shall be a separate and distinct signal from the fire alarm system.

2. Activate distinct local carbon monoxide visual/audible notification appliances for associated carbon monoxide detector in alarm condition.
3. Activate carbon monoxide detector sounder base (if present).
4. Send a distinct carbon monoxide detector supervisory signal to central office.

D. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Independent fire detection and suppression systems.
2. User disabling of zones or individual devices.
3. Loss of communication with any panel on the network.

E. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, or Ethernet module.
4. Loss of primary power at FACP.
5. Ground or a single break in internal circuits of FACP.
6. Abnormal AC voltage at FACP.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at FACP or annunciator.
10. Voice signal amplifier failure.

F. System Supervisory Signal Actions:
1. Identify specific device initiating the event at FACP, off-premises network control panels, and remote annunciators.
2. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
3. Display system status on FAAP.

2.4 FIRE ALARM CONTROL PANEL (FACP)

A. General Requirements for FACP:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.

b. Include a real-time clock for time annotation of events on the event recorder.

c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.

d. The FACP shall be listed for connection to a central station signaling system service.

e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.

3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, three line(s) of 80 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Initiating Device, Notification Appliance, and Signaling Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.

2. Pathway Survivability: Level 0. Staged evacuation Level 2 or 3.
3. Install no more than 100 addressable devices on each signaling-line circuit.
4. Serial Interfaces:
    a. One dedicated RS 485 port for remote station operation using point ID DACT.
    b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module.
    c. One USB or RS 232 port for PC configuration.
    d. One RS 232 port for VESDA HLI connection.
    e. One RS 232 port for voice evacuation interface.

D. Smoke Alarm Verification:
1. Smoke alarm verification shall not be enabled.

E. Elevator recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices.
    a. Elevator lobby detectors except the lobby detector on the designated floor.
    b. Smoke detector in elevator machine room.
    c. Waterflow switch activation.
2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
    a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

F. Notification Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.

2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.

3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Door Controls:

1. Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment:

1. Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

I. Transmission to Remote Alarm Receiving Station:

1. Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Voice/Alarm Signaling Service: Central emergency communication system with redundant preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.

a. System shall provide a minimum of 8 digital audio channels)

b. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.

c. Programmable tone and message sequence selection.

d. Standard digitally recorded messages for "Evacuation" and "All Clear."

e. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters two-way telephone communications zones.

3. preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

4. Primary Power: 24V DC obtained from 120V AC service and a power supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24V DC source.

5. Alarm current draw of entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power supply module. Initiating device, notification appliances, signaling lines, trouble signals, supervisor signals, supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24- V dc source.

L. Secondary Power: Provide sufficient battery capacity to operate the entire system upon loss of power as required by NFPA 72 Section 10.6.7.2.1. Battery capacity shall be calculated for minimum 24 hours of capacity in nonalarm (standby) mode and then 15 minutes at maximum connected load after that time period for audio voice systems and 24/5 for non audio systems. The on-site emergency power system shall not be used when sizing the battery supply. The system shall automatically transfer to the standby batteries upon power failure. Battery charging and recharging shall be automatic.

2.5 MANUAL FIRE ALARM PULL STATIONS

A. General Requirements: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACP.

2. Station Reset: Key-operated switch.

2.6 SYSTEM SMOKE DETECTORS

A. General Requirements:

1. Comply with UL 268 and FM approved; operating at 24V DC, nominal, Photoelectric type.

2. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

3. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

4. Integral Visual-Indicating Light: LED type, indicating detector alarm/power-on status.

5. Thirty (30) mesh insect screen and magnetically activated test.

6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at FACP for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACP.

   a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at FACP for 15 or 20 deg F per minute.

   b. Multiple levels of detection sensitivity for each sensor.

   c. Sensitivity levels based on time of day. Photoelectric Smoke Detectors:

7. Detector address shall be accessible from FACP and shall be able to identify the detector's location within the system and its sensitivity setting.

8. An operator at FACP, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.

   b. Device type.

   c. Present average value.

   d. Present sensitivity selected.

   e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A, 24V DC.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.

    b. Device type.

    c. Present average value.

    d. Present sensitivity selected.

    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.

4. Duct detector and housing shall be calibrated and adjusted for sensitivity at the manufacturer’s factor to U.L. standards. Detector and housing shall be self-compensating for the effect of air velocity, temperature, humidity and atmospheric pressure.

5. Each duct detector shall be provide with sampling tubes sized according to duct size, air velocity, and installation conditions.

6. Each duct detector shall be provided with remote alarm LED on a single gang plate, surface or flush mounted.

2.7 CARBON MONOXIDE DETECTORS

A. General: Carbon monoxide detector listed for connection to fire-alarm system.

1. Mounting: Adapter plate for outlet box mounting.

2. Testable by introducing test carbon monoxide into the sensing cell.

3. Detector shall provide alarm contacts and trouble contacts.

4. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.

5. Comply with UL 2075.

6. Locate, mount, and wire according to manufacturer's written instructions.

7. Provide means for addressable connection to fire-alarm system.

8. Detector base shall provide a temporal 4 alarm signal.

2.8 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACP.

2.9 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1 inch high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.

3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

D. Voice/Tone Notification Appliances:

1. Speakers shall be capable of providing 520hz.
2. Comply with UL 1480.
3. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the “Notification Appliances” and “Emergency Communications Systems” chapters of NFPA 72.
4. Speaker shall be capable of field selection of speaker voltage (25 and 70.7 Vrms) and power settings (1/4 W, 1/2 W, 1 W, 2 W).
   a. Final settings shall be field adjusted to match the acoustical environment of each speaker.

E. Exit Marking Audible Notification Appliance:

1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
2. Provide exit marking audible notification appliances at the entrance to all building exits.
3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.

2.10 FIRE ALARM ANNUNCIATOR PANEL (FAAP)

A. Graphic Annunciator Panel: Mounted in an aluminum frame with nonglare, minimum 3/16-inch thick, clear acrylic cover over graphic representation of the facility. Detector locations shall be represented by red LED lamps. Normal system operation shall be indicated by a lighted, green LED. Trouble and supervisory alarms shall be represented by an amber LED.

1. Comply with UL 864.
2. Shall Operate from 24-V dc power supplied by the FACP.

3. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and a lamp test switch.
4. Surface mounted in a NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
5. Graphic representation of the facility floorplan, and each detector shall be represented by an LED in its actual location. Floorplan shall be at 1/8-inch per foot scale or larger.
6. The LED representing a detector shall flash two times per second while detector is an alarm.

2.11 ADDRESSABLE INTERFACE DEVICE

A. General:
1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.
4. Devices shall be flush mounted in finished areas and surface mounted with back box in unfinished areas.

B. Monitor Module (SIGA-CT series): Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts using NFPA 72A Style B (Class B, Two-Wire) circuit supervision. Module responds to polling signals from FACP/Transponder and shall report alarm initiating/supervisory circuit status changes to it.

C. Control Module (EST SIGA-CRH): Microelectronic module with one (1) induvial addressable control relay with double-pole/double-throw (DPDT) contacts rated at two (7.0A) @ 120VAC/28VDC. Module response to control signals from FACP/Transponder.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from FACP and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Addressable communications circuits from system transponders shall be electrically supervised in accordance with NFPA 72A Style 6 (Class A, four-wire) standards, monitoring for alarm (shorts), trouble (opens), and ground faults. When wired in the Style 6 (Class A, four-wire) configuration, a single open or ground fault shall not prevent the receipt of an alarm condition. Addressable communications circuits shall utilize two (2) cables of two (2) No. 18 AWG twisted conductors from the transponder to the connected addressable devices.

D. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or FACP.

E. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. Communication bus failure.

F. Secondary Power: Integral rechargeable battery and automatic charger.

G. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 NETWORK COMMUNICATIONS

A. Provide network communications for fire alarm system according to fire alarm manufacturer's written requirements.

B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.

C. Provide integration gateway using BACnet for connection to building automation system when required.

2.14 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the device requiring protection.

1. Factory fabricated and furnished by device manufacturer.

2. Finish: Paint of color to match the protected device.

3. Guards must be UL cross listed with devices being used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.

2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire Alarm Pull Stations:

1. Install manual fire alarm pull station in the normal path of egress within 60 inches of the exit doorway.

2. The operable part of manual fire alarm pull station shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated. Smoke or Heat Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.

2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 30 feet.

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.

5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Fire alarm pathway and circuit wiring installation shall comply with NEC Article 760.

B. Where exposed, all fire alarm circuits shall be installed in dedicated EMT conduit.

C. Where existing wall devices are being replaced in the same location, install new fire alarm circuit wiring in existing conduit within wall (where available).

D. Pathways above recessed ceilings and in nonaccessible locations may be plenum-rated cable.

E. All pathways must be independently supported from the structure above.

F. Where passing through a wall or floor, provide a metal raceway or rigid nonmetallic conduit sleeve.

G. All penetrations of rated walls and floors shall be properly fire-stopped.

3.4 IDENTIFICATION

A. Provide an identification nameplate for each equipment cabinet. Nameplates shall correspond with labeling identified in the submittal drawings. Nameplates must be engraved and secured using rivets or screws. The use of Dymo type labels is unacceptable.

B. Fire alarm conduit shall be permanently labeled “FIRE ALARM” every 30 feet.

C. Fire alarm junction boxes shall be painted red.

D. All initiating and indicating devices shall be labeled with self-adhesive tape with black lettering and identification labeling according to circuit loop and device address/number.

E. Color code all wiring per recommended standards. Tag all wires in terminal cabinets with tie wrap tags with inked identification.

F. Install framed instructions in a location visible from FACP.

3.5 GROUNDING

A. Ground FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to FACP.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 TESTING

A. The fire alarm system manufacturer or manufacturer’s authorized representative shall test and inspect components, assemblies, and equipment installations, including connections.

B. Tests shall be witnessed by District (Owner), Engineer of Record, and the Fire Department.

C. The following tests and inspections shall be performed:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72.

   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test visible appliances for the public operating mode according to manufacturer's written instructions.

5. System manufacturer shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the

"Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire alarm system will be considered defective if it does not pass tests and inspections.

3.7 CLOSEOUT DOCUMENTATION

A. The fire alarm system manufacturer or manufacturer’s authorized representative shall prepare and submit to the Engineer of Record all NFPA 72 required closeout documentation including, but not limited to:

1. System Record of Completion
2. Notification Appliance Power Panel Supplementary Record of Completion
3. System Record of Inspection and Testing
4. Notification Appliance Supplementary Record of Inspection and Testing
5. Initiating Device Supplementary Record of Inspection and Testing
6. Periodic Inspection, Testing and Maintenance Documentation

B. Record Drawings, to include:

1. Minimum 1/8” scale floorplan drawings indicating all final device types, locations, ratings, settings and addresses
2. Wiring diagram of each device type
3. Riser diagram showing devices, device addresses, equipment, and interconnecting conduit and wire
4. Narrative of sequence of operation
5. Sequence of operation matrix (includes complete line-by-line listing for fire alarm initiating devices, device address and input/output matrix
6. Voltage drop calculations
7. Battery sizing calculations
8. Visual alarm power supply sizing calculations
9. Power supply calculations for door holders

10. Wire identification schedule
11. Legend

C. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

D. Operating instructions for mounting at fire-alarm control unit and each annunciator unit.

E. Warranty documentation.

F. All closeout documentation shall be signed and sealed by a Registered Professional Engineer in New York State.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

B. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire alarm system.

END OF SECTION 283100

SECTION 31 00 00 – SITE CLEARING

PART 1 GENERAL

1.1 This Section includes
A. Protecting existing trees and vegetation to remain.
B. Removal of trees, shrubs, designated plant life and vegetation.
C. Removal of topsoil and subsoil, rough grading and site contouring.
D. Clearing and grubbing.
E. Temporary erosion and sedimentation control measures.
F. Removal of above and below grade improvements and surface debris.

1.2 RELATED WORK SPECIFIED ELSEWHERE
A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Section 31 20 00: Excavation and Fill
C. Section 31 25 13: Erosion and Sediment Control

1.3 DEFINITIONS
A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil.
B. Clearing: Removal of trees, shrubs, bushes, and other organic matter found at or above original ground level.
C. Remove: Remove existing items from site and legally dispose of them off-site, unless indicated to be removed and reinstalled. Removal shall be completed daily.
D. Existing to Remain: Existing items that are not to be removed and that are not otherwise indicated to be removed or removed and reinstalled.

1.3 SUBMITTALS
A. Pre-Construction photographs sufficiently detailed, of existing conditions of trees, adjoining construction, and site improvements. Submit before work begins.
B. Submit schedule indicating proposed trees to be removed or trimmed to Owner and Architect for review prior to commencement of work.

1.4 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
3. Provide clear and appropriate signage for alternate routes and proper notice to people.

B. Maintain access to existing adjacent areas of the building, walkways, roads, and other adjacent occupied or used facilities.

1. This is an active facility and phasing of the work will be required and with agreement of Owner to minimize disruptions to the existing operations.
2. Do not close or obstruct adjacent areas of the building, walkways, roads, or other occupied or used facilities without agreement with the Owner and written permission from authorities having jurisdiction.

C. Utility Locator Service: Notify utility locator service (Dig Safely New York – 811 or 800-962-7962) or retain services of a private utility locating firm for area where Project is located before site clearing.

D. Hazardous Materials:

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials shall be removed as per the characterization of hazard and disposed of in accordance with NYSDEC requirements.

E. Storage of removed items or materials on-site will not be permitted, unless indicated to be removed and stockpiled on site.

F. Utility Service: Maintain existing utilities in service and protect them against damage during selective demolition operations.

G. Do not commence site clearing and demolition operations until temporary erosion and sedimentation control measures are in place.

1.5 DELIVERY AND STORAGE

A. Deliver and store materials in a manner to prevent contamination or segregation.

1.6 QUALITY ASSURANCE

A. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 PREPARATION AND PROTECTION

A. Protect and maintain benchmarks and survey control points from disturbance during construction. Damaged or lost benchmark, monuments and survey control points shall be replaced by a licensed New York State Registered Land Surveyor at the Contractor's expense.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Protect existing site improvements to remain from damage during construction.

   1. Restore damaged improvements to their original condition, as acceptable to Owner.

D. Identify trees to be removed and trimmed and confirm with Owner and Engineer prior to any demolition.

E. When unanticipated conflicts with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

F. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with adjacent areas of the building, roads, streets, walks, walkways, and other adjacent occupied and used facilities.

   1. Do not close or obstruct adjacent areas of the building, streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.
   2. Erect temporary protection, such as walks, ramps, fences, and railings where required to permit safe passage of people and vehicles.
   3. Protect existing building elements, appurtenances, and items to remain.

G. Identify and protect existing utilities.

H. Tree Protection: Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
3. Do not excavate within drip line of trees, unless otherwise indicated.

I. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people, damage to buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area.

3.2 CLEARING AND GRUBBING

A. Install erosion control measures at the limits of clearing and grubbing or as indicated on the Contract Drawings prior to commencement of clearing and grubbing. Repair and or replace erosion control devices immediately if damaged during clearing and grubbing.
B. Remove obstructions, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
C. Do not remove trees, shrubs, and other vegetation unless indicated to be removed.
D. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
E. Carefully grub within drip line of remaining trees.
F. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.3 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.
B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust. Provide temporary erosion and sediment control measures as indicated on the Contract Drawings.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within drip line of remaining trees.
   3. Stockpile surplus topsoil and allow for respreading deeper topsoil
   4. Dispose of unused topsoil at the end of the project as specified for waste material disposal.

3.4 TREE/STUMP REMOVAL

A. Removal:
   1. Remove tree, stump and root system in entirety.
   2. Remove material from the site daily.
   3. Dispose at authorized facility.
B. Restoration
   1. Place fill, rough grade area and restore to existing conditions

3.5 REMOVAL AND DISPOSAL

A. Removal:
   1. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.
   2. Remove material from the site daily.
   3. Dispose at authorized facility.
B. Burning: Do not burn demolished materials.
C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
D. Dumping: No dumping shall be allowed in any stream, corridor, wetlands, surface waters, or at unspecified locations or at locations not approved by the Engineer or regulatory agencies.
E. Leave Work area in a neat and uncluttered condition.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction. The Contractor shall temporarily relocate existing mailboxes, road signs, fences, landscaping, etc. during construction and re-install them at their original location once the work is completed.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement, slabs, sidewalks, curbs, and gutters to remain before removing existing pavement. Saw-cut faces vertically.

3.6 ROUGH GRADING

A. Identify required lines, levels, contours, and datum.
B. Identify known underground, above ground, and aerial utilities. Stake and flag locations.
C. Notify utility companies to paint out utility locations.
D. Excavate topsoil and subsoil from areas to be further excavated, re-landscaped, or re-graded.
E. Stockpile topsoil and subsoil in designated area(s).

END OF SECTION 31 00 00

SECTION 31 01 00 – SELECTIVE TREE REMOVAL

PART 1 GENERAL

1.1 This Section includes

A. Protecting existing trees and vegetation to remain.

B. Removal of trees, shrubs, designated plant life and vegetation.

C. Clearing and grubbing.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 31 00 00: Site Clearing

C. Section 31 20 00: Excavation and Fill

D. Section 31 25 00: Erosion and Sediment Control

1.3 DESCRIPTIONS

A. Company Qualifications: The Company performing the work of this section shall be insured and have a minimum of five (5) years of experience in tree removal and trimming. The person supervising the Work shall also have a minimum of five (5) years of experience in tree removal and trimming.

B. The work shall consist of the removal and disposal of selected trees including stumps and roots.

1.4 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil.

B. Clearing: Removal of trees, shrubs, bushes, and other organic matter found at or above original ground level.

C. Remove: Remove existing items from site and legally dispose of them off-site, unless indicated to be removed and reinstalled. Removal shall be completed daily.

D. Existing to Remain: Existing items that are not to be removed and that are not otherwise indicated to be removed or removed and reinstalled.

1.5 SUBMITTALS

A. Submit detailed experience and qualifications description of tree trimming and removal. Experience and qualifications package should include a description of the types of equipment and experience that can be provided.

B. Pre-Construction photographs sufficiently detailed, of existing conditions of trees, adjoining construction, and site improvements. Submit before work begins.

1.6 PROJECT CONDITIONS

A. Protect existing trees and plants during performance of the work unless otherwise indicated. Box trees and plants indicated to remain within the grading limit line with temporary orange construction fencing or solidly constructed wood barricades as required. Protect root systems from smothering. Do not store excavated material, or allow vehicular traffic or parking within the canopy drip line. Restrict foot traffic to prevent excessive compaction of soil over root systems.

1.7 COORDINATION AND SCHEDULING

A. Coordinate work with the Owner to minimize disruptions and facility operations. The Owner shall be notified at least three (3) working days prior to performing the work, and should be provided a schedule for the works progression.

1.8 QUALITY ASSURANCE

A. Comply with hauling and disposal regulations of authorities having jurisdiction.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 PREPARATION AND PROTECTION

A. Prevent damage to buildings, pavement, pipes, conduits, poles and other structures above and below ground that are adjoining or included in the contract area. Repair damage resulting from the contractor's negligence.

B. Protect existing trees and shrubs not to be removed. Cut back to point of branching all broken branches and skinned areas.

C. Store materials and equipment in cleared areas away from tree roots. Prevent employees and equipment from trampling over woodland, existing planting, and established lawns.

3.2 REMOVAL – ENTIRE TREE

A. Remove and dispose of all logs, tree trimmings, and debris from State property. Leave work area in a neat, uncluttered condition, where indicated or specified.

3.3 MAINTENANCE AND RESTORATION

A. Restore grades to indicated levels where settlement or damage due to performance of the work has occurred. Correct conditions contributing to settlement or damage.

B. Restore pavements, walks, curbs, lawns, and other exterior surfaces damaged during performance of the work to match the appearance and performance of existing corresponding surfaces as closely as practicable.

3.4 WORK AREAS AND PERFORMANCE

A. The Owner may limit or restrict work areas and scheduling of the tree trimming and/or removal based upon project progress.

END OF SECTION 31 01 00

SECTION 31 20 00 – EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes:

1. Preparing subgrades for structures, walks, pavements, grasses and plants.
2. Subbase course for concrete slabs, walks and asphalt pavement.
3. Excavating and backfilling trenches for utilities and structures.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 31 00 00: Site Clearing

C. Section 31 01 00: Selective Tree Removal and Trimming

D. Section 31 23 16: Rock Removal

E. Section 32 91 20: Topsoil

F. Section 32 92 19: Seeding

1.3 DEFINITIONS

A. Earth Excavation: The removal of all surface and subsurface material not classified as rock as defined below.

B. Unsatisfactory Soil: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction. Soil that may contain rock or gravel larger than 3 inches in any dimension, frozen materials, organic matter, vegetation, soft, nondurable particles, elongated particles or other deleterious matters.

C. Contaminated Soil: Soil that may require specific disposal method/location as it may contain items such as but not limited to trace/detect chemical, oil or soft or loose bituminous asphalt tar.

D. Construction Debris Soil: Soil containing debris, waste, rubbish, slag, cinders, ashes, metals, or other manmade or foreign materials.

E. Rock: Limestone, sandstone, shale, granite, and similar material in solid beds or masses in its original or stratified position which can be removed only by blasting operations, drilling, wedging, or use of pneumatic tools, and boulders with a volume greater than 1.0 cu yd. Concrete building foundations and concrete slabs, not indicated, with a volume greater than 1.0 cu yd shall be classified as rock.

1. Limestone, sandstone, shale, granite, and similar material in a broken or weathered condition which can be removed with an excavator or backhoe equipped with a bucket with ripping teeth or any other style bucket shall be classified as earth excavation.
2. Masonry building foundations, whether indicated or not, shall be classified as earth excavation.

F. Unclassified Earth Excavation: The excavation and disposal of all surface and subsurface materials of any description necessary to perform the work of this contract. This will include:

1. All soil deposits of any description both above and below groundwater levels. These may be naturally deposited or placed by previous construction operations.

G. Subgrade Surface: Surface upon which subbase or topsoil is placed.

H. Subbase: Select granular material or subbase course Type 2 which is placed immediately beneath pavement or concrete slabs.

I. Maximum Density: The dry unit weight in pounds per cubic foot of the soil at "Optimum Moisture Content" when determined by ASTM D 698 (Standard Proctor), or ASTM D 1557 (Modified Proctor).

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

K. Landscaped Areas: Areas not covered by structures, walks, roads, paving, or parking.

L. Unauthorized Excavation: The removal of material below required elevation indicated on the Drawings or beyond lateral dimensions indicated or specified without specific written direction by the Engineer.

M. Grading Limit Line (Shown on Drawings): Limits of grading, excavations and filling required for the work of this contract. Unless specifically noted otherwise, the Grading Limit Line and Contract Limit Line will be considered the same.

1.3 SUBMITTALS

A. Product Data:

1. Filter Fabric: Manufacturer's catalog sheets, specifications, and installation instructions.
2. Geogrid: Manufacturer's catalog sheets, specifications, and installation instructions.

B. Quality Control Submittals:

1. Subbase Materials: Material Test Reports: Classification according to ASTM D 2487, laboratory compaction curve according to ASTM D 1557 and certified gradation analysis according to ASTM C136 for each soil material proposed for fill and backfill. Name and location of source and the DOT Source Number.
2. Other Aggregates: Name and location of source and soil laboratory test results.

1.4 PROJECT CONDITIONS/COORDINATION AND SCHEDULING

A. Existing Utilities:

1. Coordinate the work to determine the extent of the areas of subsurface investigation required to locate all underground utilities and service connections in the areas of excavation.
2. Coordinate the work with the Owner and Engineer to minimize utility disruptions and facility operations. Provide a schedule for the Work required to the Owner and Engineer for approval. Upon approval of the schedule, notify the Owner and Engineer a minimum of three (3) working days prior to performing the Work.
3. Within the areas of excavation, all underground utilities and service connections shall be field located and their locations marked at least two (2) weeks prior to the performance of the required excavation work.

B. Existing Conditions:

1. Protect existing trees and plants during performance of the work unless otherwise indicated. Box trees and plants indicated to remain within the grading limit line with temporary steel fencing or solidly constructed wood barricades as required. Protect root systems from smothering. Do not store excavated material, or allow vehicular traffic or parking within the branch drip line. Restrict foot traffic to prevent excessive compaction of soil over root systems.
2. Dewatering: Include the disposal of surface water and ground water, which may accumulate in open excavations, unfinished fills, or other low areas. Remove water by pumping, or other methods to prevent softening of exposed surfaces. Surface dewatering plan shall include the rerouting of any storm water runoff or natural drainage if necessary and shall comply with NYS DEC requirements.
3. Protection and Restoration of Surfaces: Protect newly graded areas from traffic, erosion, and settlements. Repair and reestablish damaged or eroded slopes, elevations or grades and restore surface construction prior to acceptance. Protect existing streams, ditches and storm drain inlets from water-borne soil by means of straw bale dikes. Conduct work in accordance with NYS DEC requirements.

C. Cold Weather Requirements:

1. Excavation: When freezing temperatures are anticipated, do not excavate to final required elevations for concrete work unless concrete can be placed immediately.
2. Backfilling: Do not backfill with any frozen soil materials.

D. Thru-traffic or fill placement with heavy construction vehicles or equipment which causes rutting or weaving to occur within the perimeter of a building will not be permitted. If rutting or weaving occurs during placement of fill, place specified fill in a stable area outside building perimeter and spread with tracked equipment to specified layer thickness.

1.5 DELIVERY AND STORANGE

A. Deliver and store materials in a manner to prevent contamination or segregation.

B. Protect filter fabric from sunlight during transportation and storage.

1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Routine testing of existing soils and compacted material for compliance with these Specifications shall be performed by a testing agency acceptable to Engineer.

C. Compacted material that does not meet density requirements shall be removed and/or re-compacted, and retested.

PART 2 PRODUCTS

2.1 MATERIALS

A. Select Granular Fill Material: Stockpiled, sound, durable, sand, gravel, stone, or blends of these materials, free from organic and other deleterious materials. Comply with the gradation and material requirements specified below:

Sieve		**Percent Passing**
Sieve Size	**Size opening (mm)**	
2 inch	50.0	100
No. 40	0.425	0-70
No. 200	0.075	0-15

1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after four test cycles.
2. Plasticity Index: The plasticity index of the material passing the No. 40 mesh sieve will not exceed 5.0.
3. Elongated Particles: Not more than 30 percent, by weight, of the particles retained on a 1/2-inch sieve will consist of flat or elongated particles. A flat

or elongated particle is defined as one which has its greatest dimension more than three times its least dimension.

E. NYSDOT Subbase Course Type 2: Stockpiled, crushed ledge rock or approved blast furnace slag. Comply with the gradation and material requirements specified below:

Sieve		**Percent Passing**
Sieve Size	**Size opening (mm)**	
2 inch	50.0	100
1/4 inch	6.3	25-60
No. 40	0.425	5-40
No. 200	0.075	0-10

1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after four test cycles.
2. Plasticity Index: The plasticity index of the material passing the No. 40 mesh sieve will not exceed 5.0.
3. Elongated Particles: Not more than 30 percent, by weight, of the particles retained on a 1/2-inch sieve will consist of flat or elongated particles. A flat or elongated particle is defined as one which has its greatest dimension more than three times its least dimension.

F. NYSDOT #1 Crushed Stone: Clean, durable, sharp-angled fragments of rock of uniform quality. Comply with the gradation and material requirements specified below:

Sieve		**Percent Passing**
Sieve Size	**Size opening (mm)**	
1 inch	25.0	100
1/2 inch	12.5	90 – 100
¼ inch	6.3	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.

G. NYSDOT #2 Crushed Stone: Clean, durable, sharp-angled fragments of rock of uniform quality. Comply with the gradation and material requirements specified below:

Sieve		**Percent Passing**
Sieve Size	**Size opening (mm)**	
1-1/2 inch	37.5	100
1 inch	25.0	90 – 100

Sieve		Percent Passing
Sieve Size	**Size opening (mm)**	
1/2 inch	12.5	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.

H. NYSDOT #1 Screened Gravel: Clean, durable gravel free from coatings. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	**Size opening (mm)**	
1 inch	25.0	100
1/2 inch	12.5	90 – 100
¼ inch	6.3	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.

I. NYSDOT #2 Screened Gravel: Clean, durable gravel free from coatings. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	**Size opening (mm)**	
1-1/2 inch	37.5	100
1 inch	25.0	90 – 100
1/2 inch	12.5	0-15

1. Magnesium Sulfate Soundness Test: 18 percent maximum loss by weight after ten test cycles.

J. Underdrain Filter Type 2 (NYSDOT 605.10, 733-2002): Material consisting of crushed stone, sand, gravel or screened gravel. Comply with the gradation and material requirements specified below:

Sieve		Percent Passing
Sieve Size	**Size opening (mm)**	
1/2 inch	12.5	100
1/4 inch	6.3	20 – 100
No. 10	2.0	0-15
No. 20	.85	0-5

1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after ten test cycles.

K. Selected Borrow/Fill: Sound, durable, sand, gravel, stone, or blends of these materials, free from organic and other deleterious materials. Comply with the gradation requirements specified below:

Sieve		Percent Passing
Sieve Size	**Size opening (mm)**	
4 inch	101.6	100
No. 40	0.425	0-70
No. 200	0.075	0-15

L. Suitable Material (Fill and Backfill for Landscaped Areas): Material consisting of mineral soil (inorganic), blasted or broken rock and similar materials of natural or man-made origin, including mixtures thereof. Maximum particle size will not exceed 2/3 of the specified layer thickness prior to compaction. NOTE: Material containing cinders, industrial waste, sludge, building rubble, land fill, muck, and peat will be considered unsuitable for fill and backfill, except topsoil and organic silt may be used as suitable material in landscaped areas provided it is placed in the top layer of the subgrade surface.

M. Flowable Fill: Shall consist of a mixture of Portland cement, sand, water and admixtures proportioned to provide a non-segregating, free-flowing, self-consolidating material that will result in a hardened, dense backfill.

1. Shall have a 28-day compressive strength between 40 and 100 psi.

N. Pea Gravel Diaphragm: ASTM D 448 ornamental stone: washed cobbles, size No. 6

O. Bioretention Sand: Shall meet AASHTO M-6 or ASTM C-33 and have a size of 0.02” to 0.04”. Sand substitution such as diabase graystone #10 are not acceptable. No calcium carbonate or dolomitic sand substitute are acceptable. No “rock dust” can be used for sand.

2.2 GEOTECHNICAL FABRIC

A. Filter Fabric (GeoTextile):

1. Pavement Section Geogrid: Tensar TriAx Geogrid or approved equivalent.
2. Erosion Control: Filter X, Mirafi 100X, Stabilinka T140N or approved equivalent.
3. Separation for Underdrains: Amoco 2002 & 2004, Contech Construction Products Inc. C-180, Synthetic Industries Geotex 250ST & 315ST, Mirafi Geolon HP570 & HP1500 or approved equivalent.
4. ADS Geosynthetics 315WTM woven geotextile fabric.
5. ADS Geosynthetics 601T non-woven geotextile fabric.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

3.2 CLEARING AND GRUBBING

A. Clear and grub the site within the grading limit line of trees, shrubs, brush, other prominent vegetation, debris, and obstructions except for those items indicated to remain. Completely remove stumps and roots protruding through the ground surface.

1. Use only hand methods for grubbing inside the drip line of trees indicated to be left standing.
2. Where roots and branches of trees indicated to be saved interfere with new construction, carefully and cleanly cut them back to point of branching.

B. Fill depressions caused by the clearing and grubbing operations in accordance with the requirements for filling and backfilling, unless further excavation is indicated.

3.3 REMOVAL OF TOPSOIL

A. Remove existing topsoil from areas within the Grading Limit Line where excavation or fill is required.

B. Stockpile approved topsoil where directed until required for use. Place, grade, and shape stockpiles for proper drainage.

1. Topsoil will be tested prior to stockpiling. Stockpile only quantities of topsoil approved in writing for re-use.

3.4 UNDERGROUND UTILITIES

A. Locate existing underground utilities prior to commencing excavation work. Determine exact utility locations by hand excavated test pits. Support and protect utilities to remain in place.
B. Do not interrupt existing utilities that are in service until temporary or new utilities are installed and operational.
C. Utilities to remain in service: Will be re-routed as shown on the Contract Drawings.
D. Utilities abandoned beneath and five feet laterally beyond the structure’s proposed footprint will be removed in their entirety. Excavations required for their removal will be backfilled and compacted as specified herein.

E. Utilities extending outside the five feet limit specified above may be abandoned in place provided their ends are adequately plugged as described below.

1. Permanently close open ends of abandoned underground utilities exposed by excavations, which extend outside the limits of the area to be excavated.
2. Close open ends of metallic conduit and pipe with threaded galvanized metal caps or plastic plugs or other approved method for the type of material and size of pipe. Do not use wood plugs.
3. Close open ends of concrete and masonry utilities with concrete or flow-able fill.

3.5 EXCAVATION

A. Excavate earth as required for the Work.
B. Install and maintain all erosion and sedimentation controls during all earthwork operations as specified on the Contract Drawings.
C. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Comply with Code of Federal Regulations Title 29 - Labor, Part 1926 (OSHA).

1. Trenches: Deposit excavated material on one side of trench only. Trim banks of excavated material to prevent cave-ins and prevent material from falling or sliding into trench. Keep a clear footway between excavated material and trench edge. Maintain areas to allow free drainage of surface water.

D. Stockpile excavated materials classified as suitable material where directed, until required for fill. Place, grade, and shape stockpiles for proper drainage as approved by the Engineer.
E. Excavation for Structures: Conform to elevations, lines, and limits indicated. Excavate to a vertical tolerance of plus or minus 1 inch. Extend excavation a sufficient lateral distance to provide clearance to execute the work.
F. Slabs and Floors: Excavate to the following depths below bottom of concrete for addition of select granular material:

1. Interior Floors: 6 inches unless otherwise indicated.
2. Exterior Slabs and Steps: 12 inches unless otherwise indicated.

G. Pipe Trenches: Open only enough trench length to facilitate laying pipe sections. Unless otherwise indicated on the Drawings, excavate trenches approximately 24 inches wide plus the outside pipe diameter, equally divided on each side of pipe centerline. Cut trenches to cross section, elevation, profile, line, and grade indicated. Accurately grade and shape trench bottom for uniform bearing of pipe in undisturbed earth. Excavate at bell and coupling joints to allow ample room for proper pipe connections.

1. Trench in Rock: Excavate an additional 6 inches below bottom of pipe for bed of cushion material under the piping.

H. Open Ditches: Cut ditches to cross sections and grades indicated.
I. Pavement: Excavate to subgrade surface elevation.
J. Unauthorized Excavations: Unless otherwise directed, backfill unauthorized excavation under footings, foundation bases, and retaining walls with compacted select granular material without altering the required footing elevation.

Elsewhere, backfill and compact unauthorized excavation as specified for authorized excavation of the same classification, unless otherwise directed by the Engineer.

K. Notify the Engineer upon completion of excavation operations. Do not proceed with the work until the excavation is inspected and approved. Inspection of the excavation by the Engineer will be made on three working days notice.

L. Removal of Unsuitable Material Beneath Structures and Other Improvements: Excavate encountered unsuitable materials, which extend below required elevations, to additional depth as directed by the Engineer. Have cross sections taken to determine the quantity of such excavation. Do not backfill this excavation prior to quantity measurement.

3.6 DEWATERING

A. Prior to the performance of any excavations provide dewatering methods such that the groundwater table is maintained at an elevation that is beneath the excavated depth.

B. Prevent surface and subsurface water from flowing into excavations and trenches and from flooding the site and surrounding area.

C. Do not allow water to accumulate in excavations or trenches. Remove water from all excavations immediately to prevent softening of undercutting footings, and soil changes detrimental to the stability of subgrades. Furnish and maintain pumps, sumps, suction and discharge piping systems, and other system components necessary to convey the water away from the Site.

D. Convey water removed from excavations, and rain water, to collecting or run-off area. Cut and maintain temporary drainage ditches and provide other necessary diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

E. Provide temporary controls to restrict the velocity of discharged water as necessary to prevent erosion and siltation of receiving areas.

3.7 SUBGRADE SURFACE FOR WALKS AND PAVEMENT

A. Shape and grade subgrade surface as follows:

1. Walks: Shape the surface of areas under walks to required line, grade and cross section, with the finish surface not more than 1 inch above or below the required subgrade surface elevation.
2. Pavements: Shape the surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subgrade surface elevation.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Thoroughly compact subgrade surface for walks and pavement by mechanical rolling, tamping, or with vibratory equipment as approved to the density specified.

3.8 PLACING GEOTECH FABRIC

A. Place and overlap geotech fabric in accordance with the manufacturer’s installation instructions, unless otherwise shown.
B. Cover tears and other damaged areas with additional fabric layer extending three feet beyond the damage.
C. Do not permit traffic or construction equipment directly on fabric.
D. Backfill over fabric within two weeks after placement. Backfill in accordance with the fabric manufacturer’s instructions and in a manner to prevent damage to the fabric.

3.9 PLACING FILL AND BACKFILL

A. Surface Preparation of Fill Areas: Strip topsoil, remaining vegetation, and other deleterious materials prior to placement of fill. Remove all asphalt pavement in its entirety from areas requiring the placement of fill or break up old pavements to a maximum size of four inches. Prior to placement of fill, smooth out and compact areas where wheel rutting has occurred due to stripping or earthwork operations.
B. Place backfill and fill materials in layers not more than eight inches thick in loose depth unless otherwise specified. Before compaction, moisten or aerate each layer as necessary to facilitate compaction to the required density. Do not place backfill or fill material on surfaces that are muddy, frozen, or covered with ice.

    1. Place fill and backfill against foundation walls, and in confined areas such as trenches not easily accessible by larger compaction equipment, in maximum six inch thick loose depth layers.
    2. For large fill areas, the layer thickness may be modified by the Engineer, at the Contractor’s written request, if in the Engineer’s judgment, the equipment used is capable of compacting the fill material in a greater layer thickness. This request will include the type and specifications of compaction equipment intended for use.

C. Under Exterior Concrete Slabs and Steps:

    1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.
    2. Subbase Material: Place 12 inches of select granular material over subgrade surface.

D. Under Pavements and Walks:

    1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.
    2. Subbase Material: Place as indicated.

E. Landscaped Areas: Place suitable material when required to complete fill or backfill areas up to subgrade surface elevation. Do not use material containing rocks over four inches in diameter within the top 12 inches of suitable material.
F. Plastic Pipe in Trenches: Place cushion material a minimum of six inches deep under pipe, 12 inches on both sides, and 12 inches above top of pipe. Complete balance of backfill as specified.

    1. Trench in Rock: Place a minimum six-inch-deep bed of cushion material under pipe.

G. Backfilling Excavation Resulting From Removal of Unsuitable Material Beneath Structures and Other Improvements: Backfill the excavation with compacted select granular material.

3.10 COMPACTION

A. All materials with exception of open graded stone:

1. Compact each layer of fill and backfill for the following area classifications to the percentage of maximum density specified below and at a moisture content suitable to obtain the required densities, but at not less than three percent drier or more than two percent wetter than the optimum content as determined by ASTM D 698 (Standard Proctor) or 1557 (Modified Proctor).
   a. Structures (entire area within ten feet outside perimeter): 95 percent.
   b. Concrete Slabs and Steps: 95 percent.
   c. Landscaped Areas: 90 percent.
   d. Pavements and Walks: 95 percent.
   e. Pipes and Tunnels: 95 percent.
   f. Pipe Bedding: 95 percent.

2. When the existing ground surface to be compacted has a density less than that specified for the particular area classification, break up and pulverize, and moisture condition to facilitate compaction to the required percentage of maximum density.
3. Moisture Control:
   a. Where fill or backfill must be moisture conditioned before compaction, uniformly apply water to the surface and to each layer of fill or backfill. Prevent ponding or other free water on surface subsequent to, and during compaction operations.
   b. Remove and replace, or scarify and air dry, soil that is too wet to permit compaction to specified density. Soil that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a value which will permit compaction to the percentage of maximum density specified.

4. If a compacted layer fails to meet the specified percentage of maximum density, the layer will be recompacted and retested. If compaction cannot be achieved the material/layer will be removed and replaced. No additional material may be placed over a compacted layer until the specified density is achieved.

3.11 ROUGH GRADING

A. Exterior Grading: Trim and grade area within the grading limit line and excavations outside the limit line, required by this Contract, to a level of 4 inches below the finish grades indicated unless otherwise specified herein or where greater depths are indicated. Provide smooth uniform transition to adjacent areas.

1. Slope cut and fill in transition areas, outside of the grading limit line, to meet corresponding levels of existing grades at a slope of 1 vertical to 2 horizontal unless otherwise indicated.
2. Landscaped Areas: Provide uniform subgrade surface within 1 inch of required level to receive topsoil thickness specified. Compact fill as specified to within three inches of subgrade surface. Remove objectionable material detrimental to proper compaction or to placing full depth of topsoil. If the top three inches of subgrade has become compacted before placement of topsoil, harrow or otherwise loosen rough graded surface to receive topsoil to a depth of three inches immediately prior to placing topsoil.

3.12 FINISH GRADING

A. Uniformly grade rough graded areas within limits of the grading limit line to finish grade elevations indicated.
B. Grade and compact to smooth finished surface within tolerances specified, and to uniform levels or slopes between points where finish elevations are indicated or between such points and existing finished grade.
C. Grade areas adjacent to building lines so as to drain away from structures and to prevent ponding.
D. Finish surfaces free from irregular surface changes, and as follows:

1. Grassed Areas: Finish areas to receive topsoil to within one inch above or below the required subgrade surface elevations.
2. Walks: Place and compact subbase material as specified. Shape surface of areas under walks to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subbase elevation.
3. Pavements: Place and compact subbase material as specified. Shape surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subbase elevation.

3.13 MAINTENANCE AND RESTORATION

A. Restore grades to indicated levels where settlement or damage due to performance of the work has occurred. Correct conditions contributing to settlement. Remove and replace improperly placed or poorly compacted fill materials.
B. Restore pavements, walks, curbs, lawns, and other exterior surfaces damaged during performance of the work to match the appearance and performance of existing corresponding surfaces as closely as practicable.
C. Water seeded areas as required until physical completion of the work.

3.14 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS

A. Remove from property and dispose of excess and unsuitable materials, including materials resulting from clearing and grubbing and removal of existing improvements.
B. Transport excess and unsuitable materials, including materials resulting from clearing and grubbing and removal of existing improvements, to spoil areas on property, and dispose of such materials as directed.
C. Transport excess topsoil to areas on property designated by the Engineer. Smooth grade deposited topsoil.

3.15 FIELD QUALITY CONTROL

A. Special Inspections: A qualified special inspector shall perform the following special inspections:

   1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
   2. Determine that fill material and maximum lift thickness comply with requirements.
   3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: A qualified geotechnical engineering testing agency shall perform tests and inspections.
C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.16 PROTECTION

A. Protect graded areas from traffic and erosion, and keep them free of trash and debris.
B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

   1. Scarify or remove and replace soil material to depth as directed by Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 31 20 00

SECTION 31 23 16 – ROCK REMOVAL

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 31 20 00: Excavation and Fill

1.2 DEFINITIONS

A. Rock: Limestone, sandstone, shale, granite, and similar material in solid beds or masses in its original or stratified position which can be removed only by blasting operations, drilling, wedging, or use of pneumatic tools, and boulders with a volume greater than 1.0 cu yd. Concrete building foundations and concrete slabs, not indicated, with a volume greater than 1.0 cu yd shall be classified as rock.

1. Limestone, sandstone, shale, granite, and similar material in a broken or weathered condition which can be removed with an excavator or backhoe equipped with a bucket with ripping teeth or any other style bucket shall be classified as earth excavation.
2. Masonry building foundations, whether indicated or not, shall be classified as earth excavation.

B. Unauthorized Rock Removal:

1. The removal of any rock prior to performing the measurements/work required to determine quantities (Paragraph 3.01 B).
2. The removal of material below required elevation indicated on the Drawings or beyond lateral dimensions indicated or specified without specific written direction by the Director.

C. General Rock Removal: Quantities of rock removal will be paid for as General Rock Removal when:

1. The width of rock removed, as per measurement limits, is greater than or equal to the total excavation depth required.
2. Boulders removed have a volume greater than 1.0 cu yd.

D. Trench and Pier Rock Removal: Quantities of rock removal will be paid for as Trench and Pier Rock Removal when the width of rock removed, as per measurement limits, is less than the total excavation depth required.

1.3 SUBMITTALS

A. Rock Removal Procedure: Submit a detailed outline of intended rock removal procedure for the Director's information. This submittal will not relieve the Contractor of responsibility for the successful performance of method used.
   1. Where blasting is permitted, show drill hole pattern, method of blasting, explosive types, and amount of explosive load.

B. Quality Control Submittals:
   1. Certificates: Competency affidavit required under Quality Assurance Article.
   2. Blasters Qualifications Data: Submit the following for each blaster:
   3. Name, and employer's name, business address and telephone number.
   4. Names and addresses of the required number of similar projects which meet the experience criteria.

C. Measurement data for quantities of rock removal.

1.4 QUALITY ASSURANCE

A. Blasters' Qualifications: The persons performing the blasting operations shall be personally experienced in the handling and use of explosives, shall furnish satisfactory evidence of competency in performing in a safe manner the type of blasting required, and shall have performed blasting operations on 5 similar projects.

B. Regulatory Requirements: Obtain the proper Permit to Blast from authorities having jurisdiction before explosives are bought to the site.

C. Certifications: Affidavit, for each blaster, certifying that blaster is competent in performing the type of blasting required.

D. Pre-Rock Removal Conference: Before the rock removal work is scheduled to commence, a conference will be called by the Director's Representative at the site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by the Contractor's Representative and the person supervising the rock removal operations.

1.5 PROJECT CONDITIONS

A. Blasting and the use of explosive materials will not be permitted.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION, VERIFICATION & MEASUREMENT

A. Examination of Existing Property and Construction: Prior to starting rock removal Work, thoroughly examine the existing property and construction at the site and record, with notes and drawings or other documentation, existing defects and deterioration. Make this information available to the Engineer upon request.

B. Prior to removing material classified as rock, excavate test pits down to rock for the purpose of verifying the presence of sound rock and determining top of rock elevations.

1. Verification of Sound Rock: Demonstrate to the Engineer that materials to be classified as rock cannot be removed utilizing a backhoe or excavator equipped with any form of bucket, including a bucket equipped with ripping teeth.
2. Required Measurements: Take elevations and measurements as required for the purpose of determining the quantities of rock removal. Record all measurement data and submit a copy of the data to the Engineer. Backfill test pits prior to rock removal as directed. Unless otherwise indicated or directed, excavate test pits as follows:
   a. For Structures: One pit for each structure or one pit for each 1000 sq ft, whichever is greater.
   b. For Paved Areas: 3 pits for each 2500 sq ft.
   c. For Utility Lines: One pit for each 100 lin ft.

3.2 SITE PREPARATION

A. Schedule a site meeting with the Engineer and facility personnel to review the rock removal procedures in detail.

B. If required, have seismographs in place and operational as well as all safety equipment and/or fencing.

3.3 ROCK REMOVAL

A. Remove rock as required and necessary for the installation of the work on as shown on the Contract Drawings. Make sufficient clearance, within the limits specified, for the proper execution of the work.

B. Volume Determination: Top of Rock Elevations established prior to the performance of any rock removal (Section 3.01 B) will be used to determine the depth of rock removed. Measurements for the base and width of the rock excavation shall be taken of the actual rock cut, as required for the Work, or to the specified measurement limits, whichever is smaller. Unless otherwise directed in writing, measurement limits for this work shall be as follows:

1. Cast-In-Place Concrete:
    a. Vertical Limit: Bottom of rock cut for cast-in-place concrete bearing on rock shall be the bottom of concrete elevation indicated on the Drawings.
    b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth of Rock Cut	**Distance Beyond Edge of Concrete in Each Direction**
Under 3 Feet	18 Inches
3 to 15 Feet	24 Inches
Over 15 Feet	30 Inches

2. Precast Concrete Structures: Measurement will be based on the size of the precast concrete structure specified or indicated on the Drawings.
    a. Vertical Limit: Bottom of rock cut for precast concrete structure shall be 12 inches below the required bottom of structure elevation.
    b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth of Rock Cut	**Distance Beyond Edge of Concrete in Each Direction**
Under 5 Feet	12 Inches
5 to 15 Feet	18 Inches
Over 15 Feet	24 Inches

3. Pipe:
    a. Vertical Limit: Bottom of rock cut for pipe in trench shall be 6 inches below the required pipe invert elevation, with depth measured from the mean surface of the rock.
    b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth of Rock Cut	Trench Width
Under 10 Feet	24 Inches plus Pipe OD
10 to 15 Feet	36 Inches plus Pipe OD
Over 15 Feet	48 Inches plus Pipe OD

3.4 FIELD QUALITY CONTROL

A. Provide the Engineer with the recorded top of rock elevations. Prior to the performance of any rock removal operations obtain, in writing, that the Engineer as reviewed the information and is in agreement with the measurements taken.

B. Notify the Engineer at least 3 work days in advance of all phases of blasting operations.

C. Allow time for visual inspection of bottom of rock cut required for the work.

3.3 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS

A. Remove from site and dispose of excess and unsuitable rock materials.

B. Transport excess and unsuitable rock materials to spoil areas on site designated by the Engineer, and dispose of such materials as directed.

3.4 ADJUSTING

A. Unauthorized Rock Removal:

a. Horizontal Direction: Backfill and compact unauthorized rock removal in the horizontal direction as specified for authorized excavation of the same classification, unless otherwise directed.

b. Vertical Direction: Immediately report unauthorized rock removal in the vertical direction to the Engineer. Correct unauthorized rock removal in the vertical direction in accordance with directions of the Engineer.

3.4 CLEANING

A. Where footings and walls will rest entirely on rock, clean rock surfaces free of soil and loose rock.

END OF SECTION 31 23 16

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SECTION 31 23 19 – DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes construction dewatering.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 31 20 00: Excavation and Fill

1.3 SUBMITTALS

A. Field quality-control reports.

B. Existing Conditions: Using photographs, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before work begins.

C. Record Drawings: Identify locations and depths of abandoned-in-place dewatering equipment.

D. Shop Drawings: Submit drawings and diagrams, with all pertinent data, showing the dewatering system proposed for use. Indicate the spacing and location of wellpoints and reading wells, and location of header lines, pumps, valves and discharge lines.

1.3 QUALITY ASSURANCE

A. Qualifications: The work of this Section shall be performed by a firm experienced in wellpoint dewatering work. The firm shall have satisfactorily completed such work for at least 5 projects of comparable size.

B. The dewatering system shall consist of equipment, appliances and materials designed or suitable for controlling groundwater in construction work.

1.4 PROJECT CONDITIONS

A. Blasting and the use of explosive materials will not be permitted.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities

having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

3.2 INSTALLATION

A. Install the dewatering system in accordance with approved shop drawings and as required by site conditions. Locate elements of the system to allow a continuous dewatering operation without interfering with the installation of any permanent project work.
   a. Space well points or wells at intervals required to provide sufficient dewatering.
   b. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.3 OPERATIONS

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
   a. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
   b. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
   c. Maintain piezometric water level a minimum of 24 inches below bottom of excavation.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap below overlying construction.

3.4 FIELD QUALITY CONTROL

A. Maintain a careful check to detect any settlement in existing adjacent Work. Notify the Engineer of any signs of settlement. Establish settlement point benchmarks and take periodic readings when directed.
B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation. Prepare reports of observations.

3.5 PROTECTION

A. Protect and maintain dewatering system during dewatering operations. Promptly repair damages to adjacent facilities caused by dewatering.

3.6 REMOVAL

A. When the dewatering system is no longer required and when directed, dismantle and remove the system and all appurtenances from the site.

END OF SECTION 31 23 19

SECTION 31 25 13 – EROSION AND SEDIMENT CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Furnish, install, inspect, maintain, and remove soil erosion and sediment control measures during construction as shown on the Contract Documents prepared for this project.
   2. Minimize the potential short-term adverse environmental impacts associated with construction activity in environmentally sensitive areas.
   3. Assure the quantity and quality of stormwater runoff is not substantially altered due to construction activities.
   4. Stabilize slopes and protect offsite areas by the installation and maintenance of stabilization and erosion control measures.
   5. Dewatering operation procedure.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Section 31 20 00: Excavation and Fill

1.3 REFERENCE STANDARDS

A. New York Standards and Specifications for Erosion and Sediment Control, NYSDEC, latest edition.
B. NYSDEC: Reducing the Impacts of Stormwater Runoff for New Development, latest edition.
C. NYSDEC Environmental Conservation Law, Article 17. Titles 7, 8 and Article 70.
D. 6 NYCRR Parts 611 – 613 and all additions.
E. OSHA 40 CFR Part 258 and all additions. New York State: Standards and Specifications for Erosion and Sediment Control, latest edition.

1.4 PROJECT CONDITIONS

A. A Storm Water Pollution and Prevention Plan (SWPPP) has been prepared for this project. Install and maintain the temporary storm water and diversion control items as shown on the drawings before starting any grading or excavation and maintain compliance of all Storm Water Pollution Plan/SPDES regulations. Provide any temporary sediment and erosion control measures that may be required within limits of the work, including any staging areas, throughout construction in conformance with the plan, and as directed by the Director's Representative. Place the permanent control practices required before the removal of the temporary storm water diversion and control items.

B. During construction conduct operations in such a manner as to prevent or reduce to a minimum any damage to any water body from pollution by debris, sediment, chemical or other foreign material, or from the manipulation of equipment and/or materials in or near a stream or ditch flowing directly to a stream. Any water which has been used for wash purposes or other similar operations which become polluted with sewage, silt, cement, concentrated chlorine, oil, fuels, lubricants, bitumens, or other impurities shall not be discharged into any water body.

C. In the event of conflict between these specifications and the regulation of other Federal, State, or local jurisdictions, the more restrictive regulations shall apply.

D. The Contractor shall adhere to all requirements of the Storm Water Pollution Prevention Plan as presented on the Contract Drawings and the SWPPP.

E. The Contractor will submit copies of certificates documenting that on-site workers have completed a NYS Department of Environmental Conservation endorsed Erosion & Sediment Control training as required by State Pollutant Discharge Elimination System (SPDES) General Permit for Stormwater Discharges from Construction Activity (GP-0-20-001).

F. The Work shall consist of furnishing, installing, inspecting, maintaining, and removing soil and erosion control measures as shown on the contract documents or as ordered by the Director's Representative during the life of the contract to provide erosion and sediment control.

G. Temporary structural measures provide erosion control protection to a critical area for an interim period. A critical area is any disturbed, denuded slope subject to erosion. These are used during construction to prevent offsite sedimentation. Temporary structural measures shall include check dams, construction road stabilization, stabilized construction entrance, dust control, earth dike, level spreader, perimeter dike/swale, pipe slope drain, portable sediment tank, rock dam, sediment basin, sediment traps, silt fence, storm drain inlet protection, straw/hay bale dike, access waterway crossing, storm drain diversion, temporary swale, turbidity curtain, water bars or other erosion control devices or methods as required.

H. Permanent structural measures also control protection to a critical area. They are used to convey runoff to a safe outlet. They remain in place and continue to function after completion of construction. Permanent structural measures shall include debris basins, diversion, grade stabilization structure, land grading, lined waterway (rock), paved channel, paved flume, retaining wall, riprap, rock outlets, and stream bank protection or other erosion control devices or methods as required.

I. Vegetative measures shall include brush matting, dune stabilization, grassed waterway, vegetating waterway, mulching, protecting vegetation, seeding, sod, straw/hay bale dike, stream bank protection, temporary swale, topsoil, and vegetating waterways.

J. Biotechnical measures shall include wattling (live fascines, brush matting, brush layering, live cribwall, and branchpacking) vegetated rock gabions, live staking, tree revetment, and fiber rolls.

K. Weekly inspections will be completed by the Engineer. Comply with and correct all deficiencies found as a result of these inspections. At the end of the construction season when soil disturbance activities will be finalized or suspended until the following spring, the frequency of the inspections may be reduced. If soil disturbance is completely suspended and the site is properly stabilized, a minimum of monthly inspections must be maintained. The stabilization activities must be completed before snow cover or frozen ground. If vegetation is required, seeding, planting and/or sodding must be scheduled to avoid die-off from fall frosts and allow for proper germination/establishment. Weekly inspections must resume no later than March 15.

1.5 DEFINITIONS

A. Stabilized Construction Entrance: A stabilized pad of aggregate underlain with geo-textile where traffic enters a construction site to reduce or eliminate tracking of sediment to public roads.

B. Dust Control: Prevent surface and air movement of dust from disturbed soil surfaces.

C. Portable Sediment Tank: A compartmented tank to which sediment laden water is pumped to retain sediment before pumping the water to adjoining drainage ways.

D. Sediment Basin: A barrier constructed across a drainage way to intercept and trap sediment.

E. Sediment Traps: A control device formed by excavation to retain sediment at a storm inlet or other points of collection.

F. Silt Fence: A barrier of geo-textile fabric installed on contours across the slope to intercept runoff by reducing velocity. Replace after 1 year.
G. Storm Drain Inlet Protection: A semi-permeable barrier installed around storm inlets to prevent sediment from entering a storm drainage system.
H. Straw/Hay Bale Dike: Intercept sediment laden runoff by reducing velocity. Replace after 3 months.
I. Storm drain Diversion: The redirection of a storm drain line or outfall channel for discharge into a sediment trapping device.
J. Temporary Swale: A temporary excavated drainage swale.
K. Protecting Vegetation: Protecting trees, shrubs, ground cover and other vegetation from damage.
L. Temporary Seeding: Erosion control protection to a critical area for an interim period. A critical area is any disturbed, denuded slope subject to erosion.
M. Permanent Seeding: Grasses established and combined with shrubs to provide perennial vegetative cover on disturbed, denuded, slopes subject to erosion.
N. Sod: Used where a quick vegetative cover is required.

1.6 SUBMITTALS

A. Product Data: Manufacturer's catalog cuts, specifications and installation instructions.
B. Contingency Action Plan for prompt remedial action in the event spillage of petroleum products or other pollutants should occur. Contingency Action Plan shall be submitted to the Engineer for acceptance prior to the start of construction.
C. Name and location of all material suppliers.
D. Certificate of compliance with the standards specified above for each source of each material.
E. List of disposal sites for waste and unsuitable materials and all required permits for use of those sites.
F. Where a Stormwater Pollution Prevention Plan has been prepared, the Engineer shall file a Notice of Intent (NOI) with NYSDEC prior to commencing construction activities and a Notice of Termination (NOT) with NYSDEC following construction.
G. Where a Stormwater Pollution Prevention Plan has been prepared, the Contractor will submit copies of certificates documenting that on-site workers have completed a NYS Department of Environmental Conservation endorsed Erosion & Sediment Control training as required by General Permit GP-0-20-001. The Contractor will submit copies of

certificates documenting that on-site workers have completed a NYS Department of Environmental Conservation endorsed Erosion & Sediment Control training as required by General Permit GP-0-20-001.

PART 2 PRODUCTS

2.1 MATERIALS

A. Silt Fence
   1. Mirafi, Envirofence365 South Holland Drive, Pendergrass, Ga, 30567, (888) 795-0808, http://www.tencategeo.us/en-us/
   2. Filter X
   3. Stabilinka T140N
   4. Approved equivalent

B. Filter fabric inlet protection

C. Stone and block inlet protection

D. Temporary filters for inlet protection

E. Hardwood staking material

F. Stone material

G. Dry Rip Rap
   1. NYSDOT Standard Specification Section 620

H. Slope stabilization fabric

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to any construction activities, install temporary erosion and sediment control barriers or measures as indicated on the Contract Drawings, per manufacturer's specifications

B. Where a Stormwater Pollution Prevention Plan has been prepared, the Contractor shall comply with all provisions of the "Stormwater Pollution Prevention Plan", prepared by Passero Associates

C. The Contractor shall be required to protect and preserve existing trees and shrubs in areas designated on the Contract Drawings. Contractor shall replace any tree or shrubs damaged in kind to the satisfaction of the Owner.

D. The Contractor shall contact the Engineer once the erosion and sediment control structures have been installed.

E. Prior to commencement of construction, the Engineer shall conduct an assessment of the site and certify that the appropriate erosion and sediment control structures as shown on the Contract Drawings have been adequately installed and implemented.

F. Staging of Earthwork Activities: All earthwork shall be scheduled so that the smallest possible areas will be unprotected from erosion for the shortest time feasible.

G. Vegetation adjacent to or outside of access roads or rights-of-way shall not be damaged.

H. The Engineer has the authority to limit the surface area of erodible earth exposed by earthwork operations and to direct the Contractor to provide immediate temporary or permanent erosion measures to minimize damage to property and contamination of watercourses and water impoundments. Under no circumstances will the area of erodible earth material exposed at one time exceed 5 acres. The Engineer may increase or decrease this area of erodible earth material exposed at one time as determined by their analysis of project, weather and other conditions. The Engineer may limit the area of clearing and grubbing and earthwork operations in progress commensurate with the Contractor's demonstrated capability in protecting erodible earth surfaces with temporary, permanent, vegetative or biotechnical erosion control measures.

I. Schedule the work so as to minimize the time that earth areas will be exposed to erosive conditions. Provide temporary structural measures immediately to prevent any soil erosion.

J. Provide temporary seeding on disturbed earth or soil stockpiles exposed for more than 7 days or for any temporary shutdown of construction. In spring, summer or early fall apply rye grass at a rate of 1 lb/ 1000 sq.ft. In late fall or early spring, apply certified Aroostook Rye at a rate of 2.5 lbs./ 1000 sq. ft. Apply hay or straw at a rate of 2 bales/ 1000 sq. ft. or wood fiber hydromulch at the manufacturer's recommended rate. Hay or straw shall be anchored.

K. Provide temporary grading to facilitate dewatering and control of surface water.

L. Coordinate the use of permanent controls or finish materials shown with the temporary erosion measures.

M. After final stabilization has been achieved, temporary sediment and erosion controls must be removed. Areas disturbed during removal must be stabilized immediately.

N. Disposal of spoil material shall not be in any flood plain, wetland, stream, brook, or sensitive environmental area. The Contractor shall dispose of spoils within staging areas and provide sediment control barriers accordingly.

3.2 CLEARING

A. Tree trunks and roots, vegetation, and project debris shall not be buried on site.

B. Staging areas (for storage of materials and stockpiles) shall be located as shown on the plans. Where areas must be cleared for staging area temporary structures, provisions shall be made for regulating drainage and controlling erosion.

C. All abandoned or useless objects including equipment, supplies, personal property, rubbish, (including those present prior to construction activities) should be removed from the project work area and properly disposed of in accordance with local, state, and federal regulations.

3.3 SWPPP COMPLIANCE

A. The Owner shall have a qualified professional, as described in the NYSDEC SPDES General Permit for Stormwater Discharge from Construction Permit No. GP-0-20-001, conduct a site inspection following the commencement of construction at least every 7 calendar days.

B. All erosion and sediment control devices must be maintained in working order until the site is stabilized. All preventative and remedial maintenance work, including clean out, repair, replacement, re-grading, re-seeding, or re-mulching, must be performed immediately.

C. The Contractor shall, at the direction of the Engineer, use necessary methods to minimize erosion within access roads, especially in areas that drain to watercourse areas.

D. Cuts, fills, and other disturbed areas will be maintained to prevent erosion until adequate vegetative/impervious cover is established.

E. Water, resulting from dewatering operations that will reduce the quality of receiving waters shall not be directly discharged. The Contractor shall provide, install, and maintain sump pits where necessary to dewater operations as detailed on the plans. Stone used within the sump pits shall be washed clean stone. The Contractor shall provide, install and maintain dewatering bags, as deemed necessary to control sediment deposits at critical environmental areas. Lifting straps shall be placed under the unit to facilitate removal after use. Dewatering bags shall be placed on stabilized areas over grass. Discharge hose from pump shall be inserted a minimum of six inches and tightly secured with attached strap to prevent water from flowing out of the unit without being filtered. Water from dewatering operations shall be treated to eliminate the discharge of sediment and other pollutants to streams and watercourses. The unit shall be replaced when it is half full of sediment or when the sediment has reduced the flow rate of the pump discharge to an impractical rate. Remove and dispose of sediment and dewatering bag off-site.

F. Silt fence, where identified on plans, shall be installed at down gradient locations to control sediment deposits off-site at critical environmental areas. The silt fence shall be staked (unless noted otherwise), anchored and set as per manufactures specifications. The silt fence shall be inspected on a daily basis and after a rain fall event and repaired as necessary.

G. A stabilized construction entrance shall be installed and maintained for vehicular access on and off site. The entrance shall be constructed of 2" stone, or approved equal, and shall have a minimum length of 50 feet. The condition of the entrance shall be inspected daily and repaired as necessary.

H. Dust control shall be controlled by the use of water, or calcium chloride application. Water application shall be applied at a rate where mud is not produced. The rate of application of the calcium chloride shall not exceed Federal, State and Local application rates or manufactures recommendations. Dust control shall be applied on adjacent public streets.

I. Dry rip-rap shall conform to the lines, grades and thicknesses indicated on construction plans. It shall be a well-graded mass of variable size stones with no areas of uniform size material. Align stones to obtain a close fit and to minimize voids. Fill spaces between stones with spalls of suitable size.

J. Paved areas within access corridors and parking areas shall be swept on a regular basis (minimum twice per week) as needed to minimize sediment and dust tracked from the work area. Should sediment and dust be tracked off-site, Contractor shall be responsible for sweeping public streets.

K. During the final site restoration, the Contractor shall remove all sediment and debris deposited in the temporary and permanent erosion and sediment control barriers or measures including but not limited to all culverts and drainage swales, at no additional cost to the Owner.

L. When all disturbed areas are stable, all temporary erosion and sediment control measures shall be removed per the approval of the Engineer. The measures are temporary and shall be removed and the areas restored to its original condition when they are no longer required, at no additional cost to the Owner.

M. The Owner and Contractor shall maintain a record of all erosion and sediment control inspection reports at the site in a log book. The site log book shall be maintained on the site and be made available to the permitting authority. The Owner / Contractor shall post at the site, in a publicly accessible location, a summary of the site inspection activities on a monthly basis.

N. The Contractor is fully responsible for maintaining, repairing, and protecting his work throughout the project, at no additional cost to the Owner, until the Owner accepts the work.

END OF SECTION 31 25 13

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SECTION 32 12 16 – ASPHALT PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Hot-mixed asphalt pavement for roads
B. Hot-mixed asphalt patching

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Section 31 20 00: Excavation and Fill
C. Section 32 17 23: Pavement Marking

1.3 REFERENCE STANDARDS

A. New York State Department of Transportation (DOT) Specification Section 400, latest edition.

1.4 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Discontinue paving when surface temperatures fall below requirements listed in DOT Table 402-1 unless otherwise specified in the General Conditions of this Contract or as directed by the Engineer.
   2. Do not place asphalt concrete on wet surfaces, or when weather conditions otherwise prevent the proper handling or finishing of bituminous mixtures as determined by the Engineer.
   3. Pavement is restricted by dates listed in the General Conditions or by temperatures.

1.5 SUBMITTALS

A. Product Data:
   1. Paving Synthetics: including Manufacturer’s name, specifications, MSDS as required and installation instructions (including adhesion type and rate) for each item specified.
   2. Asphaltic Pavement: Include mix design from NYSDOT approved Batch Plant, Mix Design Test results that are less than 6 months old
B. Batch plant name, NYSDOT Plant Number, and location of asphalt plant.
C. Pavement Quality Control Submittals: Material Delivery Tickets

1. At the time of delivery, a copy of the delivery ticket must be presented to the Director’s Representative with the following minimum information:
    a. Ticket Number.
    b. Plant Identification.
    c. Project Name.
    d. Mix Type.
    e. Quantity of material in vehicle.
    f. Date and Time.

D. Qualification Data: For manufacturer and testing agency.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the NYSDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the NYSDOT for asphalt paving work.

D. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

PART 2 PRODUCTS

2.1 AGGREGATES

A. All aggregate used in design mixes shall be as specified in DOT Specification Section 401-2.02 B.; Coarse Aggregate Type F2 Conditions.

B. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel.

2.2 ASPHALT MATERIALS

A. General: Use locally available materials and gradations that exhibit a satisfactory record of previous installations.

B. Asphalt Pavement: Paving materials shall comply with the New York State Department of Transportation Standard Specification dated “Current Version.” Section 400 – Hot Mix Asphalt.

C. Trueing & Leveling Course: DOT Table 401-1 Composition of Hot Mix Asphalt Mixtures, Type 5 (Shim).

D. Asphalt Cement: ASTM D 3381 for viscosity-graded material. ASTM D 946 for penetration-graded material.

E. Asphalt Cement Tack Coat: Material shall conform to NYSDOT Section 407 – Tack Coat.

F. Prime Coat: Cut-back asphalt type, ASTM D 2027; MC-30, MC-70 or MC-250.

2.3 AUXILIARY MATERIALS

A. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.

B. Joint Sealant: ASTM D 3405 or AASHTO M 301, hot-applied, single-component, polymer-modified bituminous sealant.

C. Paving Synthetics: A non-woven fabric designed for use in pavement rehabilitation to reduce reflective cracking, act as a vapor barrier and have one side heat bonded only.
1. Tensar Triax Geogrid
2. Tencate
3. Propex Fabrics
4. Fibertex
5. Approved equivalent

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:
1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: NYSDOT (Type 37.5 F9 Base Course HMA, series 80 compaction) per Contract Drawings.
3. Binder Course: NYSDOT (Type 19 F9 Binder Course HMA, series 80 compaction) per Contract Drawings.
4. Top Course: NYSDOT (Type 9.5 F2 Top Course HMA, series 80 compaction) per Contract Drawings.
5. True and Leveling Course: Binder Course mix to be used in placed in a lift greater than 2 inches thick. Top Course mix to be used in a lift less than 2 inches thick.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that sub-grade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subgrade in accordance with Specification Section 312000: Excavation and Fill

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

D. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving

E. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

F. Tack Coat: If top course is not placed within twenty-four (24) hours of binder placement, a tack coat shall be applied to clean surface prior to placement of top course. Apply uniformly to surfaces of pavement at a rate of 0.05 to 0.15 gal./sq. yd.

G. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.

H. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off using a self-propelled paving machine with vibrating screed. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
   3. Spread mix at minimum temperature of 250 deg F.
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
   5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix

placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.

2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 12 inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Binder Course: Plus or minus 1/2 inch.
   2. Surface Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. Base Course: 1/4 inch.
   2. Surface Course: 1/8 inch.
   3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.7 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new sub-grade.

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.8 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
   1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.9 FIELD QUALITY CONTROL

A. Special Inspections: Contractor shall engage a qualified special inspector to perform the following special inspections:

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses shall be determined according to ASTM D 3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course shall be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency shall take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979.
   1. Reference maximum theoretical density shall be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement shall be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
      a. One core sample shall be taken for every 1000 sq. yd or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 32 12 16

SECTION 32 17 23 – PAVEMENT MARKING

PART 1 GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Section 32 12 16: Asphalt Paving

1.2 REFERENCE STANDARDS

A. New York State Department of Transportation (DOT) Specification Section 400, latest edition.

1.4 PROJECT CONDITIONS

A. Perform the painting operations after working hours, on weekends or at such time so as not to interfere with the flow of traffic. Provide temporary barriers to prevent vehicles from driving over newly painted areas.
B. Apply paint on dry pavement surface, when the air temperature is above 40 degrees F and not exceeding 95 degrees F.

1.5 SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties. Indicate pavement markings to be used, colors, dimensions and symbols.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable.
B. Requirements of NYSDOT for pavement-marking work and the "National Manual on Uniform Traffic Control Devices" latest edition and the "NYS Supplement."

PART 2 PRODUCTS

2.1 MATERIALS

A. Paint: DOT Section 640-2, yellow or white as indicated, or if not indicated as directed. Delete reference to Glass Beads.

B. Rapid Dry Paint:
   1. Aexcel Corp., www.aexcelcorp.com, 72W-A042 White, 72Y-A082 Yellow
   2. Sherwin-Williams, www.swpavementmarkings.com, TM2152 White, TM2153 Yellow, TM2224 Blue.
   3. Franklin Paint Company, Inc., www.franklinpaint.com, 2014 White, 2015 Yellow.
   4. Approved equivalent

PART 3 EXECUTION

3.1 PREPARATION

A. Remove dust, dirt, and other foreign material detrimental to paint adhesion.

B. Mark layout of stripes and lines with chalk or paint.

3.2 APPLYING PAVEMENT MARKING

A. Apply paint in accordance with DOT Section 640-3.02, except as follows:
   1. Delete references to Glass Beads.

B. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer.

C. Allow paving to cure for 30 days before starting pavement marking.

D. Sweep and clean surface to eliminate loose material and dust.

E. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 17 23

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Dog specific synthetic grass outdoor surface.

1.2 RELATED SECTIONS

A. Section 31 20 00 – Excavation and Fill

1.3 REFERENCE

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern. The latest edition of the following standards as references herein shall be applicable.

B. Factory Mutual Research Corporation: FM P7825 Approval Guide

C. ASTM – American Society for Testing and Materials.

1. ASTM D418 – “Standard Method of Testing Pile Yarn Floor Covering Construction”
2. ASTM D1335 – “Standard Test Method for Tuft Bind of Pile Yarn Covering”
6. ASTM D1557 – “Standard Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort (56,000 ft-lbf/cubic foot)”
7. ASTM D1557 – “Standard Test Method for Linear Density of Textile Fibers”
8. ASTM D1682 – “Standard Method of Tests for Breaking Load and Elongation of Textile Fabrics”
9. ASTM D2256 – “Standard Test Method for Tensile Properties of Yarns by the Single Strand Method”
10. ASTM D2859 – “Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials”.
11. ASTM D2922 – “Standard Test Method for Density of Soil and Soil Aggregate in Place by Nuclear Methods”
12. ASTM D5034 – “Standard Test Method for Breaking Strength and Elongation of Textile fabrics (Grab Test)”
14. ASTM D5848 – “Standard Test Method for Mass per Unit Area of Pile Yarn Floor Coverings”

1.4 SYSTEM DESCRIPTION

A. Design Requirements

1. Furnish all labor, materials, tools and equipment necessary to install multipurpose,

infilled artificial turf playfields as indicated on the contract documents in strict accordance with the manufacturer's installation instructions and all approved shop drawings.

a. Coordinate with applicable subcontractors to ensure perimeter edge details shown on the Contract Documents comply with the requirements of the synthetic turf manufacturer and are approved by the Project Designer.
b. Ensure that the synthetic turf system maintains ASTM F355 G-max measurements of between 100 and 180 for the life of the warranty. G-max measurements at the time of the installation shall not exceed 125.

1.5 SUBMITTALS

A. Comply with the requirements of Section 01330 – Submittal Procedures and as modified below.
B. Product Data

1. Submit manufacturer's product literature, technical specifications, product characteristics, performance characteristics, installation instructions and similar information demonstrating compliance with the specified requirements.
2. Submit fiber manufacturer's name, type of fiber and composition of fiber.
3. Provide sample copy of all required warranties as specified in this section.

C. Shop Drawings: Provide submissions of the following shop drawings indicating:

1. Roll and seaming layout.
2. Methods of attachment and perimeter conditions.

D. Samples: Provide submissions of the following samples (Note: samples shall exactly match the specified products to be installed on project):

1. Synthetic Turf: Two samples, minimum 12" x 12" in size.

E. Quality Control Submittals.

F. Contract Closeout Procedures: Comply with the requirements of Section 01770. The submission shall include maintenance instructions as specified in the "Operating and Maintenance Data" manual requirements described in this section including all necessary instructions for the proper care and preventative maintenance of the new synthetic turf system.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacturing of products specified in this section.

B. Installer Qualifications: company specializing in the installation of synthetic turf specified for this project

C. Pre-Installation Meeting: Schedule and conduct a pre-installation meeting at least one week prior to the beginning of the installation of the synthetic grass surfacing system including the Owner, Architect, Engineer and Prime Contractor or designated representative, applicable subcontractor representative and synthetic grass surfacing representative.

1.7 PROJECT CONDITIONS

A. Field Measurements: Establish and maintain required lines and elevations for grade control. Verify measurements shown on the contract documents in field prior to ordering or installing materials.

1.8 WARRANTY

A. The Site Work Prime Contracting and/or Manufacturer shall provide a warranty to the Owner.

1.9 MAINTENANCE SERVICE

A. The synthetic turf contractor shall provide training for the Owner’s facility maintenance staff in the use of the equipment to be utilized for maintenance of the synthetic turf.

B. Extra Materials: Upon final completion, provide excess material directly to the Owner.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Basis of Design: K9 Grass Classic PLus synthetic grass manufactured by ForeverLawn. Approved equivalents are acceptable.

B. K9 Classic Plus Synthetic Grass Minimum Properties Standard Property Specification

1. Primary – Polyethylene; Secondary: Heat set textured nylon monofilament containing antimicrobial agent.
2. Yarn Count: Primary 5,000/4; Secondary: 4,200/8
3. ASTM D5848 Pile Height 7/8” (+/-1/8”)

4. ASTM D5848 Pile Weight 65.0 oz./sq. yd.
5. ASTM D5848 Total Weight 70.0 oz./sq. yd.
6. Construction: Knitted
7. Color: Primar: Summer Green; Secondary: Turf Green
8. Backing: Flow-through knitted backing
9. Seaming: Turf adhesive
10. Finished Roll Width: 15 ft
11. Finished Roll Length: Up to 150 feet

C. Plastic Nailer Board: Base and Attaching Components: Base is to be prepared using plastic 2”x4” board and secured using 1” length ¼” crown stainless steel staples. Turf is to be secured around all edges.

PART 3 – EXECUTION

3.1 BASE AND DRAINAGE CONSTRUCTION

A. Excavation: Existing ground cover shall be excavated to the depth established on the excavation plan. The sub-grade shall also be compacted to a recommended 90% compaction rate.

B. Plastic Nailer Board: The synthetic turf perimeter fastening structure shall be installed before the drainage aggregate.
1. Install a synthetic nailer board around perimeter and all penetrating objects. Nailer board shall be flush to grade (or as specified in site detail drawings) when adjacent to soft surface (i.e. natural grass, mulch). Nailer board shall be 1/2” to 3/4” below grade when adjacent to hard walking surface (i.e. concrete or tile).
2. This shall be the responsibility of the synthetic turf base contractor. See synthetic turf edge attachment detail.

C. Base Drainage Aggregate: Installation of the free draining base aggregate of 3/8” to 5/8” clean compactable angular stone (any mix with fines in excess of 20% must be approved by manufacturer), shall follow procedures provided. If the sub-base does not permit liquids to freely percolate, auxiliary drainage is required. Base material must be installed to a recommended depth of 3 1/2”. The drainage network and its existing elevations shall not be disrupted through ground pressures from trucks, dozers, or by any other means.
1. The stone shall be left firm and compacted while allowing the porosity and drainage capabilities of the aggregate profile.
2. The free draining base course should be designed to meet local soil and weather conditions. It must be installed to a minimum depth of 3” with a recommended compaction rate of 90%.

3.2 SYNTHETIC GRASS SYSTEM INSTALLATION

A. Synthetic grass rolls shall be joined via adhesive bond seaming and reinforced with specialty turf adhesive where necessary.
   1. Seams shall be flat, tight, and permanent with no separation or fraying.
   2. Grass rolls must be installed with pile leaning the same direction.

B. Synthetic Turf Perimeter Attachment
   1. After final layout and seaming of the synthetic grass product, the synthetic turf material shall at a minimum be secured to the top of plastic nailer board firmly anchored to sidewalk, curb, wall, orby rebar making up the perimeter of the synthetic turf area.
   2. The turf shall be attached to plastic nailer board by stainless steel staples, screws, and/or nails.
   3. Soil or surfacing material outside of the defined synthetic turf area shall be backfilled against turf wrapped perimeter edge and have zero transition edge to synthetic turf unless otherwise specified.
   4. Concrete and solid walking surfaces should be 1/2” to 3/4” higher than the top of the board.

C. Infill Application: It is imperative that no infill is utilized with synthetic turf used with dogs.

3.3 INSTALLATION

A. Contractor shall provide the labor, supplies, and equipment as necessary for final cleaning of surfaces and installed items.

B. During the contract and at intervals as directed by the owner or owner’s representative and as synthetic grass system installation is completed, clear the site of all extraneous materials, rubbish, or debris, and leave the site in a clean, safe, well-draining, neat condition.

C. Surfaces, recesses, enclosures, etc. shall be cleaned as necessary to leave the work area in a clean, immaculate condition ready for immediate occupancy and use by the Owner.

END OF SECTION 321824

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SECTION 32 31 13 – CHAIN LINK FENCE AND GATE

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes:

1. Fence framework, fabric and accessories.
2. Excavation for post bases and center drop for gates.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 03 30 00: Cast in Plan Concrete

C. Section 31 20 00: Excavation and Fill

1.3 REFERENCE STANDARDS

A. ASTM A 53 for requirements of Schedule 40 piping.

1.4 SUBMITTALS

A. Shop Drawings: Complete detailed drawings for each height and style of fence and gate required. Include separate schedule for each listing all materials required and technical data such as size, weight, and finish, to ensure conformance to specifications.

B. Product Data: Manufacturer’s catalog cuts, specifications, and installation instructions for each item specified.

C. Samples:

1. Fence Fabric: Minimum one square foot.
2. Fence and Gate Posts: Two each, one foot long, if requested.
3. Miscellaneous Materials and Accessories: One each, if requested.

D. Quality Control Submittals:

1. Certificates: Affidavit required under Quality Assurance Article.

1.1 QUALITY ASSURANCE

A. Comply with standards of the Chain Link Fence Manufacturer’s Institute.

B. Fence shall be installed in accordance with ASTM F-567 and gates shall be installed in accordance with ASTM F-900.

C. Provide steel fence and related gates as a complete compatible system including necessary erection accessories, fittings, and fastenings.

D. Posts and rails shall be continuous without splices.

1.2 WARRANTY

A. Special Warranty: Manufacturer's standard form in which installer agrees to repair or replace components of chain-link fences that fail in materials or workmanship within specified warranty period.

B. Failures include, but are not limited to, the following:

1. Faulty operation of gate operators and controls.
2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
3. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 STEEL FRAMEWORK

A. All pipe shall be Schedule 40, conforming with ASTM F-1083.

B. End Posts, Corner Posts and Pull Posts:

1. 4' Fence Height Pipe: 2 inches O.D.
2. 6' and 8' Fence Height Pipe: 3 inches O.D.
3. 10' Fence Height Pipe: 6 inches O.D.

C. Line Posts:

1. 4' Fence Height Pipe: 2 inches O.D.
2. 6' and 8' Fence Height Pipe: 2 1/2 inches O.D.
3. 10' Fence Height Pipe: 3 inches O.D.

D. Rails and Post Braces:

1. 4' Fence Height Pipe: 1 5/8 inches O.D.
2. 6' and 8' Fence Height Pipe: 1 5/8 inches O.D.
3. 10' Fence Height Pipe: 1 5/8 inches O.D.

E. Metallic Coating for Steel Framework:

1. Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
2. External, Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil thick, zinc-pigmented coating.
3. Coatings: Any coating above.

2.2 STEEL FABRIC

A. One-piece widths for fence heights up to 12'-0".

B. Chain link, 2 inch mesh, No. 9 gauge

C. Selvages: Top edge; bottom edge knuckled.

D. Zinc-Coated (galvanized) Fabric: ASTM A 392, Type II, Class 1, 1.2 oz./sq. ft. with zinc coating applied after weaving.

E. Aluminum wire ties shall not be allowed.

2.3 Bands:

A. 6' Fence Height: 6 each bands per fence direction.

B. 8' Fence Height: 8 each bands per fence direction.

C. 10' Fence Height: 10 each bands per fence direction.

2.4 SWING GATE POSTS

A. Single width of gate up to 6'-0" wide and less than 10'-0" high:

1. Pipe: 2.875 inches OD (Schedule 40).

B. Single width of gate 6'-0" to 12'-0" wide or over 10'-0" high:

1. Pipe: 4 inches OD (Schedule 40).

2.5 SWING GATE FRAMES

A. Up to 6'-0" high, and leaf width 8'-0" or less.

1. Pipe: 1.660 inches OD (Schedule 40).

B. Height: 6'-0" - 12'-0", or leaf width exceeding 8'-0":

1. Pipe: 1.90 inches OD (Schedule 40).

C. Assemble gate frames by welding or with special steel fittings and rivets for rigid connections. Install mid-height horizontal rails on gates over 10 feet high. When width of gate leaf exceeds 10 feet, install mid-distance vertical bracing of the same size and weight as frame members. When either horizontal or vertical bracing is not required, provide truss rods as cross bracing to prevent sag or twist.

2.6 SWING GATE HARDWARE

A. Hinges: Non-lift-off type, offset to permit 180-degree swing, and of suitable size and weight to support gate. Provide 1-1/2 pair of hinges for each leaf over 6 feet high.

B. Latch: Forked type for single gates 10 feet wide or less. Drop bar type with keeper for double gates and single gates over 10 feet wide complete with flush plate set in concrete. Drop bar length shall be 2/3 the height of the gate. Padlock eye shall be an integral part of latch construction.

2.7 ROLLING/SLIDING GATE

A. 24 feet wide, 4 feet high rolling gate

B. 4' Fence Height Pipe: 2 inches O.D.

C. Pre-packaged rolling gate hardware kit

D. 1-5/8” O.D HF20 pipe and tube
E. 9-gauge galvanized fabric, 2” mesh
F. Tension bands and bolts secure stretch of wire to frame.
G. Stainless steel wire ties. Aluminum wire ties shall not be allowed.
H. Gates shall be installed in accordance with manufacturer’s guidelines.

2.8 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Rails and Post Braces:
   1. Pipe: 1.660 inches OD, 2.27 pounds per linear foot (Schedule 40).
B. Fittings and Post Tops: Steel, wrought iron, or malleable iron.
   1. Fasteners: Tamper-resistant cadmium plated steel screws.
C. Stretcher Bars: One piece equal to full height of fabric, minimum cross-section 3/16 inch by 3/4 inch.
D. Metal Bands (for securing stretcher bars): Steel, wrought iron, or malleable iron.
E. Wire Ties: Conform to American Steel Wire gauges.
   2. For tying fabric to line posts, rails and braces: 9 gauge (.1483 inch) steel wire.
F. Truss Rods: 3/8 inch diameter.
G. Concrete: Portland Cement concrete having a minimum compressive strength of 4000 psi at 28 days.
   1. Terminal/ End/ Corner Post Foundations:
      a. 4’ and 6’ Fence Height Foundations: 3’-6” deep post embedment in 4’ deep concrete footing, 12” inches diameter.
      b. 8’ Fence Height Foundations: 4’-6” deep post embedment in 5’ deep concrete footing, 18” inches diameter.
      c. 10’ and greater Fence Height Foundations: 5’-0” deep post embedment in 5’ deep concrete footing, 18” inches diameter.
   2. Line Post Foundations:
      a. 4’ and 6’ Fence Height Foundations: 3’-6” deep post embedment in 4’-0” deep concrete footing, 12” inches diameter.
      b. 8’ Fence Height Foundations: 4’-6” deep post embedment in 5’ deep concrete footing, 12” inches diameter.
      c. 10’ and greater Fence Height Foundations: 5’-0” deep post embedment in 5’ deep concrete footing, 12” inches diameter.
H. Spiral Paper Tubes:
   1. Sonotube by Sonoco Products Co., North Second St., Hartsville, SC 29550, (800) 377-2692.

2. Sleek/tubes by Jefferson Smurfit Corp., P.O. Box 66820, St. Louis, MO 63166, (314) 746-1100.
3. Approved equivalent

I. Cold Galvanizing Compound: Single component compound giving 93 percent pure zinc in the dried film, and meeting the requirements of DOD-P-21035A (NAVY).

2.9 FINISHES

A. Steel Framework:

1. Pipe: Galvanized in accordance with ASTM A 53, 1.8 ounces zinc per square foot.

B. Fabric

1. Galvanized Finish: ASTM A 392 class II zinc coated after weaving, with 2.0 ounces per square foot.

C. Fence and Gate Hardware, Miscellaneous Materials, Accessories:

1. Wire Ties: Galvanized Finish, ASTM A 90 1.6 ounces zinc per square foot, or aluminized finish, ASTM A 809 0.40 ounces per square foot.
2. Hardware and Miscellaneous Items: Galvanized Finish, ASTM A 153 (Table 1).

PART 3 EXECUTION

3.1 PREPARATION

A. Clear and grub along fence line as required to eliminate growth interfering with alignment. Remove debris from State property.

B. Do not begin installation of fence in areas to be cut until finished grading has been completed.

3.2 APPLYING PAVEMENT MARKING

A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.

B. Space posts equidistant in the fence line with a maximum of 10 feet on center. For fences 16 feet and higher space posts a maximum of 8 feet on center.

C. Setting Posts in Earth: Drill holes for post footings. If existing grade at the time of installation is below finished grade, provide spiral paper tubes to contain concrete to finish grade elevation. Set posts in center of hole and fill hole with concrete. Plumb and align posts. Vibrate or tamp concrete for consolidation. Finish concrete in a dome shape above finish grade elevation to shed water. Do not attach fabric to posts until concrete has cured a minimum of 7 days.

D. Setting Posts in Rock: Drill holes into solid rock one inch wider than post diameter, 18 inches deep for end, pull, corner, and gate posts, and 12 inches deep for line posts. Set posts into holes and fill annular space with shrink-resistant grout.

E. Locate corner posts at corners and at changes in direction. Use pull posts at all abrupt changes in grade and at intervals no greater than 500 feet. On runs over 500 feet, space pull posts evenly between corner or end posts. On long curves, space pull posts so that the strain of the fence will not bend the line posts.

F. Install top rail continuously through post tops or extension arms, bending to radius for curved runs. Install expansion couplings as recommended by fencing manufacturers.

G. Install bottom and intermediate rails in one piece between posts and flush with post on fabric side using special offset fittings where necessary.

H. Brace corner posts, pull posts, end posts, and gate posts to adjacent line posts with horizontal rails.

I. Diagonally brace corner posts, pull posts, end posts, and gate posts to adjacent line posts with truss rods and turnbuckles.

J. Attach fabric to security side of fence. Maintain a 2 inch clearance above finished grade except when indicated otherwise. Thread stretcher bars through fabric using one bar for each gate and end post and 2 for each corner and pull post. Pull fabric tight so that the maximum deflection of fabric is 2 inches when a 30 pound pull is exerted perpendicular to the center of a panel. Maintain tension by securing stretcher bars to posts with metal bands spaced 15 inches oc. Fasten fabric to steel framework with wire ties spaced 12 inches oc for line posts and 24 inches oc for rails and braces. Bend back wire ends to prevent injury. Tighten stretcher bar bands, wire ties, and other fasteners securely.

K. Position bolts for securing metal bands and hardware so nuts are located opposite the fabric side of fence. Tighten nuts and cut off excess threads so no more than 1/8 inch is exposed. Peen ends to prevent loosening or removal of nuts.

1. Secure post tops and extension arms with tamper-resistant screws.

L. Install gates plumb and level and adjust for full opening without interference. Install ground-set items in concrete for anchorage, as recommended by fence manufacturer. Adjust hardware for smooth operation and lubricate where necessary.

M. Tension Wire: Support bottom edge of fabric with tension wire. Weave tension wire through fabric or fasten with hog rings spaced 24 inches oc. Tie tension wire to posts with 9 gauge wire ties.

N. Wire brush and repair welded and abraded areas of galvanized surfaces with one coat of cold galvanizing compound.

O. Restore disturbed ground areas to original condition. Topsoil and seed to match adjacent areas.

3.3 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.4 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 32 31 13

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SECTION 323300 – EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Light fixtures, light poles, accessories and mounting for proposed exterior site lighting.
2. Light fixtures, light poles, accessories and mounting for proposed stadium lighting.
3. Electrical design, including conduits and grounding, are not included in this specification.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 03 30 00: Cast-in-Place Concrete Site Work

C. Section 31 20 00: Excavation and Fill

1.3 SUBMITTALS

A. Submittals: Submit the following products specified in this section:

1. Luminaires
2. Poles and accessories
3. Bases

B. Product Data: Submit catalog sheets with dimensions, ratings, performance data, specifications and installation instructions. Include candlepower distribution curves.

C. Product List: Cross-reference to locations of application areas. Use same designations indicated on Contract Drawings.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain first paragraph below for fiberglass or laminated wood poles.

D. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of design for site and building mounted lighting is ALED Field-Adjustable Area Light manufactured by RAB. Contractor may submit approved equivalents.

B. Basis of design for site light poles is PS4 manufactured by RAB. Contractor may submit approved equivalents.

2.2 LUMINAIRES

A. ALED Field-Adjustable Area Lights Medium Series with Luminous Window. Single fixture on single pole as indicated on the Contract Drawings. Approved equivalents are acceptable.

1. Style
    a. Pole Mount – ALEDM5TNB
    b. Wall Mount – ALEDM4T
2. LED Quantity
    a. 72LED
3. Color Temperature:
    a. 4000K
    b. 5000K
4. Distribution
    a. Type V (5T)
    b. Type IV (4T)
5. Mounting Configuration
    a. Post Arm
    b. Wall Mount
6. Finish
    a. Black (B)

2.3 POLES

A. Basis of Design: Architectural Area Lighting. Approved equivalents acceptable.

1. 4” square steel shaft
2. Model: PS4
3. Pole Height
    a. 15’0”
4. Shaft Type
    a. 46,000 psi minimum yield, 11 gauge, 1/8” wall thickness.
5. Finish
    a. Black
6. Handhole
    a. 3” x 5”
    b. 18” above top of base plate

B. Provide all required accessories for installation as required by manufacturer.

2.4 Base cover

A. Basis of Design: RAB. Approved equivalents acceptable.

1. 8” square, ¾” thick
2. 8.5” bolt circle

2.5 IN-GROUND FLAG UPLIGHTS

A. Basis of Design: Lumascape. Approved equivalents acceptable.

1. LS3060 - Erden E6 In-ground
2. Static White: 3,500 K
3. Lumen Output: 2,245 lm
4. Efficacy: 91 lm/W
5. Installation: LS6052-K Pre-Installation Blockout - Per manufacturer’s recommendations via pre-installation block out for concrete application
6. Cover to be flush with Grade
7. Cover: Model SS316 - Polished

2.6 CONCRETE PEDESTAL

A. Mixture: Concrete shall be air entrained and have a minimum 28 day compressive strength of 4500 psi. Design slump limits shall fall between 4” minimum and 6” maximum.

B. The material shall comply with ASTM Standard C-94 for concrete mixture, ASTM C-150 Type 1A for Portland Cement, ASTM C-33 for aggregates. The materials shall also be in conformance with ACI 318-05.

C. Curing: Any concrete which contains reinforcing steel shall be allowed to cure for a minimum of 28 days prior to erection of the pole on to the foundation. All reinforcing steel shall be Grade 60.

D. Concrete Reinforcement: Concrete reinforcement shall be in conformance with ASTM A-615, except ties can be in conformance with ACI 315 and 318.

E. Strength: Concrete must attain 70% of the design strength prior to pole installation and fixture mounting.

F. Installation: Maximum free drop of concrete limited to 6’-0”.

G. Foundation: Shall be augered into undisturbed natural soil or compacted fill, as per the Contract Drawings.

H. Height

1. Light Height: 17.5’ = 2.0’ high concrete pedestal

2.7 GROUT

A. L&M Const. Chemicals Inc.’s Crystex, Protex Industries Inc.’s Propak, Sonneborn’s Sonogrout, or U.S. Grout Corp.’s 5 Star Grout or approved equal.

2.8 FINISH

A. Assembly shall be powder coat finished as indicated on the Contract Drawings.

1. Prior to coating, assembly shall be chemically cleaned and etched to ensure corrosion resistance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify foundations are ready to receive fixtures.

3.2 EXISTING WORK

A. Disconnect and remove abandoned exterior luminaries.

3.3 PREPARATION

A. Before installing any Work, lay out the proposed course for the conduits, location of poles, etc. and have same approved.

3.4 INSTALLATION

A. Install concrete bases for area lighting at locations as indicated on Contract Drawings.

1. Prepare a level surface on compacted earth, undisturbed earth or concrete footing. Set bases on the prepared surface. Have all bases checked and approved by the Engineer for level and elevation prior to making any conduit connections.

B. Install poles for area lighting as indicated by manufacturer.

C. Install luminaires as indicated on Contract Drawings.

3.5 ADJUSTING

A. Aim and adjust luminaries to provide illumination levels and distribution, indicated on Contract Drawings.

3.6 CLEANING

A. Clean photometric control surfaces as recommended by manufacturer.

B. Clean finishes and touch up damage.

END OF SECTION 323300

SECTION 329200 – TOPSOIL AND SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes:

1. Topsoil.
2. Soil Amendments.
3. Fertilizing.
4. Mulches.
5. Lawn.
6. Lawn Restoration.
7. Erosion Control Materials.
8. Maintenance.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 312000: Excavation and Fill.

C. Section 329300: Plants.

1.3 SUBMITTALS

A. Product Certification: Certification signed by manufacturers certifying that their products comply with specified requirements.

1. Manufacturer's certified analysis for standard products.
2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

B. Certification of grass seed from seed vendor stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated. Include percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content.

1. Analysis of existing surface soil.

2. Analysis of imported topsoil.

D. Report suitability of existing surface soil and imported topsoil for lawn and plant growth. State recommended quantities of soil amendments to be added to produce satisfactory results.

1.4 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

1.5 CLOSEOUT SUBMITTALS

A. Before expiration of required maintenance periods, Contractor is to submit maintenance instructions recommending procedures to be performed by Owner for maintenance of landscape during an entire year.

1.6 QUALITY ASSURANCE

A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

1.7 QUALIFICATIONS

A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience and a record of successful landscape establishment.

1. Installer’s Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that work of this section is in progress.

C. Testing Agency: To qualify for acceptance, an independent testing agency must demonstrate to Owner’s satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials in sealed containers showing weight, analysis, and name of manufacturer.

B. Protect materials from deterioration during delivery and while stored at site.

1.9 PROJECT CONDITIONS

A. Utilities: Determine location of above grade and underground utilities prior to the start of Work. Perform Work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by the Engineer.

B. Excavation: When conditions detrimental to lawn growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Engineer before planting.

1.10 COORDINATION AND SCHEDULING

A. Coordinate with other site operations to avoid conflict and damage to new work.

B. Planting season for Seeded areas: As indicated on the Contract Drawings.

1.11 WARRANTY

A. General: The guarantee specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Guarantee: Upon completion and acceptance of the landscaping, guarantee the materials for two years. Guarantee shall include material and labor costs. At the end of the guarantee period, the Owner’s onsite representative shall inspect all planter materials. The Contractor shall promptly make all required replacements with plant materials meeting specifications.

1.12 LAWN MAINTENANCE

A. Begin maintenance immediately after each area is planted and continue until acceptable lawns and plants are established, but for not less than the following periods:

1. Lawns and Seeded Areas: 120 days after date of Substantial Completion.

2. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during the next planting season.

B. Maintain and establish seeded areas by watering, weeding, replanting, and other operations. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth surface.

C. Watering: Provide and maintain temporary piping, hoses, and watering equipment to convey water from sources and to keep grass uniformly moist to a depth of 4 inches. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

1. Water all seeded areas at the minimum rate of 1 inch per week.

D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain a grass height of 1½ to 2½ inches.

PART 2 PRODUCTS

2.1 PLANTING BACKFILL

A. Mixture shall be 4 parts topsoil (on-site or imported), 1 part peat moss, ½ part well-rotted manure and 10 pounds 5-0-5 planting fertilizer, mixed thoroughly per cubic yard.

2.2 TOPSOIL

A. Source: Provide topsoil from existing stockpiles stripped from the project site and approved by the Engineer.

B. Where existing topsoil is not available, provide topsoil conforming to the following:

1. Original loam topsoil, well drained homogeneous texture and of uniform grade, without the admixture of subsoil material and entirely free of dense material, hardpan, sod, or any other objectionable foreign material.

2. Containing not less than 5 percent nor more than 20 percent organic matter in that portion of a sample passing a 1/4-inch sieve when determined by the wet combustion method on a sample dried at 105 degrees C.

3. Containing a pH value within the range of 6.5 to 7.5 on that portion of the sample that passes a 1/4-inch sieve.

4. Containing the following gradations:

SIEVE DESIGNATION	PERCENT PASSING
1 inch	100
1/4 inch	97 - 100
No. 200	20- 60

2.3 SOIL AMENDMENTS

A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 85 percent calcium carbonate equivalent, with a minimum 90 percent passing a No. 10 mesh sieve and a minimum 50 percent passing a No. 100 mesh sieve.

1. Provide lime in the form of dolomitic limestone.

2. Add lime soil as necessary to achieve a soil pH between 5.5 – 7.0.

B. Aluminum Sulfate: Commercial grade, unadulterated.

C. Herbicides: EPA registered and approved, of type recommended by manufacturer.

D. Sand: Clean, washed, natural or manufactured, free of toxic materials.

E. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decimeters/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

2.4 FERTILIZER

A. Application of any fertilizer is prohibited between December 1st and April 1st and cannot be applied within 20’ of a water body.

B. Fertilizer: Mixed commercial fertilizers shall contain total nitrogen, available phosphoric acid and soluble potash in the ratio of 10-0-10. No fertilizer containing phosphorus is permitted on site.

C. Other fertilizers meeting DOT Specification Section 713-03 Fertilizer can be used.

2.5 MULCH

A. Dry Application, Straw: Stalks of oats, wheat, rye or other approved crops that are free of noxious weed seeds. Weight shall be based on a 15 percent moisture content.

B. Hydro Application: Colored wood cellulose fiber product specifically designed for use as a hydro-mechanical applied mulch. Acceptable Product: Conwed Hydro Mulch, Conwed Fibers, 231 4th Street SW, Hickory, NC or approved equivalent.

C. Mulch used in bioretention areas shall be uncolored shredded hardwood, aged 6 months minimum.

2.6 SEED

A. Furnish fresh, clean, new-crop seed mixed in the proportions specified for species and variety and conforming to Federal and State Standards.

B. Acceptable material in a seed mixture other than pure live seed consists of nonviable seed, chaff, hulls, live seed of crop plants and inert matter. The percentage of weed seed shall not exceed 0.1 percent by weight.

C. All seed will be rejected if the label or test analysis indicates any of the following contaminates: Timothy, Orchard Grass, Sheep Fescue, Meadow Fescue, Canada Blue Grass, Alta Fescue, Kentucky 31 Fescue, and Bent Grass.

D. Provide seed mixture equal to Scotts Pure Premium Sun and Shade North Grass Seed Mixture, comprised of the following:

1. Low maintenance Fescue Lawn grass seed mix
   a. Seeding Rate: 6 lbs/1,000 square feet
   b. Mix:

AMOUNT BY WEIGHT IN MIXTURE	SPECIES OR VARIETY
25 PERCENT	FIREFLY HARD FESCUE
25 PERCENT	BIG HORN GT HARD/SHEEP
20 PERCENT	INTRIGUE CHEWINGS FESCUE
20 PERCENT	QUATRO SHEEP FESCUE
10 PERCENT	MINOTAUR HARD FESCUE

2. Wet-occasion wet locations
   a. Seeding Rate: 4 lbs/1,000 square feet
   b. Mix:

AMOUNT BY WEIGHT IN MIXTURE	SPECIES OR VARIETY
20 PERCENT	RED TOP
20 PERCENT	ALKALI GRASS
10 PERCENT	AUTUMN BENTGRASS
20 PERCENT	VIRGINIA WILD RYEGRASS
20 PERCENT	FOX SEDGE
10 PERCENT	FOWL BLUEGRASS

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PLANTING SOIL PREPARATION

A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

B. Mix soil amendments and fertilizers with topsoil as necessary to meet applicable ASTM standards.

C. For lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime from contacting roots of acid-tolerant plants.

3.3 LAWN AREA PLANTING PREPARATION

A. Limit sub-grade preparation to areas that will be planted in the immediate future.

B. Loosen sub-grade to a minimum depth of 4 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous materials.

C. Spread topsoil to depth (4 inches minimum) required to meet the thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or sub-grade is frozen.

1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened sub-grade to create a transition layer and then place remainder of planting soil mixture.

D. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll (112-pound roller maximum) and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches in any dimension, and other objects that may interfere with planting or maintenance operations.

E. Moisten prepared lawn and grass areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.4 FERTILIZING

A. The soil shall be tested for pH and lime added as necessary. All amendments shall be checked and approved by the Landscape Architect before amendments are made.

B. Apply fertilizer at a rate of 20 LBS/1,000 SF.

3.5 SEEDING

A. Assume all risks when seed is sowed before approval of seed analysis.

B. Sow seed by hand broadcasting or hydroseeding. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.

2. Do not sow immediately following rain, when ground is too dry, or during windy periods.

C. Sow seed at the following rates:

1. Low Maintenance Fescue Lawn, Seeding Rate: 6 lbs per 1000 sq. ft.

2. Seed Mix for Wet Locations, Seeding Rate: 4 lbs per 1000 sq. ft.

D. Rake seed lightly into top 1/8 inch of topsoil, roll lightly, and water with fine spray, immediately after each area has been mulched. Saturate to 4 inches of soil.

E. Protect seeded areas with slopes less than 1:3 against erosion by spreading mulch after completion of seeding operations.

1. Mulch rates.
    a. Oat or wheat straw applied at a minimum rate of 2 tons per acre to form a continuous blanket 1-1/2 inches loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
    b. Fill tank with water and agitate while adding seeding materials. Use sufficient fertilizer, mulch, and seed to obtain the specified application rate. Add seed to the tank after the fertilizer and mulch have been added. Maintain constant agitation to keep contents in homogenous suspension. Prolonged delays in application or agitation that may be injurious to the seed will be the basis of rejection of material remaining in tank.
    c. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply mulch at a minimum rate of 57 gal/1000 sf (2500-lb/acre dry weight but not less than the rate required to obtain specified seed-sowing rate.

F. Anchor mulch by spraying with asphalt-emulsion tackifier at the rate of 10 to 13 gal. per 1000 sq. ft. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

3.6 LAWN RESTORATION

A. Renovate existing lawn within work limit.

B. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

C. Reestablish lawn where settlement or washouts occur or where minor regrading is required.

    1. Install new planting soil as required.

D. Remove lawn from diseased or unsatisfactory existing lawn areas; do not bury in soil.

E. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

F. Where substantial lawn remains, mow, dethatch, core aerate, and rake. Remove weeds before seeding.

G. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

H. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and lawn, and legally dispose of them off Owner's property.

I. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

J. Apply soil amendments and fertilizers required for establishing new lawn and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

K. Apply seed and protect with straw mulch as required for new lawn.

L. Provide lawn maintenance as required for new lawn.

3.7 SATISFACTORY LAWNS, GRASS, AND LAWN RESTORATION

A. Satisfactory Lawns, Grass, and Lawn Restoration: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 95 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Reestablish those that do not comply with requirements and continue maintenance until satisfactory.

3.8 CLEANUP AND PROTECTION

A. During landscaping, keep pavements clean and work area in an orderly condition.

B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 329200

SECTION 329300 – PLANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Trees Materials.
2. Shrubs.
3. Herbaceous Plants
4. Planting Soil
5. Soil Amendments.
6. Fertilizer
7. Mulch.
8. Stakes and Guys.
9. Miscellaneous Materials.
10. Establishment of Planting
11. Warranty Period

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 312000: Excavation and Fill.

C. Section 329200: Topsoil and Seeding.

1.3 SUBMITTALS

A. Product Certification: Certification signed by manufacturers certifying that their products comply with specified requirements.

1. Manufacturer’s certified analysis for standard products.
2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

1.4 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. Plants: Living trees, shrubs, perennials, ground cover, and other plant materials specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Before expiration of required maintenance periods, Contractor is to submit maintenance instructions recommending procedures to be performed by Owner for maintenance of landscape during an entire year.

1.6 QUALITY ASSURANCE

A. Provide quality, size, genus, species, and variety of plant material indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."

B. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.

1.7 QUALIFICATIONS

A. Nursery: Company specializing in growing and cultivating plants with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience and a record of successful landscape establishment.

   1. Installer’s Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that work of this section is in progress.

C. Tree Pruner: Company specializing in performing work of this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver in containers showing weight, analysis, and name of manufacturer.

B. Plant Materials: Deliver freshly dug plant materials. Keep plants moist. Do not prune before delivery. Protect bark, branches, and root systems from sunscald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop plant materials.

C. Deliver trees after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.

2. Do not remove container-grown stock from containers before time of planting.

3. Water plant material stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

D. Protect and maintain plant life until planted.

E. Handle balled and burlapped plant material by the root ball.

F. Plants will be rejected when ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

G. Plant material damaged as a result of delivery, storage or handling will be rejected.

H. Protect materials from deterioration during delivery and while stored at site.

I. Salvaged plant material shall be stored and watered as described above. See plans.

1.9 PROJECT CONDITIONS

A. Utilities: Determine location of above grade and underground utilities prior to the start of work. Perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by the Engineer.

B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Engineer before planting.

1.10 COORDINATION AND SCHEDULING

A. Coordinate installation of planting materials during normal planting seasons, as indicated on the Contract Drawings, for each type of material required. Coordinate with other site operations to avoid conflict and damage to new work.

1.11 WARRANTY

A. General: The special warranty specified in this Section shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from incidents that are beyond Contractor’s control.

1. Plants.

C. Remove and replace dead plant materials immediately unless required to plant in the succeeding planting season.

D. Replace plant materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

E. Replacement plants shall be the same size and species as specified, planted in the next growing season, with a new warranty commencing on the date of replacement.

1.12 PLANT MAINTENANCE

A. Maintain plant material by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray trees as required to keep them free of insects and disease. Restore or replace damaged tree wrappings. Maintain plant material for the following period:

1. Maintenance Period: 2 years following Substantial Completion.

PART 2 PRODUCTS

2.1 TREE MATERIAL

A. General: Furnish nursery-grown trees conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, healthy, vigorous stock, free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement,

B. Grade: Provide trees of sizes and grades conforming to ANSI Z60.1 for type of trees required. Trees of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Label each tree with securely attached, waterproof tag bearing legible designation of botanical and common name.

D. Single-stem Deciduous Trees: Intact leader and well-spaced structural branches oriented uniformly around a straight trunk, of a height to caliper ratio typical for the species and conforming to ANSI Z60.1 for type of tree[s] required.

1. Branching Height: ⅓ to ½ of tree height.

2.2 SHRUBS

A. General: Furnish shrubs of the species and size specified conforming to ANSI Z60.1. Provide healthy, vigorous, well-shaped and well-rooted stock free of disease, insects, eggs, larvae and defects or disfigurement.

1. Field Grown: Provide plants with the proper minimum root ball size for the type specified with the diameter and depth to encompass enough of the fibrous and feeding root system necessary for full establishment of the plant.

2. Container Grown: Plants shall have a well-established root system reaching the side of the container so as to maintain a firm ball when the container is removed, but shall not have excessive root growth encircling the inside of the container.

2.3 HERBACEOUS PLANTS

A. General: Provide plants of the species and size indicated complying with ANSI Z60.1 that are healthy, vigorous, well-rooted and established in the container in which they are growing. Plants shall have a well-established root system reaching the sides of the container to maintain a firm root ball but shall not be pot-bound with roots encircling the inside of the container.

2.4 PLANTING SOIL

A. Topsoil – as indicated in specification section 329120.

B. Planting Soil (for every 4 CY of topsoil) shall include:

1. Peat Moss: 7-1/2 cu ft bale or 15 bushels (loose measure).
2 Fertilizer: 5 lb.
3. Bonemeal: 80 lb.

2.5 SOIL AMENDMENTS

A. Peat Moss: As indicated on the contract drawings.

B. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.

2.6 FERTILIZER

A. Bonemeal: As indicated on the contract drawings.

B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.

2.7 MULCH

A. Shredded Wood: Wood fiber produced from either hardwood or softwood trees, free of tannic acid, leaves, young green growth, wood shavings, sawdust or other objectionable foreign material.

2.8 STAKES AND GUYS

A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 inches and/or 3 inch diameter minimum red cedar stakes, by length indicated, pointed at one end.

B. Guy and Tie Wire: ASTM A 641 (ASTM A 641M), #12 gauge galvanized-steel wire, 2-strand, twisted, 0.106 inch in diameter.

C. Hose Friction Guard: Reinforced rubber or plastic hose at least 1/2 inch in diameter, black, cut to lengths required to protect trees from damage.

D. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.9 MISCELLANEOUS MATERIALS

A. Anti-desiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for all plant materials. Deliver in original, sealed, and fully labeled containers and mix and apply according to manufacturer's instructions.

B. Root Ball Wrap: Natural or untreated burlap. Treated or rot-resistant burlap that retards decomposition and will bind with the soil after decomposition is acceptable. Plastic or poly tree ball wrap is not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 EXCAVATION FOR PLANTS

A. See Landscape Details and Notes on Contract Drawings.

B. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.

C. Obstructions: Notify the Engineer if unexpected rock or obstructions detrimental to trees are encountered in excavations.

D. Drainage: Notify the Engineer if subsoil conditions evidence unexpected water seepage or retention in tree pits.

E. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees.

3.3 PLANTING

A. Setting Plants:

1. Backfill pits with planting soil and firm to the level upon which plants were previously growing. Set plants plumb. Plant budded or grafted plants 2 inches below bud or graft line. Complete backfilling with planting soil and settle continually with water.

2. Balled Plants: Set plants in position and backfill 1/3 depth of ball. Remove burlap from top and adjust to eliminate air pockets. Complete backfill and settle with water.

3. Bare-root Plants: Set plant in position and place planting soil around roots settling with water. Use care to avoid bruising or breaking roots when firming soil. Prune bruised or broken roots.

3.4 TREE PRUNING

A. Prune, thin, and shape trees according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Landscape Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees.

3.5 TREE GUYING AND STAKING

A. See Landscaping Details and Notes on the Contract Drawings.

B. Guying: Guy deciduous trees 4 inches and over in caliber; trees over 6 feet high with 3 or more stems; and evergreens 6 feet or over in height, with 3 guys immediately after planting. Attach guys to stakes and trees as indicated. Connect multi-stem trees with protected connecting wires maintaining each stems relationship to one another.

C. Wrapping: Wrap deciduous trees within 4 days after planting from the ground line to the height of the second branches. Wrap in a single layer wound spirally starting from base and overlapping 1-1/2 inches. Secure wrapping in place by use of approved staples or other approved methods and materials.

D. Staking: Set tree stakes into solid ground below bottom of plant before backfilling. Place stakes at the outer edge of the roots or ball in line with the prevailing wind at a 10 degree angle from the tree trunk.

3.6 MULCHING

A. Spread mulch over finished surface of each plant or plant bed in the following amounts:

1. Shredded Hardwood Bark Mulch: 3 inches for plant beds and individual trees in lawn areas, unless otherwise specified.

3.7 INSTALLATION OF MISCELLANEOUS MATERIALS

A. Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.

1. When deciduous trees are moved in full-leaf, spray with anti-desiccant at nursery before moving and again 2 weeks after planting.

3.8 CLEANUP AND PROTECTION

A. During landscaping, keep pavements clean and work area in an orderly condition.

B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

3.10 ESTABLISHMENT OF PLANTING

A. Maintain plantings immediately following planting operations and continue throughout until final acceptance. Establishment of plantings shall consist of keeping plants in healthy, growing conditions by watering, weeding, cultivating, pruning, spraying, tightening of guys, remulching and by any other necessary operations of establishment. Water all plants at least once a week between April 1 and October 31 with approximately 5 gallons per square yard (1 inch layer of water) per watering unless otherwise directed. Provide additional watering during periods of dry weather when required or when directed. Treat plants with good horticultural preventative or remedial measures to control insects, diseases or rodents.

3.11 WARRANTY PERIOD

B. Warranty period for plant materials shall be for two (2) years from final acceptance.

END OF SECTION 329300

SECTION 33 41 00 – STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Under this section the Contractor shall provide all labor, equipment and material necessary to furnish, install and test all storm utility drainage pipe and fittings as shown on the Contract Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

B. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

C. Section 31 20 00: Excavation and Fill

D. Section 33 49 00: Storm Drainage Structures

1.3 PROJECT CONDITIONS

A. Location of Sewers and Sewer Structures: The location, elevation, and grades of sewers and sewer structures are shown on the Contract Drawings and shall be adhered to as closely as possible. If during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.

B. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.

1.4 SUBMITTALS

A. Shop Drawing: Pipes and associated fittings.

B. Product Data: Manufacturer’s specifications, including dimensions, allowable height of cover information, and installation instructions.

C. Manufacturer’s product literature, installation instructions and shop drawings for infiltration systems.

D. As-built record drawings at project closeout of installed storm sewerage piping and products. An as-built survey prepared by licensed NYS Surveyor depicting the installed storm sewer piping and structures including rim and invert elevations of structures pipe size, pipe type, and invert of all piping. Both hard copy and electronic copy shall be provided to the Owner and Engineer.

1.5 QUALITY ASSURANCE

A. Comply with standards of the Chain Link Fence Manufacturer's Institute.

B. Provide steel fence and related gates as a complete compatible system including necessary erection accessories, fittings, and fastenings.

C. Posts and rails shall be continuous without splices.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of the General Conditions.

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.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate with other utility work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Corrugated Polyethylene Pipe (HDPE, Dual Wall with Smooth Interior): Conform to AASHTO M-294.

1. Classification: Soil-tight, integral bell and spigot joints. Joints shall be sealed with factory installed rubber O-ring gaskets that meet ASTM F-477.
2. Coefficient of Roughness (interior pipe surface): 0.012 maximum (Manning formula).
3. Joint Couplings (Soil-tight): Polyethylene, bell-and-spigot type couplers utilizing an elastomeric gasket conforming to ASTM F-477.
4. Fittings:
   a. High density polyethylene meeting the properties specified for the pipe.
   b. Either molded or fabricated.
   c. Designed specifically for the pipe furnished and manufactured by the pipe manufacturer.
5. Acceptable Manufacturer:
   a. ProLink ST (N-12 IB ST), Smooth Interior Pipe & Fittings by Advanced Drainage Systems, Inc., (ADS) 3300 Riverside Dr., Columbus, OH 43221; (614) 457-3051
   b. Approved equivalent.

B. High Density Polyethylene Pipe (HDPE) Perforated Pipe: Perforated double wall smooth interior pipe complying with the following:
   1. 4” to 10” diameter pipe to conform to AASHTO M 252.
   2. 12” to 36” diameter pipe to conform to AASHTO M 294
   3. Coefficient of Roughness (Interior Pipe Surface): 0.012 maximum (Manning Formula).
   4. Classification: Type S
   5. Joint Couplings: Polyethylene, bell and spigot type couplers utilizing an elastrometric gasket conforming to ASTM F 477. Snap on type or split collar through 24” diameter.
   6. Corrugated to match pipe corrugations, width not less than one half the pipe diameter.
   7. Split couplings shall engage an equal number of corrugations on each side of the joint.
   8. Fittings: Either molded or fabricated, high density polyethylene components meeting the properties specified for, and designed specifically for the pipe manufactured by the pipe manufacturer.
   9. Perforated Pipe: Conform to AASHTO M-252 or AASHTO M-294, Type SP with Class I perorations.
   10. Specifications have been based on products manufactured by Advanced Drainage Systems, Inc, Columbus, Ohio (Tel. #614-457-3051) or Hancor, Inc., Findlay, Ohio (Tel. #800-847-5880).

C. Polyvinyl Chloride (PVC) Pipe for in-line drain piping, solid: Conform to ASTM D-3034 and ASTM F1336 (SDR-35)
   1. Conform to shape, dimensions, and thickness shown on the Contract Drawings.
   2. Provide fittings of the same size and pressure rating as the pipe to which they are connected.
   3. Rubber gasketed joints manufactured in accordance with ASTM D-3139.
   4. Rubber gaskets shall comply with ASTM D3212 Internal Pressure Test and Vacuum Test at 5 degrees of gasket joint deflection.
   5. AdvanEdge Pipe and Couplings, as manufactured by Advanced Drainage Systems, Inc., (ADS) 3300 Riverside Dr., Columbus, OH 43221; (614) 457-3051, or approved equivalent.

D. Underdrain Piping: 6” Rigid Schedule 40 PVC. Conform to ASTM D1785 or AASHTO M-278.
   1. Perforations shall be 3/8” diameter at 6-inches on center with 4 holes per row.

2.2 GEOTECHNICAL FABRIC

A. Filter Fabric (GeoTextile):

1. Separation for Underdrains: Amoco 2002 & 2004, Contech Construction Products Inc. C-180, Synthetic Industries Geotex 250ST & 315ST, Mirafi Geolon HP570 & HP1500 or approved equivalent.

PART 3 EXECUTION

3.1 MAINTENANCE OF EXISTING STORMWATER FLOWS

A. Provide all temporary facilities required to safely and adequately bypass existing stormwater flows from the Work area during construction.

B. The bypassing of such flows shall prevent any hazards to public health and welfare when the stormwater flows are bypassed from the Work area during construction.

C. The Contractor is fully responsible for any and all damages to construction, adjacent properties, utilities, and/or buildings in the area caused by these operations.

3.2 INSPECTION

A. Inspect pipe and fittings before installation. Remove defective materials from the Site.

B. Concrete pipes shall be free from fractures, cracks, and surface roughness.

C. Pipe with damaged ends will not be accepted when such damage would prevent making a satisfactory joint.

3.3 INSTALLATION

A. General Locations and Arrangements: Contract Drawings (plans and details) indicate the general location and arrangement of the underground storm sewerage system piping. Location and arrangements of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical. If, during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.

B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

C. Use manholes or catch basins for changes in direction, except where a fitting is indicated. Use fittings for branch connections, except where direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.

E. Install piping pitched down in direction of flow, at minimum slope of 1 percent, except where indicated otherwise.

F. Extend storm sewerage system piping to connect to building storm drains, of sizes and in locations indicated.

G. Fill excess excavation with suitable materials and tamp.

3.4 STORM SEWER RELATION TO WATER LINE

A. Horizontal Separation: Storm sewers should be laid at least 10 feet, horizontally, from any existing or proposed water line.

B. Vertical Separation: Whenever sewers must cross water line, the storm sewer shall be laid at such so there is an 18-inch vertical separation between the two lines. When the elevation of the sewer cannot be varied to meet the above requirements, the water main shall be relocated to provide this separation or reconstructed with push-on joint pipe for a distance of 10 feet on each side of the sewer. One full length of water main should be centered over the sewer so that both joints will be as far from the sewer as possible.

C. Special Conditions: When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the water main should be constructed of a slip-on or mechanical-joint ductile iron pipe, and the sewer constructed of mechanical-joint ductile iron pipe and both pressure tested to assure water tightness.

3.5 PROTECTING PIPE

A. During the progress of the Work keep pipe clean from all sediment, debris, and other foreign material.

B. Close all open ends of pipes and fittings securely with removable plugs at end of Work day, during storms, when the Work is left at any time, and at such times as Engineer may direct.

3.6 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.

B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3000-psi 28-day compressive-strength concrete.

C. Make branch connections from side into existing 4- to 21-inch piping by removing section of existing pipe and installing wye fitting, into existing piping. Encase entire wye with not less than 6 inches of 3000-psi 28-day compressive-strength concrete or,

D. Make branch connections from side into existing 24-inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Provide concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.
    a. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.7 FIELD QUALITY CONTROL

A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
3. Flush piping between manholes, if required by local authority, to remove collected debris.

B. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

1. Make inspections of pipe between manholes/fittings, after pipe has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
2. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and re-inspect.

C. Water Tightness of Sewer Structures: It is the intent of the Contract Drawings and these Specifications that the completed storm sewer lines shall be as watertight and free from infiltration as practical, unless specified otherwise. All visible leaks or points of infiltration shall be repaired.

END OF SECTION 33 41 00

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SECTION 33 49 00 – STORM DRAINAGE STRUCTURES

PART 1 GENERAL

1.1 This Section includes:
- A. Under this section the Contractor shall provide all labor, equipment and material necessary to furnish, install and test all storm utility drainage structures and fittings as shown on the Contract drawings, specified herein and approved by the Engineer.

1.2 RELATED WORK SPECIFIED ELSEWHERE
- A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 31 20 00: Excavation and Fill
- C. Section 33 41 00: Storm Drainage Piping

1.3 REFERENCES
- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. American Society for Testing and Materials (ASTM)

1.4 PROJECT CONDITIONS
- A. Location of Sewers and Sewer Structures: The location, elevation, and grades of sewers and sewer structures are shown on the Contract Drawings and shall be adhered to as closely as possible. If during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.
- B. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system may be installed in compliance with original design and referenced standards.

1.5 SUBMITTALS
- A. Shop drawings for precast concrete storm drainage structures, including cast iron frames, grates, covers, precast dry well and infiltrator system components. Submittal shall include installation, inspection and maintenance instructions for the infiltration system.
- B. Product Data: Manufacturer’s catalog cuts, specifications, and installation instructions. And manufacturer's certificates.

C. As-built record drawings at project closeout of installed storm sewerage piping and products. An as-built survey prepared by licensed NYS Surveyor depicting the installed storm sewer piping and structures including rim and invert elevations of structures pipe size, pipe type, and invert of all piping. Both hard copy and electronic copy shall be provided to the Owner and Engineer.

1.6 QUALITY ASSURANCE

A. Manufacturer data: All products must be produced by a facility that demonstrations five (5) years of experience in the production of similar products.

B. All material utilized in construction of structures shall comply with all applicable ASTM and NYSDOT standards.

C. Environmental Compliance: Comply with applicable portions of local health department and environmental agency regulations pertaining to storm sewerage systems.

D. Utility Compliance: Comply with local utility regulations and standards pertaining to storm sewerage.

E. All storm sewer system components shall be installed in accordance with applicable plumbing code requirements and in accordance with all license requirements.

F. All storm sewer construction shall be subject to inspection by the Engineer prior to backfilling.

1.7 DELIVERY, STORAGE AND HANDLING

A. Contractor shall check all materials upon delivery to assure that the proper materials have been received.

B. Contractor shall check the structures for shipping damage prior to installation. Units that have been damaged must not be installed. Contractor shall contact manufacturer immediately upon discovery of any damage.

C. All material shall be delivered to the site and unloaded with handling that conforms to the manufacturer’s instructions for reasonable care.

D. Protect material from dirt and damage.

E. All material shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Storage of the structure on the job shall be in accordance with the manufacturer’s recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Precast Rectangular Reinforced Concrete Drainage Structures:
   1. Structure shall be manufactured by the Fort Miller Co. Inc. or approved equivalent.
   2. Structure shall be designed for HS20-44 vehicular loading plus 25% impact.
   3. Riser Sections: ASTM C 478.
   4. Joints Between Riser Sections - One of the following:
      a. Rubber Gaskets: ASTM C-443.
      b. Butyl Joint Sealant: ConSeal CS-202 by Concrete Sealants, Inc., or approved equivalent.
   5. Concrete for Precast Units: Air content 6% by volume with an allowable tolerance of 1.5% +/-. Minimum compressive strength of 4,500 PSI after 28 days.
   6. Concrete Reinforcement: Reinforcement for structure shall be designed by a Licensed New York State Professional Engineer prior to construction.
      a. Welded Wire Fabric: ASTM A 185.
      b. Steel Bars: ASTM A 615, Grade 60.
   7. Steps:
      a. Reinforced Plastic: 1/2-inch steel reinforced (ASTM A-615, Grade 60) polypropylene, or other plastic material complying with NYSDOT 725-02.01.
      b. Capable of withstanding a 300 lb. concentrated live load without permanent distortion and with rungs a minimum 10 inches wide designed to prevent feet from slipping off the ends.
      c. Manufactured by MA Industries or approved equivalents.

B. Precast Square Reinforced Concrete Drainage Structure
   1. Structure shall be manufactured by the Fort Miller Co. Inc. or approved equivalent.
   2. Structure shall be designed for HS20-44 vehicular loading plus 25% impact.
   3. Structure shall have integral base.
   4. Riser Sections: ASTM C 890, height and width as indicated on the Contract Documents.
   5. Concrete for Pre-Cast Units: Air content 6% by volume with an allowable tolerance of +/-1.5%. Minimum compressive strength of 4,500 psi after 28 days.
   6. Pre-Cast Concrete Structure Load Rating: AASHTO HS-20 with 30% impact and 130 lb/cf equivalent soil pressure.

a. Casting Load Rating: AASHTO H20 wheel loading requirements. Manufacture, workmanship and certified proof-load tests shall conform to AASHTO M306-89 Standard Specification for Drainage Structure Castings.
b. Coatings: Minimum one shop coat of asphaltum to be applied to all frame and grate surfaces.
c. Acceptable Casting: As indicated on Contract Drawings.

C. Frames, Grates, and Covers for Precast Reinforced Concrete Drainage Structures:
1. Style: Heavy Duty Frame and Grate Assembly
2. Size: 30” x 48”
3. Frame and Grate: Provide castings of uniform quality, free from blow holes, porosity, hard spots, shrinkage defects, cracks or other injurious defects. Manufacture all castings true to pattern and free from surface imperfections. Provide heavy duty frames and grates with machined horizontal bearing surfaces.
4. Design of each shall be the same throughout the project unless otherwise specified or indicated on the Contract Drawings.
5. Units shall meet AASHTO HS20-44 vehicular loading plus 25% impact. Manufacturer, workmanship and certified proof-load tests shall conform to AASHTO M306-89-Standard Specification for Drainage Structure Castings.
6. A.D.A. and Bicycle compliant.
7. Material:
a. Cast iron: ASTM A48, Class 30B or 35B.
b. Delivered to site free of any coatings, unless otherwise specified.

F. Basin and Grate for Yard Inlet Basins:
1. In-Line Drain and Grate: As manufactured by Nyloplast-ADS or equivalent, 13.5” by 13.25” in-line drain with cast iron HS20-44 rated grate.
2. Grate: Round domed ductile iron model 1899CGD and 0899CGD by NYLOPLAST, or approved equivalent.
3. Acceptable Drainage Structure Basin and Grate: Pattern 1899CGD and 0899CGD by NYLOPLAST, or approved equivalent.

G. Frame, Grate and Cover for Storm Manholes:
1. Heavy Duty, Round Frame and Grate or Frame and Cover Assembly
2. Size: 24” diameter
3. Grates shall be A.D.A. and Bicycle compliant.
4. Material:
c. Cast iron: ASTM A48, Class 30B or 35B.
d. Delivered to site free of any coatings, unless otherwise specified.

H. Pipe-to-Drainage Structure Connection:
1. Non-shrink cement mortar, ASTM C 270, Type M.
2. Concrete Coating: Waterborne, non-flammable, VOC Compliance, 3 mil dry film thickness, catonic asphalt emulsion (55% - 60% petroleum asphalt), PGS 96 by Pipe Gasket & Supply Co., 2701 South Coliseum Boulevard, Suite 1010, Fort Wayne, Indiana, 46003, (219) 426-4575, or approved equivalent.

I. Materials for use in mortar shall conform to the following requirements:
1. Cement: Cement shall conform to the Standard Specifications for Portland Cement, ASTM Serial Designation C150 with latest amendments.
2. Sand: Sand shall be sharp, clean, free from deleterious substances and shall be uniformly graded and shall conform to the "Standard Specification for Aggregate for Masonry Mortar", ASTM C144 with the latest amendments.
3. Water: Water used in making mortar or concrete shall be clean and free from oil, alkali, sugar or other deleterious substances. When potable water is in reach, no other water shall be used.

J. STORMWATER WATER QUALITY UNIT

1. General: Stormwater water quality unit (SWTU) standard of quality to be “CDS Unit” as manufactured by Contech Construction Products Inc. of West Chester, OH. Approved equivalents acceptable.
2. SWTU components to be installed within a precast concrete structure that is in compliance with manufacturer’s installation requirements.
3. Screen and support structure shall be manufactured of Type 316 and 316L stainless steel conforming to ASTM F 1267-01;
4. Hardware shall be manufactured of Type 316 stainless steel conforming to ASTM A 320;
5. Fiberglass components shall conform to the ASTM D-4097
6. Access system(s) conform to the following:
7. Manhole castings shall be designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A 48 Class 30.

PART 3 EXECUTION

3.1 INSTALLATION

A. Construct structures with precast reinforced riser sections to the dimensions shown on the Contract Drawings. Seal joints between precast riser sections with material specified. Install steps 12 inches o.c. from top to bottom and in a manner capable of withstanding a lateral pull of 1,000 lbs.

B. Position tops of structures flush with finished grade.

C. All lifting holes shall be sealed by driving a tapered rubber plug into to hole and filling the remaining void with a non-shrink grout.

D. Cast iron frames, grates and covers shall be set to the proper elevation in a full bed of mortar. The frame shall be completely mortared onto the manhole as shown on the Contract Drawings.

E. Temporary Shoring: Provide and maintain shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of existing structures and construction to remain. Strengthen or add new supports when required during progress of selective demolition.

3.2 BRICK TO BRING STORM DRAINAGE STRUCTURE TO GRADE

A. Brick shall be used in conjunction with precast concrete spacers to bring frames to grade for heights under twelve (12) inches in the following manner:

1. Bricks shall be thoroughly wet when used and each brick shall be laid in a full bed of mortar including side and end joints. Normal 3/8 inch joints shall be used except when the brick is laid radially, in which case the narrowest part of the joint will not exceed ¼ inch. Brick shall be laid neatly with sufficient width to adequately support the cast iron frame. The entire stack shall be completely plastered on the exterior side when initially constructed. The brick work shall be kept moist for a period of five (5) days after completion and adequately protected to prevent freezing during cold weather. The interior of the brick shall be neatly plastered once final grading and paving is completed so that the frame and cover will not the disturbed by additional work.

3.3 CHAMBER INSTALLATION AND BACKFILLING

A. Excavation must be free of standing water. Dewatering measures must be taken if required.

B. Prepare the chamber bed’s subgrade soil as outlined in the Contract Drawings. Requirement for subgrade soil bearing capacity should meet or exceed the chamber manufacturer’s required allowable subgrade soil bearing capacity. The Contractor must report any discrepancies with subgrade soil’s bearing capacity to the Engineer.

C. Install chamber system flat or at constant slope between points an elevations indicated.

D. Construct fabric and stone foundation per chamber manufacturer’s installation instructions.

E. Construct the chamber bed by joining the chambers lengthwise in rows. Attach chambers by overlapping the end corrugation of one chamber onto the end corrugation of the last chamber in the row.

F. See pipe manufacturer’s installation instructions for pipe assembly.

G. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of the chamber manufacturer’s installation instructions.

H. The contractor must refer to the chamber manufacturer’s installation instructions for a table of acceptable vehicle loads at various depths of cover. The contractor is responsible for preventing vehicles that exceed the chamber manufacturer’s requirements from traveling across or parking over the chamber system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.

I. Refer to the chamber manufacturer’s installation instructions for minimum requirements for backfill material above the stormwater chamber system.

J. See pipe manufacturer’s installation instructions for guidance on installing the plastic pipe fittings to the chamber system.

K. Protect all inlets to the stormwater chamber system during construction. Once construction has ceased, the pipe plugs are removed to allow normal system functionality.

3.4 FIELD QUALITY CONTROL

A. Cleaning: Clear interior of structures of dirt and other superfluous material as work progresses.

B. Flush piping between manholes, if required by local authority, to remove collected debris.

C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.

D. Make inspections of pipe between manholes/fittings, after pipe has been installed and approximately 2 feet of backfill is in place, and again at completion of project.

E. If inspection indicates poor alignment, debris, displaced pipe, infiltration, or other defects, correct such defects and re-inspect.

F. Water Tightness of Storm Sewer Structures: It is the intent of the Contract Drawings and these Specifications that the completed storm sewer structure shall be as watertight and free from infiltration as practical. All visible leaks or points of infiltration shall be repaired.

3.5 INSPECTION AND MAINTENANCE

A. Utilize inspection port to allow for inspection of the stormwater system during normal operations.

B. Refer to the chamber manufacturer's Operation and Maintenance manual for guidance on inspection intervals during normal system operation.

C. Maintenance of the isolator row shall utilize a vacuum jet process to remove sediments that have accumulated over time.

END OF SECTION 33 49 00

SECTION 335900 – SANITARY SEWER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Under this section the Contractor shall provide all labor, equipment and material necessary to furnish, install and test all sanitary sewer utility pipe and fittings as shown on the Contract Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 312000: Excavation and Fill

C. Section 335903: Sanitary Sewer Structures

1.3 SUBMITTALS

A. Shop Drawing: Pipes and associated fittings.

B. Product Data: Manufacturer's specifications, including dimensions, allowable height of cover information, and installation instructions.

C. Manufacturer's product literature, installation instructions and shop drawings for infiltration systems.

D. As-built record drawings at project closeout of installed sanitary sewerage piping and products. An as-built survey prepared by licensed NYS Surveyor depicting the installed sanitary sewer piping and structures including rim and invert elevations of structures pipe size, pipe type, and invert of all piping. Both hard copy and electronic copy shall be provided to the Owner and Engineer.

1.4 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of local health department and environmental agency regulations pertaining to sanitary sewerage systems.

B. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage.

C. All sanitary sewer system components shall be installed in accordance with applicable plumbing code requirements and in accordance with all license requirements.

D. All sanitary sewer construction shall be subject to inspection by the Engineer prior to backfilling.

1.5 PROJECT CONDITIONS

A. Location of Sewers and Sewer Structures: The location, elevation, and grades of sewers and sewer structures are shown on the Contract Drawings and shall be adhered to as closely as possible. If during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.

B. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.

C. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner and Engineer no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of the General Conditions.

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.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Sewer Piping
1. Pipe: ASTM D 3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Laterals: SDR 21 PVC
3. Fittings: ASTM D 3034, PVC with bell ends.
4. Gaskets: ASTM F 477, elastomeric seals.

B. Preinsulated PVC Gravity Sewer Pipe
1. Preinsulated Gravity Sewer: PVC Carrier Pipe - 160 psi (SDR 26) PVC pipe meeting ASTM D1784; PVC Casing Pipe - Material ASTM D1784, Pipe - SDR 1 or heavier - ASTM D2241; Rubber sealing rings (gaskets) - molded solid compression type seal;

Foam - polyurethane - 1.5 to 2.5 lb./cu. Ft., 90 percent closed cell content, K value - 0.14 Btu/inch/hr./degree F/sq. ft.

2. Provide rubber end seals on all full and cut-down sections to protect insulation.
3. Utilize SDR 26 gasketed PVC fittings. Encase in concrete following leakage testing.
4. Acceptable Manufacturer: Thermal Pipe Systems, Inc., 5205 W. Woodmill Dr., Suite 33, Wilmington, DE 19808, (302) 999-1588, www.thermalpipesystems.com or approved equivalent

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect all pipe and fittings before installation. Remove defective pipe and fittings from the site.

B. Pipe with damaged ends will not be accepted when such damage would prevent making a satisfactory joint.

C. Do not backfill before installation is inspected by the Engineer.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 – Earthwork.

3.3 INSTALLATION

A. Install Contract Drawings indicate location and arrangement of underground sanitary sewer piping. Where specified location and arrangement is not allowable due to unforeseen conditions, please notify the Engineer as soon as possible.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Lay pipe to indicated line and grade with a firm uniform bearing for the entire length of the pipe. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

E. Install gravity-flow, nonpressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 0.40 percent unless otherwise indicated.
2. Install piping with 48-inch minimum cover.
3. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.

F. Arrange for installation of green warning tapes directly over piping.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping.

3.4 PIPE JOINT CONSTRUCTION

A. Wipe inside of sockets and outside of pipe to be jointed, clean and dry.

B. Install rubber gaskets in accordance with the manufacturer’s specifications.

C. Join gravity-flow, nonpressure, drainage piping according to the following:
   1. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
   1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

      a. Flexible couplings for pipes of same or slightly different OD.
      b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
      c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.5 LEAKAGE TEST

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

   1. Submit separate report for each system inspection.
   2. Defects requiring correction include the following:

      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.

   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
b. Close openings in system and fill with water.
c. Purge air and refill with water.
d. Disconnect water supply.
e. Test and inspect joints for leaks.

6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, and the following:

a. Option: Test plastic gravity sewer piping according to ASTM F 1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

E. Additional leakage tests and a final test shall be performed as directed by the Engineer.

3.6 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION 335900

SECTION 335903 – SANITARY SEWER STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Under this section the Contractor shall provide all labor, equipment and material necessary to furnish, install and test all sanitary sewer structures as shown on the Contract Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 312000: Excavation and Fill

C. Section 335900: Sanitary Sewer Piping

1.3 SUBMITTALS

A. Shop Drawing: Structures including manholes, septic tanks and cleanouts

B. Product Data: Manufacturer's specifications, including dimensions, and installation instructions.

C. Manufacturer's product literature, installation instructions and shop drawings.

D. As-built record drawings at project closeout of installed sanitary sewerage products. An as-built survey prepared by licensed NYS Surveyor depicting the installed sanitary sewer structures including rim and invert elevations of structures pipe size, pipe type, and invert of all piping. Both hard copy and electronic copy shall be provided to the Owner and Engineer.

1.4 QUALITY ASSURANCE

A. Environmental Compliance: Comply with applicable portions of local health department and environmental agency regulations pertaining to sanitary sewerage systems.

B. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage.

C. All sanitary sewer system components shall be installed in accordance with applicable plumbing code requirements and in accordance with all license requirements.

D. All sanitary sewer construction shall be subject to inspection by the Engineer prior to backfilling.

1.5 PROJECT CONDITIONS

A. Location of Sewers and Sewer Structures: The location, elevation, and grades of sewers and sewer structures are shown on the Contract Drawings and shall be adhered to as closely as possible. If during construction of the project, it becomes necessary to make changes in the location or grades of the sewers, the Engineer will issue appropriate directions after being contacted by the Contractor.

B. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.

C. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner and Engineer no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner’s written permission.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of the General Conditions.

B. Provide temporary closures on openings. Maintain in place until installation.

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

1.7 SEQUENCING AND SCHEDULING

A. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Cleanouts
1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping, as indicated on plans.
2. Frame and Cover – EJ Group Frame PN#00156446 and Cover PN#00156411 or approved equal.

B. Standard Precast Concrete Manholes

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: As indicated on schedule sheet.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: 6-inch minimum thickness for floor slab and 6-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.

5. Riser Sections: 6-inch minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C 923 cast or fitted into manhole walls, for each pipe connection.
9. Steps: Wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12 to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Manhole Frame and Cover

1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser, with 4-inch minimum-width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: Cast iron unless otherwise indicated. Manufactured by EJ Group or approved equal.

D. Concrete

1. General: Cast-in-place concrete complying with ACI 318, and the following:
   a. Cement: ASTM C 150, Type II.
   b. Fine Aggregate: ASTM C 33, sand.
   c. Coarse Aggregate: ASTM C 33, crushed gravel.
   d. Water: Potable.

E. Portland Cement Design Mix: 4000 psi minimum, with 0.5 maximum water/cementitious materials ratio.

1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

F. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.5 maximum water/cementitious materials ratio. Include channels and benches in manholes.

G. Grease Trap: Basis of Design: Elliptical Fiberglass (FRP) grease interceptor construction, as manufactured by Zurn. Approved equivalents acceptable.

1. Include accessways, tanks, and piping and baffle openings to retain grease and solids.

2. Factory installed Schedule 40 PVC cement welded type socket ports, or straight pipe, fitted into interceptor walls for each pipe connection.
3. Accessway Extension Collar: 24-inch Fiberglass risers (EC2)
4. Accessway Frames and Covers: Round cover with non-slip cover finish, gasketed and non-vented.
5. Cast Iron: AASHTO M306, HS20 Traffic load rated. 24 inch- (610-mm-) diameter cover with 0.25" (6-mm-) gasket. Two closed pickholes. Non-Bolted option. Weight 249 lbs. ASTM A48 CL35B. 36-inch (915-mm) optional alternate is acceptable to match fiberglass risers.
6. Watertight Flexible Caulking: Sikaflex 255 or Sikaflex 221 or approved alternate to provide watertight seal at extension collar joints.
7. Capacity
   a. Total Wet Volume = 1,000 gallons
   b. Maximum Grease Capacity = 577 gallons
   c. Maximum Solids Capacity = 295 gallons

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect all structures before installation. Remove defective structures from the site.

B. Do not backfill before installation is inspected by the Engineer.

3.2 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 – Earthwork.

3.3 MANHOLE INSTALLATION

A. General: Install manholes complete with appurtenances and accessories indicated on the Contract Drawings. Where specified location and arrangement is not allowable due to unforeseen conditions, please notify the Engineer as soon as possible.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

E. Install manhole-cover inserts in frame and immediately below cover.

F. Arrange for installation of green warning tapes at outside edges of underground manholes.
   1. Use detectable warning tape over outside edges of underground manholes.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 17 by 17 by 7-1/2 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.5 CLEANING

A. Clean dirt and superfluous material from interior of structure. Flush with potable water.

END OF SECTION 335903

SWPPP REPORT

April 10, 2024

20223470.0003

NEWBURGH CTE BUILDING

CITY OF NEWBURGH, NY

PREPARED FOR:
Newburgh Enlarged City School District
Career & Technical Education (CTE) Building
201 Fullerton Avenue
Newburgh, NY. 12550

TABLE OF CONTENTS

APPENDICES

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1.0 EXECUTIVE SUMMARY

The proposed development is the construction of a new 74,000 square feet building on a parcel in the city of Newburgh. The project site has its frontage along Fullerton Avenue with the northern property line abutting Gidney Avenue, Western property line abutting West street and Southern property line abutting South Street. The property, also known as Tax Lot 6-5-18, is approximately 44 acres in size and is located withing the R-1 zoning district. The property currently contains an existing building (Newburgh Free Academy School Building) that will remain. An aerial map showing additional details of the project area has been provided as Appendix A.

This proposed development was originally part of the 2019 Capital Improvements project for Newburgh Enlarged School District and as part of the site design process the contracted engineering team (CPL: Architecture, Engineering and Planning Firm) submitted a Stormwater Pollution Prevention Plan dated September 2021. This report is an amendment and change to the original SWPPP and the report will be utilizing some of the pre-development parameters from the original SWPPP as shown within Appendix F.

The existing building (Newburgh Free Academy) is served by an existing public water supply and public sewer service within the Fullerton Avenue Right of Way. However, the proposed building will be served by a public water supply and public sewer service within the West Street and Gidney Avenue Right of Way. Stormwater will be collected onsite and treated through proposed infiltration basins, a dry swale and bioretention filtering systems, which are NYSDEC approved Stormwater management practices. Pretreatment is provided through the use of sediment forebays and/or hydrodynamic separators. The summary table below shows the site water quantity and quality comparisons between existing and proposed conditions:

Table 1: *Summary Table*

Summary Table			
Water Quantity			
	Existing	**Proposed**	**Reduction (%)**
1-Year Runoff (cfs)	6.18	4.380	29.13%
10-Year Runoff (cfs)	18.15	13.11	27.77%
100-Year Runoff (cfs)	41.33	25.6	38.06%
Water Quality			
	Required	**Provided**	
Water Quality Volume (WQv) (acre-ft)	0.566	0.566	
Minimum Allowable Runoff Reduction Volume (RRv) (acre-ft)	0.127	0.395	
Channel Protection Volume (CPv) (acre-ft)	0.901	1.130	
	Existing	**Proposed**	
Qp (cfs)	18.15	13.110	
Qf (cfs)	41.330	25.600	

As shown on the previous page, the proposed Stormwater Pollution Prevention Plan (SWPPP) meets the minimum stormwater quality and quantity requirements set forth by the NYSDEC. Reduction in runoff from existing to proposed conditions is met in the 1, 10, and 100-year storm events. This SWPPP includes post-construction stormwater management practices, as well as erosion and sediment controls measures.

2.0 PROJECT DESCRIPTION

Project construction activities will consist of constructing a proposed building, pavement, new parking areas, and proposed stormwater management areas. Pollutants to mitigate could include sediments and construction vehicle fuels and lubricants. Current NYSDEC regulations under the General Stormwater permit GP-0-20-001 require that any construction site proposing a disturbance of one acre or greater prepare a SWPPP. This SWPPP consists of the following mitigation measures: water quality treatment and control, water quality control and Erosion and Sediment control Plan (designed in conformance with New York Standards and Specifications for Erosion and Sediment Controls). Preparation of each portion of the SWPPP depends on the type of construction proposed. As part of this SWPPP, the 1-year (Channel Protection Volume, CpV), 10-year (Overbank Flood, Qp) and 100-year (Extreme Storm, Qf) events were analyzed.

As a school district, this project is located within a regulated, non-traditional land use control Municipal Separate Stormwater Sewer System (MS4). However, an MS4 SWPPP Acceptance Form is not required to accompany the NOI submitted to the NYSDEC because the New York State Education Department has clarified with the NYSDEC that school districts will not require that form. Although the school is located in the City of Newburgh, the District is NOT required to have the City review and/or authorize an MS4 acceptance form, as they are not the MS4 of jurisdiction.

A copy of this SWPPP and associated inspection logs will be kept on site and SWPPP mailbox.

Owner/Operator	**SWPPP Preparer**
Newburgh Enlarged City School District	Passero Associates
124 Grant Street	6 Front Street. 2nd Floor
Newburgh, NY 12550	Newburgh, NY 12550
(845) 563-3400	(845) 219-5271
Contact:	Contact: Chris LaPorta, P.E.

3.0 EXISTING SITE CONDITIONS

3.1 Wetlands/Tributary

The site was reviewed for the existence of federal and state regulated wetlands within the property boundaries. Federal wetlands were researched using the National Wetlands Inventory (NWI) using an online U.S. Fish and Wildlife website search. State regulated wetlands were researched using the NYSDEC's online Environmental Resource Mapper website. Refer to Appendix B for the federal and state regulated wetlands mapping. The site contains a 0.37-acre federal wetland (that will not be disturbed).

3.2 Floodplain

Floodplains were researched using the online Firmette tools found at FEMA Map Service Center. Review of the floodplain mapping indicates that the project area is within Zone A, Zone AE, and Zone X according to FEMA maps 36027C0268E and 36027C0269E dated May 2nd, 2012. Appendix D provides the FEMA Firmette maps showing the nearby floodplains.

3.3 Environmental Resources

The NYSDEC has an Environmental Resource Mapper on its website. The Environmental Resource Mapper is an interactive mapping application that can be used to identify some of New York State's natural resources and environmental features that are state protected, or of conservation concern. It displays the following:

- Animals and plants that are rare in New York, including those listed as Endangered or Threatened (generalized locations). [Updated May 2008]
- Significant natural communities, such as rare or high-quality forests, wetlands, and other habitat types.
- New York's streams, rivers, lakes, and ponds; water quality classifications are also displayed.

A habitat assessment was conducted, and it was determined that the Indiana bat is an endangered species located in vicinity of the site. Refer to Appendix D for the Environmental Resource Mapper, and Appendix V for the Habitat Suitability Assessment Report and Species List. The proposed project does include any further tree clearing.

3.4 State Historic Preservation Office Review

The site was reviewed for the presence of an archeological sensitive area within the property boundary. The archeo-sensitive areas were located using online GIS tools found at the NYS Historic Preservation Office (SHPO). It was determined that site is not within archeological-sensitive area. Refer to Appendix R for the SHPO Letter of No Impact from the original SPDES permit for this project.

3.5 Topography/ Drainage

The parcel has varied land cover, which ranges from impervious areas to woods. The land also varies in slope throughout the site. The soil boundaries and types shown are provided by the U.S. Department of Agriculture

National Resources Conservative Service, a detailed soil classification report including maps is provided in Appendix C. According to the USDA soils report, soils throughout the project area consist of Alden Silt Loam, Farmington Silt Loam, Mardin Gravelly Silt Loam and Rock Outcrop-Farmington Complex, which are classified as hydrologic soil groups C and D.

A geotechnical report entitled "Geotechnical Engineering Report, Newburgh Enlarged City School District Career and Technical Education Building, West Street, Newburgh, New York" by Quality Geo Engineering, P.C. was completed on January 6, 2021. With the information available on the site survey and USGS Mapping, the drainage occurring on and throughout the project site has been divided into three watershed areas. A figure and descriptions of the watershed areas have been provided (after page 6), depicting the watershed areas that were utilized in the hydraulic computer model.

The existing watershed area has been divided into five areas which drain to three outlet locations identified within this report as Design Points. With stormwater storage and controlled outflow, there is a decrease in peak discharge. Additionally, the site uses Standard Stormwater Management practices to meet NYSDEC stormwater quality minimum requirements, which include water quality volume, runoff reduction volume, and channel protection volume (See Section 5 for more detail).

3.6 Existing Drainage Area 1

This area consists of approximately 7.21 acres of land located in the center portion of the site. The terrain consists of mainly the wooded area on the west side of the site, and the abandoned buildings with their associated driveways and site features. Runoff from this area begins with sheet flow from a high spot centrally located on the site at the ridge line. The runoff then changes to concentrated flow until it reaches the existing drainage system bordering the south end of the soccer field. Runoff is then conveyed through a series of catch basins to the municipal drainage system that eventually leads to the Analysis Point 1 (AP-1). The Curve Number value is 79 and the time of concentration is 26.5 minutes.

3.7 Existing Drainage Area 2

This area consists of approximately 0.77 acres of land located in the southern portion of the site. The coverage in this area consists of mainly wooded areas and some lawn and driveways. Runoff from this area begins at a highpoint on the southern side of the drainage catchment as sheet flow transitions to shallow concentrated flow through the wooded area and back to the south to Analysis Point 2 (AP-2). The Curve Number value is 78 and the time of concentration is 13.3 minutes.

3.8 Existing Drainage Area 3

This area consists of approximately 0.56 acres of land located in the northeastern portion of the site. The terrain consists of mainly the wooded area along the ridge line. Runoff from this area travels as sheet flow from a wooded high point on the ridgeline to Analysis Point 3 (AP-3)) which eventually continues down the slope to the east. The Curve Number value is 77 and the time of concentration is 12.4 minutes.

3.9 Existing Drainage Area 4

This area consists of approximately 0.73 acres of land located in the southeastern portion of the site. The terrain consists of mainly the wooded area on the east side of the ridge line. Runoff from this area begins with sheet flow from a high spot located on the site at the ridge line. The runoff then changes to concentrated flow until it reaches the existing wooded slope leading down to the existing school building to Analysis Point 4 (AP-4). The Curve Number value is 80 and the time of concentration is 18.7 minutes.

3.10 Existing Drainage Area 5

This area consists of approximately 1.1 acres of land located in the northern portion of the site. The terrain consists of mainly the wooded area on the northern portion of the site down to Gidney Avenue. Runoff from this area begins with sheet flow from a high spot on the north side of the site. The runoff then changes to concentrated flow until it reaches Analysis Point 5 (AP-5) at the existing drainage system in Gidney Avenue. The Curve Number value is 78 and the time of concentration is 11.7 minutes.

The existing drainage map is based upon the pre-existing site (the site conditions that the approved SWPPP developed by CPL used) conditions and graphically shows all drainage areas, as well as the other hydraulic characteristics.

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4.0 DEVELOPED SITE CONDITIONS

The developed site will be segmented into eleven drainage areas. See below for a description of these drainage areas:

4.1 Proposed Drainage Area 1:

This area consists of approximately 1.04 acres of land located in the south-central portion of the site. The terrain consists of grass, and 0.83 acres of proposed impervious area consisting of buildings, sidewalks and parking areas. Stormwater sheet flows across the lawn area and is picked up by an inlet located at the low point in the lawn, where it is then piped under the driveway to an infiltration basin and then to Analysis Point 4 (AP-4). The Curve Number value is 94 and the time of concentration is 14.2 minutes.

4.2 Proposed Drainage Area 1A:

This area consists of approximately 0.20 acres of land consisting of the area including and directly contributing to Infiltration Basin 2P. The terrain consists of grass, and 0.83 acres of proposed impervious area consisting of buildings, sidewalks and parking areas. Stormwater sheet flows across the lawn area and is picked up by an inlet located at the low point in the lawn, where it is then piped under the driveway to an infiltration basin and then to Analysis Point 4 (AP-4). The Curve Number value is 80 and the time of concentration is 6.0 minutes.

4.3 Proposed Drainage Area 2:

This 0.79-acre area is located at the southern end of the site, and includes some parking areas, lawn and infiltration basin 3P. The terrain consists of grass with some lightly forested areas bordering the property line, and 0.49 acres of impervious area consisting of parking areas. This drainage area is pretreated with a hydrodynamic separator and is treated in Infiltration Basin 3P and discharges to Analysis Point 2 (AP-2). The calculated Curve Number value is 91 and the time of concentration is 6.0 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.4 Proposed Drainage Area 3:

This 1.019-acre area is located at the southwest end of the site, and includes a portion of the new building some parking areas, lawn and infiltration basin 4P. The terrain consists of grass with some lightly forested areas bordering the property line, and 0.797 acres of impervious area consisting of parking areas. This drainage area is pretreated with a hydrodynamic separator and is treated in Infiltration Basin 4P and discharges to Analysis Point 1 (AP-1). The calculated Curve Number value is 91 and the time of concentration is 10.8 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.5 Proposed Drainage Area 4:

This 1.245-acre area is in the central area of the site, and includes part of the building, a drive which exits the site, lawn and infiltration basin 5P. The terrain consists of grass areas bordering the property line, and 0.757 acres of impervious area consisting of parking areas. This drainage area enters a diversion structure which leads to a bioretention pool (5P) where it passes through a bioretention filter which eventually leads to a detention basin (7P) before discharging in Analysis Point 1 (AP-1). The calculated Curve Number value is 91 and the time of concentration is 5.3 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.6 Proposed Drainage Area 4A:

This 0.488-acre area is in a northwest portion of the site and includes a large lawn area and infiltration basin 7P. The terrain consists entirely of a grass areas. This drainage doesn't require pretreatment and the area leads to detention basin 7P and discharges to Analysis Point 1 (AP-1). The calculated Curve Number value is 80 and the time of concentration is 6.0 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.7 Proposed Drainage Area 4B:

This 0.688-acre area is located at the most northwest end of the site and includes Analysis Point 1. The terrain consists of grass with some lightly forested areas bordering the property line. This drainage area doesn't need to be pretreated and discharges to Analysis Point 1 (AP-1). The calculated Curve Number value is 80 and the time of concentration is 6.2 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.8 Proposed Drainage Area 5:

This 2.987-acre area is in the northeastern end of the site, and includes some parking areas, a portion of the building, lawn and bioretention pool 7P. The terrain consists of grass areas bordering the property line, and 2.33 acres of impervious area consisting of parking areas. This drainage area leads to a diversion structure and then to bioretention pool 6P which is filtered before leading to detention basin 7P that leads to Analysis Point 1 (AP-1). The calculated Curve Number value is 94 and the time of concentration is 6.2 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.9 Proposed Drainage Area 5A:

This 1.342-acre area is located at the northernmost end of the site, and includes some parking areas, lawn and analysis point 5. The terrain consists of grass with some lightly forested areas bordering the property line, and 0.015 acres of impervious area consisting of parking areas. This drainage area doesn't need to be pretreated and discharges to Analysis Point 2 (AP-2). The calculated Curve Number value is 80 and the time of concentration is 6.1 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.10 Proposed Drainage Area 6:

This 4.121-acre area is in the north central part of the site and includes some paved areas and lawn. The terrain consists of grass areas, and 0.095 acres of impervious area consisting of paved areas. This drainage area is sent to bioretention pool 10P then to dry swale 11P which eventually leads to an underdrain which discharges offsite. The calculated Curve Number value is 95 and the time of concentration is 6.0 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

4.11 Proposed Drainage Area 7:

This 0.471-acre area is in the southwestern most portion of the site, and includes some paved areas, lawn and infiltration basin 1P. The terrain consists of grass areas bordering the property line, and 0.167 acres of impervious area consisting of paved areas. This drainage area is treated in Infiltration Basin 1P and discharges to Analysis Point 1 (AP-1). The calculated Curve Number value is 86 and the time of concentration is 7.3 minutes. The Proposed Drainage Map graphically shows both drainage areas, as well as the other hydraulic characteristics.

5.0 STORMWATER QUALITY

Stormwater quality requirements will be achieved using green infrastructure practices as well as standard stormwater practices. Chapter 5 of the NYSDEC Stormwater Management Design Manual was used to design the green infrastructure for this project. The design manual outlines which practices are best suited for specific scenarios, and how to properly size these practices. Water Quality Volume (WQv) and Runoff Reduction Volume (RRv) requirements are met using green infrastructure practices as well as other standard stormwater management practices. This project will use Infiltration Basins, Bio-Retention and a Dry Swale to meet all NYSDEC requirements for stormwater quality.

5.1 Infiltration Basins:

The Infiltration Basins shown on the plans will treat runoff from portions of the proposed parking area and building. This practice will reduce runoff volume, remove sediment, pollutants and provide partial attenuation of peak flows for storm events equal to or less than the design storm. These infiltration practices are designed using the NYSDEC Stormwater Manual for infiltration basins. These systems are designed to infiltrate the entire water quality volume and, in some instances, up to and including the 100-year storm event as well as to provide detention above the infiltration zone to attenuate peak volumes of larger storm events to meet flood control requirements.

A design test was conducted on June 6, 2023, to verify the infiltration test in the location of the infiltration basins. The infiltration rates ranged from 4”/hour to 12”/hour, each of the four basins use the specific rate measured in the basins location.

5.2 Bioretention:

The Bioretention area shown on the plans will filter runoff from portions of the proposed parking area and building. This practice will reduce runoff rate, remove sediment, pollutants and provide partial attenuation of peak flows for storm events equal to or less than the design storm. These bioretention practices are sized using the NYSDEC design guidance in the Stormwater Manual. These systems are designed to filter the water quality volume before being directed the detention basin which will manage the discharge rates to meet or reduce runoff rates from the existing condition.

5.3 Dry Swale:

The Dry Swale area shown on the plans will filter runoff from a portion of the proposed driveway leading up from Gidney Avenue. This practice will reduce runoff rate, remove sediment, pollutants and provide partial attenuation of peak flows for storm events equal to or less than the design storm. This dry swale practice is designed using the NYSDEC design guidance in the Stormwater Manual. This system is designed to filter the water quality volume before being directed the offsite drainage system at discharge rates to meet or reduce runoff rates from the existing condition.

Table 2: *Stormwater Quality*

Water Quality		
Description:	**Required**	**Provided**
WQv Total (acre-ft)	0.594	0.594
Min RRv Total (acre-ft)	0.175	0.388
CPv Total (acre-ft)	0.901	1.130
Description:	**Existing**	**Proposed**
Qp Total (cfs)	18.15	13.110
Qf Total (cfs)	41.330	25.600

6.0 STORMWATER QUANTITY

The proposed development will increase impervious cover on site, which increases the rate of stormwater runoff from the site. This runoff must be reduced to a rate that is less than the onsite flow rate during existing conditions. Reduction for this project is achieved through a new underground stormwater management area that will release stormwater runoff at a controlled rate via an outlet control structure.

See the comparison table below for the sites analysis points under existing and proposed conditions:

Table 3: *Stormwater Quantity Comparison*

Runoff Comparison Table

Analysis Point:	Condition:	Runoff (cfs) 1-year	10-year	100-year
Analysis Point 1	EXISTING	4.37	12.8	29.01
	PROPOSED	3.46	10.24	19.28
	PERCENT REDUCTION	20.82%	20.00%	33.54%
Analysis Point 2	EXISTING	0.57	1.74	4
	PROPOSED	0	0	0
	PERCENT REDUCTION	100.00%	100.00%	100.00%
Analysis Point 3	EXISTING	0.4	1.26	2.96
	PROPOSED	0	0	0
	PERCENT REDUCTION	100.00%	100.00%	100.00%
Analysis Point 4	EXISTING	0.55	1.56	3.48
	PROPOSED	0	0	0
	PERCENT REDUCTION	100.00%	100.00%	100.00%
Analysis Point 5	EXISTING	0.97	2.96	6.81
	PROPOSED	0.93	2.87	6.41
	PERCENT REDUCTION	4.12%	3.04%	5.87%

As shown above, the proposed design meets the requirements of stormwater management by releasing the water at a reduced rate that does not lead to erosion or high levels or pollution. Refer to Appendix H, I, J for a detailed hydrologic and hydraulic analysis of each watershed area.

7.0 CONSTRUCTION EROSION CONTROL PRACTICES & INSPECTIONS

The Owner (The School District) is responsible for having monthly inspections of the storm water management facility completed. The inspections shall review and document the following at a minimum: visual inspection of the outlet structure, check of the outlets for excessive sediment accumulation, burrowing, or any other issues of concern. The school district is also responsible for having SWPPP inspections once per week once disturbance of the site starts. Copies of the SWPPP inspection reports will be sent to the City, owner, and contractor and deficiencies should be addressed immediately.

Several erosion control practices will be utilized during construction by the contractor under direct supervision by the school district and a qualified SWPPP inspector (S.W.T.). These practices are explained below and shown in detail in appendix M of this report and the construction plans:

7.1 Temporary Erosion and Sediment Control Measures

The temporary erosion and sediment control measures described in the following sections are included as part of the construction documents.

a. Stabilized Construction Access

Prior to construction, stabilized construction access(es) will be installed, per accompanying plans, to reduce the tracking of sediment onto public roadways. Construction traffic must enter and exit the site at the stabilized construction access(es). The intent is to trap dust and mud that would otherwise be carried off-site by construction traffic.

The access(es) shall be maintained in a condition which will control tracking of sediment onto public rights-of-way or streets. When necessary, additional aggregate will be placed atop the filter fabric to assure the minimum thickness is maintained. All sediment and/or soil spilled, dropped, or washed onto public rights-of-way must be removed immediately. Periodic inspection and needed maintenance shall be provided after each substantial rainfall event.

b. Dust Control

Water trucks shall be used as needed during construction to reduce dust generated on-site. Dust control must be provided by the Contractor(s) to a degree that is acceptable to the School District, and in compliance with the applicable local and state dust control requirements.

c. Temporary Soil Stockpile

Materials, such as topsoil, will be temporarily stockpiled (if necessary) on the site during the construction process. Stockpiles shall be located in an area away from storm drainage, water bodies and/or courses, and will be properly protected from erosion by a surrounding silt fence barrier.

d. Silt Fencing

Prior to the initiation of and during construction activities, a geotextile filter fabric (or silt fence) will be established downgradient of all disturbed areas. These barriers may extend into non-impact areas to provide adequate protection of adjacent lands. Clearing and grubbing will be performed only as necessary for the installation of the sediment control barrier. To facilitate effectiveness of the silt fencing, daily inspections, and inspections immediately after significant storm events will be performed by the Contractor(s). Maintenance of the fence will be performed as needed.

e. Temporary Seeding

For areas undergoing clearing, grading, and disturbance as part of construction activities, where work has temporarily ceased, temporary soil stabilization measures must be initiated by the end of the next business day and completed within fourteen (14) days from the date the soil disturbance activity has temporarily ceased.

f. Filter Fabric Drop Inlet Protection

Install filter fabric or silt fence with wooden stakes at the perimeter of existing or proposed catch basins located in lawn areas, to prevent sediment from entering the catch basins and storm sewer system. Remove sediment accumulation and repair or replace fabric as necessary to ensure proper function.

g. Temporary Sediment Trap

Temporary sediment traps shall be constructed to intercept sediment-laden runoff, reduce the amount of sediment leaving the disturbed areas, and protect drainage ways, properties, and rights-of-way. Accumulated sediment shall be removed from the trap when it reaches no greater than 50 percent of the design capacity. Sediment shall not be placed downstream from the embankment, adjacent to a stream, or floodplain. Temporary sediment traps depicted on the accompanying plans have been designed to provide 3,600 CF of storage per acre of tributary watershed.

h. Dewatering Operations

Dewatering will be used to intercept sediment-laden stormwater or pumped groundwater and allow it to settle out of the pumped discharge prior to being discharged from the site. Water from dewatering operations shall be treated to eliminate the discharge of sediment and other pollutants. Water resulting from dewatering operations shall be directed to temporary sediment traps or dewatering devices. Temporary sediment traps and dewatering bags will be provided, installed, and maintained at downgradient locations to control sediment deposits to downstream surfaces.

7.2 Permanent Erosion and Sediment Control Measures

The permanent erosion and sediment control measures described in the following sections are included as part of the construction documents.

a. Establishment of Permanent Vegetation

Disturbed areas that will be vegetated must be seeded in accordance with the contract documents. The type of seed, mulch, and maintenance measures as described in the contract documents shall also be followed. Permanent soil stabilization measures must be initiated by the end of the next business day and completed within fourteen (14) days from the date the soil disturbance activity has permanently ceased.

Final site stabilization is achieved when all soil-disturbing activities at the site have been completed and a uniform, perennial vegetative cover with a density of 80 percent has been established or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

7.3 Other Pollutant Controls

Other necessary pollutant controls are listed below:

a. Solid and Liquid Waste Disposal

No solid or liquid waste materials, including building materials, shall be discharged from the site with stormwater. All solid waste, including disposable materials incidental to any construction activities, must be collected, and placed in containers. The containers shall be emptied periodically by a licensed trash disposal service and hauled away from the site. Substances that have the potential for polluting surface and/or groundwater must be controlled by whatever means necessary in order to ensure that they do not discharge from the site. As an example, special care must be exercised during equipment fueling and servicing operations. If a spill occurs, it must be contained and disposed of so that it will not flow from the site or enter groundwater, even if this requires removal, treatment, and disposal of soil. In this regard, potentially polluting substances should be managed in a manner consistent with the impact they represent.

b. Sanitary Facilities

Temporary sanitary facilities will be provided by the Contractor throughout the construction phase. They must be utilized by all construction personnel and will be serviced by a licensed commercial Contractor. These facilities must comply with state and local sanitary or septic system regulations.

c. Water Source

Non-stormwater components of site discharge must be clean water. Water used for construction, which discharges from the site, must originate from a public water supply or private well approved by the Health Department. Water used for construction that does not originate from an approved public supply must not discharge from the site; such water can be retained in temporary ponds/sediment traps until it infiltrates and/or evaporates.

7.4 Construction Housekeeping Practices

During the construction phase, the Contractor(s) will implement the following measures:

a. Material Stockpiles

Material resulting from clearing and grubbing operations that will be stockpiled on-site must be adequately protected with downgradient erosion and sediment controls.

b. Equipment Cleaning and Maintenance

The Contractor(s) will designate areas for equipment cleaning, maintenance, and repair. The Contractor(s) and subcontractor(s) will utilize those areas. The areas will be protected by a temporary perimeter berm.

c. Detergents

The use of detergents for large-scale washing is prohibited (i.e., vehicles, buildings, pavement surfaces, etc.)

d. Spill Prevention and Response

A Spill Prevention and Response Plan shall be developed for the site by the Contractor(s). The plan shall detail the steps required in the event of an accidental spill and shall identify contact names and phone numbers of people and agencies that must be notified. The plan shall include Safety Data Sheets (SDS) for all materials to be stored on-site. All workers on-site will be required to be trained in safe handling and spill prevention procedures for all materials used during construction. Regular tailgate safety meetings shall be held and all workers that are expected on the site during the week shall be required to attend.

e. Concrete Wash Areas

Concrete trucks will be allowed to wash out or discharge surplus concrete or drum wash water on the site, but only in specifically designated diked and impervious washout areas, which have been prepared to prevent contact between the concrete wash and stormwater. Waste generated from concrete wash water shall not be allowed to flow into drainage ways, inlets, receiving waters, or highway right of ways, or any location other than the designated concrete wash areas. Proper signage designating the "Concrete Wash Areas" shall be placed near the facility. Concrete wash areas shall be located at minimum 100 linear feet from drainage ways, inlets, and surface waters.

The hardened residue from the concrete wash areas will be disposed of in the same manner as other non-hazardous construction waste materials. Maintenance of the wash area includes removal of hardened concrete. Facility shall have sufficient volume to contain all the concrete waste resulting from washout and a minimum freeboard of 12 inches. Facility shall not be filled beyond 95% capacity and shall be cleaned out once 75% full unless a new facility is constructed. The Contractor will be responsible for seeing that these procedures are followed.

Sawcut Portland Cement Concrete (PCC) slurry shall not be allowed to enter drainage ways, inlets, and/or surface waters. Sawcut residue should not be left on the surface of pavement or be allowed to flow over and off pavement.

The Project may require the use of multiple concrete wash areas. All concrete wash areas will be located in an area where the likelihood of the area contributing to stormwater discharges is negligible. If required, additional BMPs must be implemented to prevent concrete wastes from contributing to stormwater discharges.

f. Material Storage

Construction materials shall be stored in a dedicated staging area. The staging area shall be located in an area that prevents negative impacts of construction materials on stormwater quality. Chemicals, paints, solvents, fertilizers, and other toxic material must be stored in waterproof containers. Except during application, the contents must be kept in trucks or within storage facilities. Runoff containing such material must be collected, removed from the site, treated, and disposed of at an approved solid waste or chemical disposal facility.

Additional measures may be required during construction at the guidance of the School District or certified SWPPP Inspector. The contractor shall begin to make all adjustments to the erosion control within 24 hours of receipt of any deficiencies. The School District will be responsible for providing twice-weekly reports by a qualified inspector in accordance with the GP-0-20-001, during construction.

Any modifications to the SWPPP will be reported and approved by the NYSDEC in writing prior to implementation. The School District is responsible for having a qualified operator on site at all times who has at least 4 hours of erosion control training in accordance with the GP-0-20-001. Once the site has achieved 80% stabilization and ground cover, the Town may sign off on the Notice of Termination prior to submission to the NYSDEC. Removal of all temporary erosion and sediment control practices is required prior to demobilization.

8.0 POST CONSTRUCTION

The School District will be responsible for all post construction practices. The contact information for the School District is illustrated on the cover of this plan as well as the design plans for the project. The post construction practices include performing annual inspections of the SMAs to ensure proper working conditions and ensure continual stabilized cover of all project areas to 80% cover, minimum. All applicable inspection and maintenance activities shall continue until the 80% cover is met. Any silt removal will be disposed either off site or on site and immediately stabilized in accordance with the practices of this plan.

Additionally, annual monitoring of the storm sewer structures will be provided by the school district to ensure that they are functioning properly. All documentation related to this SWPPP, and post construction monitoring reports shall be kept by the school district for five years after project completion. These inspections will be certified by a Professional Engineer and a copy of the inspection report will be furnished to the School District.

9.0 SUMMARY

The proposed project requires stormwater management practices which conform to NYSDEC regulations. The proposed standard stormwater management practices will also result in a net decrease in peak runoff from the site while meeting the NYSDEC requirements for Runoff Reduction, Water Quality and Channel Protection. Continued monitoring of the practices included in this plan will be provided by the school district and a designated SWPPP Inspector.

The following appendices of this report illustrate the additional requirements and specifications for stormwater pollution prevention. All practices included in this report and incorporated in the proposed project have been designed in compliance with the NYS Storm Water Design Manual and NYS Standards and Specifications for Erosion and Sediment Control.

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APPENDICES

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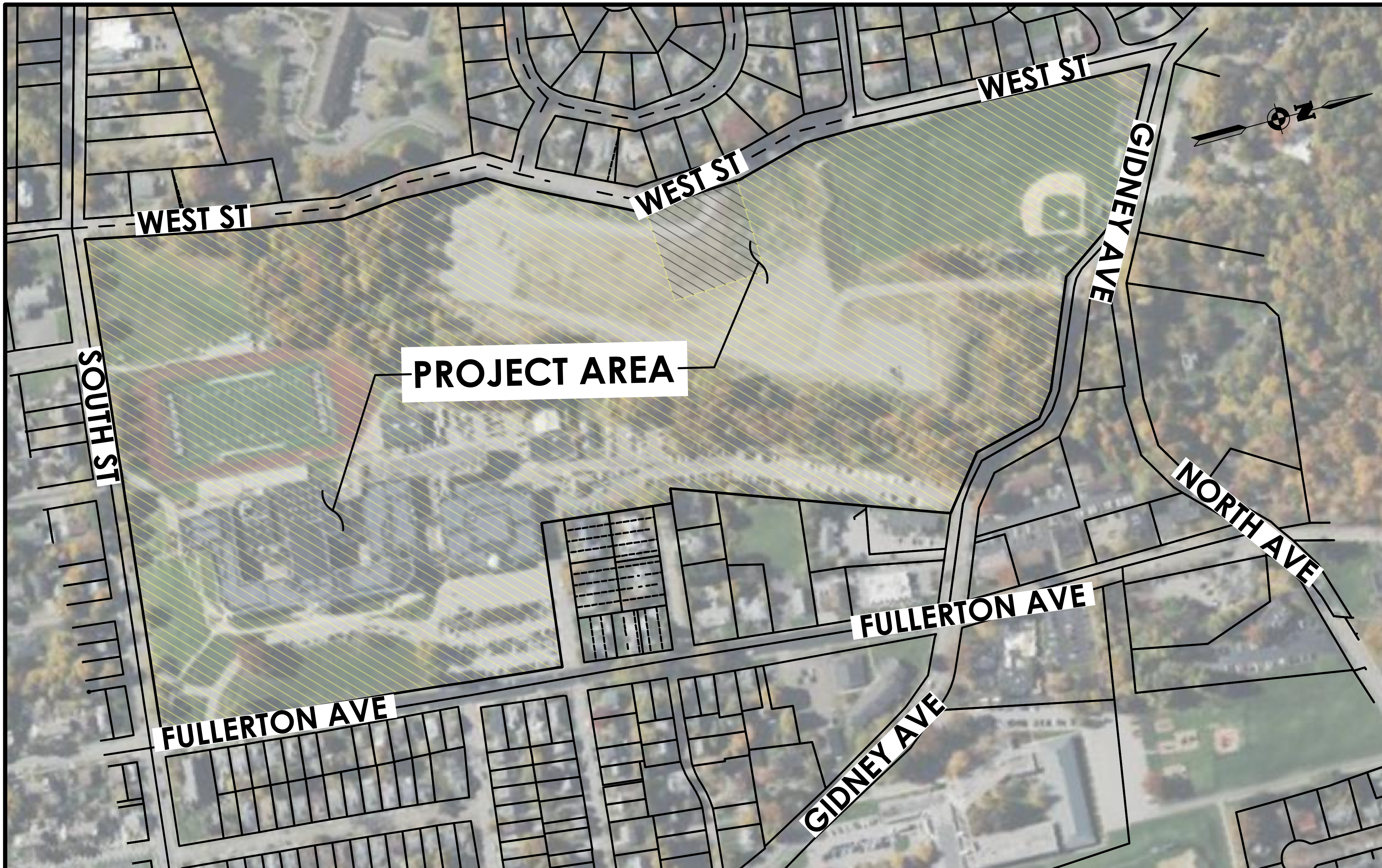
APPENDIX A: AERIAL PHOTOGRAPH



NEWBURGH CTE
LOCATION MAP

Drawn By: MP
Date: OCTOBER 2023

PASSERO ASSOCIATES
engineering architecture
242 West Main Street, Suite 100
Rochester, NY 14614

Client: NEWBURGH ENLARGED CITY SCHOOL DISTRICT
HYDE PARK, NY 12538

Project Number: 20223470.0003

Scale: 1"=300'
Sheet No: 1 OF 1

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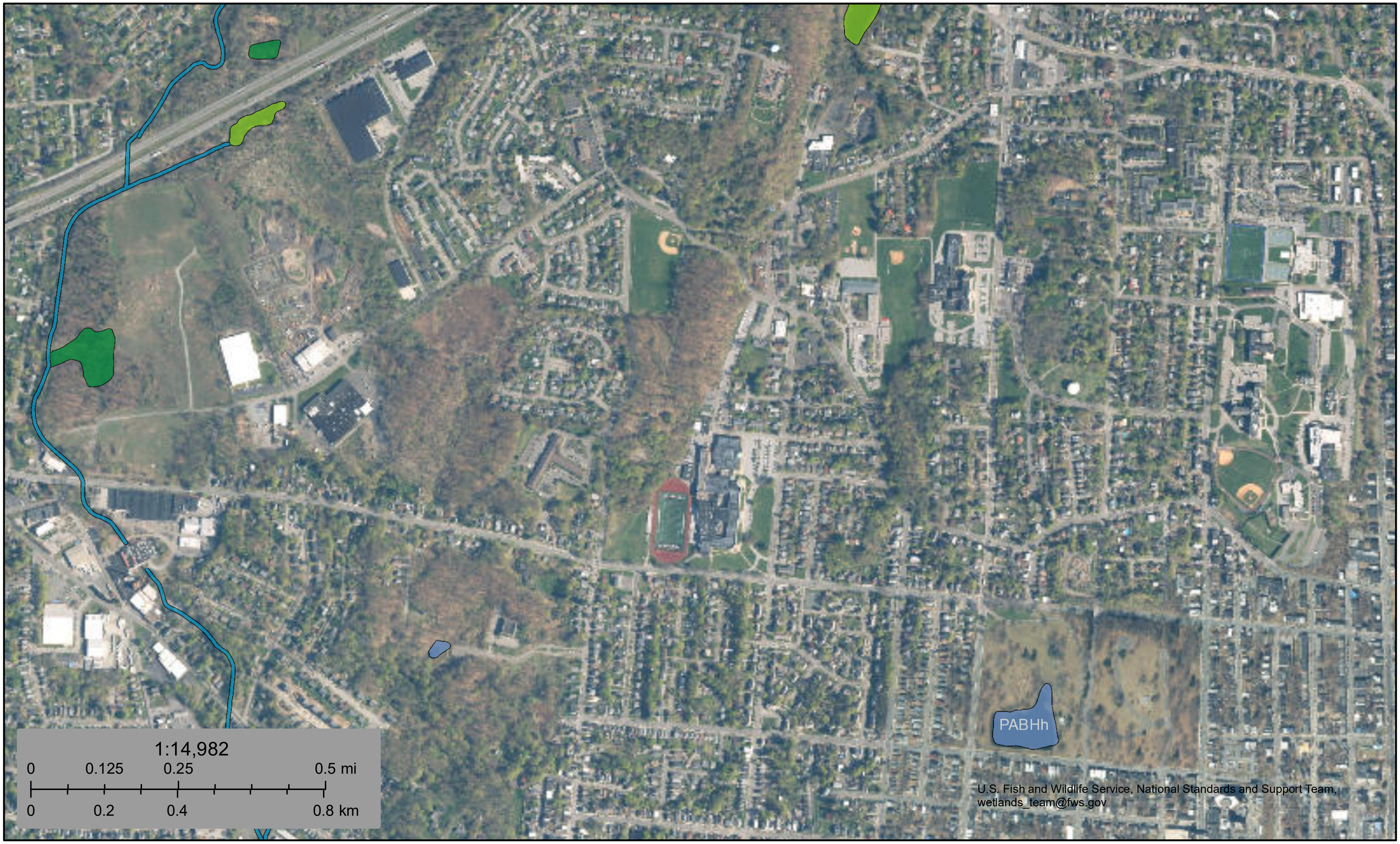
APPENDIX B: WETLAND MAPPING

U.S. Fish and Wildlife Service

National Wetlands Inventory

Newburgh CTE NWI



October 18, 2023

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

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APPENDIX C: ENVIRONMENTAL RESOURCE MAPPER

Environmental Resource Mapper

October 18, 2023

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

New York State, Maxar, Esri, HERE, Garmin, iPC

NYS Department of Environmental Conservation
Not a legal document

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APPENDIX D: SOILS REPORT

United States Department of Agriculture

NRCS

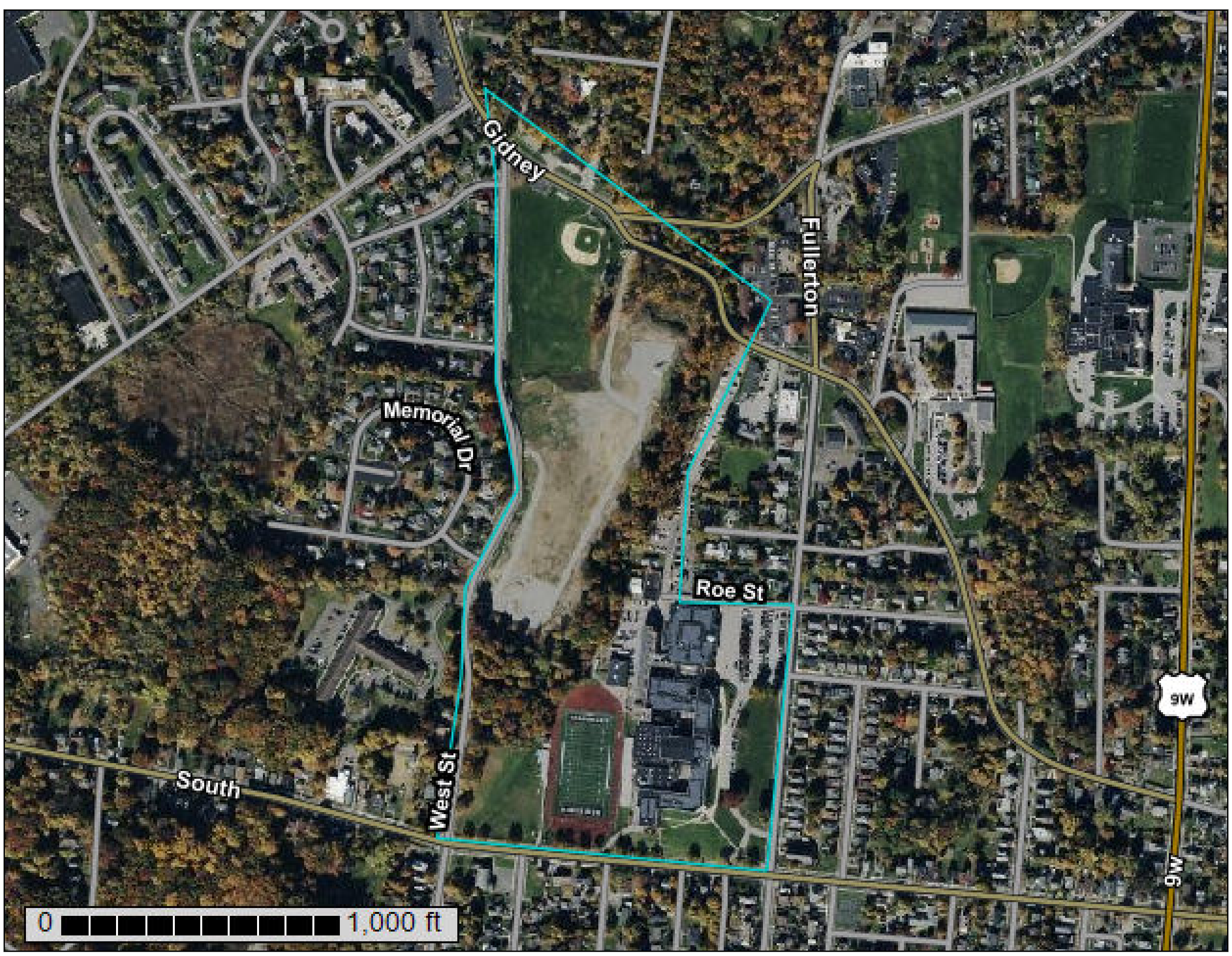
Natural Resources Conservation Service

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

Orange County, New York

Newburgh CTE Soils Map



October 18, 2023

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.

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Contents

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.

Soil Map

Map Scale: 1:4,990 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

N

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 1:15,800.

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: Orange County, New York
Survey Area Data: Version 24, Sep 6, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 21, 2022—Oct 27, 2022

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
Ab	Alden silt loam	5.8	11.2%
AC	Alden extremely stony soils	0.1	0.2%
FAC	Farmington silt loam, sloping	15.8	30.5%
MdB	Mardin gravelly silt loam, 3 to 8 percent slopes	20.4	39.4%
RMD	Rock outcrop-Farmington complex, hilly	9.7	18.7%
Totals for Area of Interest		**51.9**	**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.

Orange County, New York

Ab—Alden silt loam

Map Unit Setting

National map unit symbol: 9vtc
Elevation: 300 to 1,500 feet
Mean annual precipitation: 42 to 52 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Alden and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alden

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: A silty mantle of local deposition overlying loamy till

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 36 inches: silt loam
H3 - 36 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 1 percent
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: C/D
Ecological site: F144AY040NY - Semi-Rich Very Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Canandaigua

Percent of map unit: 5 percent
Landform: Depressions

Hydric soil rating: Yes

Erie

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: No

Wayland

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

Carlisle

Percent of map unit: 5 percent
Landform: Swamps, marshes
Hydric soil rating: Yes

AC—Alden extremely stony soils

Map Unit Setting

National map unit symbol: 9vtd
Elevation: 130 to 1,480 feet
Mean annual precipitation: 42 to 52 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Alden, extremely stony, and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Alden, Extremely Stony

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: A silty mantle of local deposition overlying loamy till

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 36 inches: silt loam
H3 - 36 to 60 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 1 percent
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Ecological site: F144AY040NY - Semi-Rich Very Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Canandaigua

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Lyons

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Palms

Percent of map unit: 5 percent
Landform: Marshes, swamps
Hydric soil rating: Yes

Erie

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: No

Wayland

Percent of map unit: 5 percent
Landform: Flood plains
Hydric soil rating: Yes

FAC—Farmington silt loam, sloping

Map Unit Setting

National map unit symbol: 9vvc
Elevation: 100 to 900 feet
Mean annual precipitation: 42 to 52 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Farmington and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Farmington

Setting

Landform: Till plains, ridges, benches
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till or congeliturbate derived from limestone, dolomite, shale, and sandstone, and in many places mixed with wind and water deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 19 inches: silt loam
H3 - 19 to 23 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Somewhat excessively drained
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
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Very low (about 2.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: F144AY035MA - Shallow Semi-Rich Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Arnot

Percent of map unit: 5 percent
Hydric soil rating: No

Nassau

Percent of map unit: 5 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 5 percent
Hydric soil rating: Unranked

Mardin

Percent of map unit: 5 percent
Hydric soil rating: No

Pittsfield

Percent of map unit: 5 percent
Hydric soil rating: No

MdB—Mardin gravelly silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2v30j
Elevation: 330 to 2,460 feet
Mean annual precipitation: 31 to 70 inches
Mean annual air temperature: 39 to 52 degrees F
Frost-free period: 105 to 180 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Mardin and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mardin

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till

Typical profile

Ap - 0 to 8 inches: gravelly silt loam
Bw - 8 to 15 inches: gravelly silt loam
E - 15 to 20 inches: gravelly silt loam
Bx - 20 to 72 inches: gravelly silt loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: 14 to 26 inches to fragipan
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 13 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: D
Ecological site: F144AY008CT - Moist Till Uplands
Hydric soil rating: No

Minor Components

Volusia

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Lordstown

Percent of map unit: 5 percent
Landform: Hills, mountains
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Mountaintop, interfluve, crest
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Bath

Percent of map unit: 5 percent
Landform: Mountains, hills
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

RMD—Rock outcrop-Farmington complex, hilly

Map Unit Setting

National map unit symbol: 9vwr
Elevation: 100 to 900 feet
Mean annual precipitation: 42 to 52 inches
Mean annual air temperature: 46 to 52 degrees F
Frost-free period: 135 to 215 days
Farmland classification: Not prime farmland

Map Unit Composition

Rock outcrop: 60 percent
Farmington and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Typical profile

H1 - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Capacity of the most limiting layer to transmit water (Ksat): Very low to very high (0.00 to 19.98 in/hr)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydric soil rating: Unranked

Description of Farmington

Setting

Landform: Till plains, ridges, benches
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy till or congeliturbate derived from limestone, dolomite, shale, and sandstone, and in many places mixed with wind and water deposits

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 14 inches: silt loam
H3 - 14 to 23 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Somewhat excessively drained
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
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: F144AY035MA - Shallow Semi-Rich Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Pittsfield

Percent of map unit: 5 percent
Hydric soil rating: No

Nassau

Percent of map unit: 3 percent
Hydric soil rating: No

Arnot

Percent of map unit: 2 percent
Hydric soil rating: No

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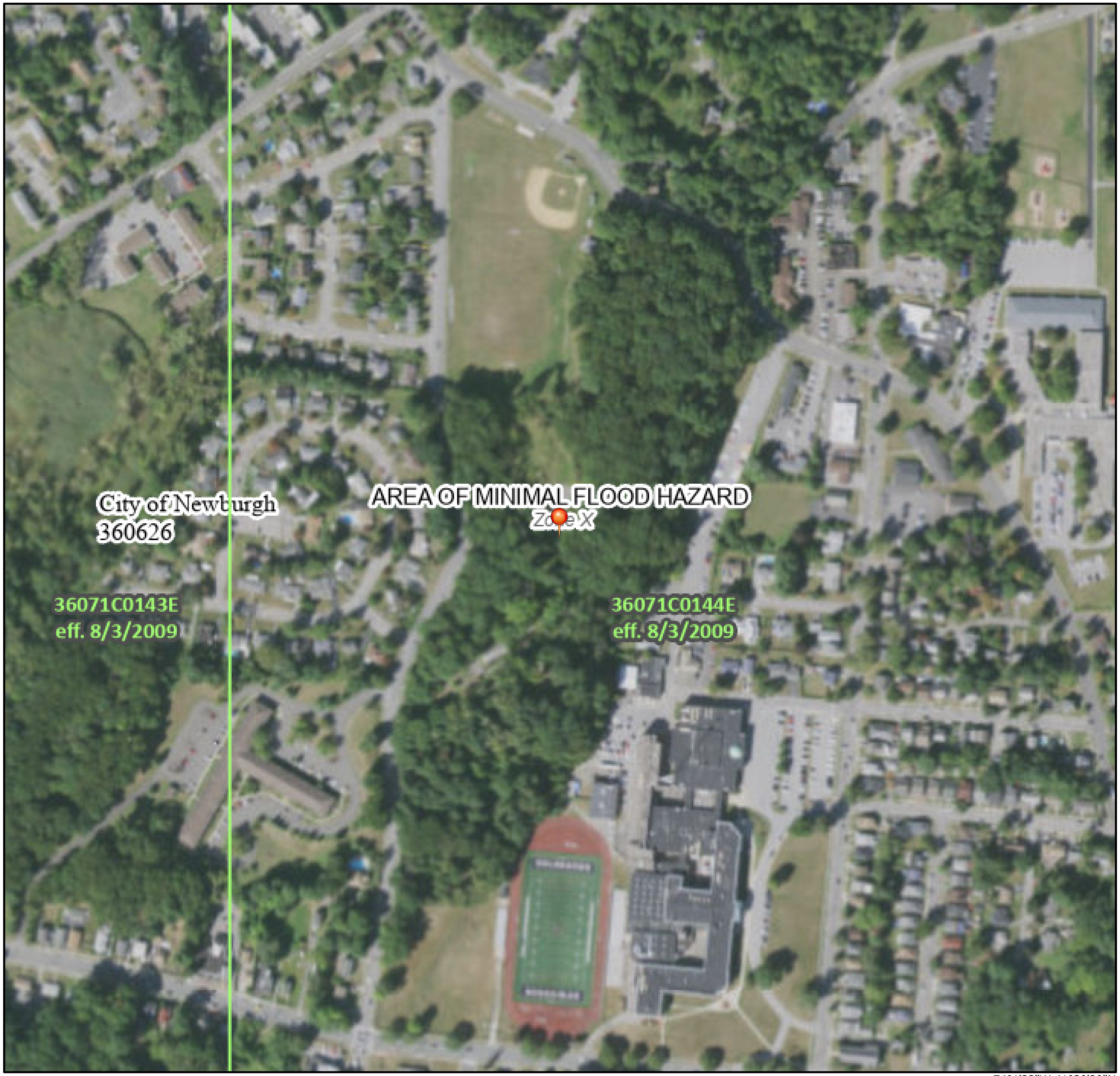
APPENDIX E: FEMA MAPPING

National Flood Hazard Layer FIRMette

FEMA

74°2'W 41°30'56"N



74°1'23"W 41°30'29"N

Feet
0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

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
- 8 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 10/18/2023 at 7:04 PM 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.

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APPENDIX F: RAINFALL DATA

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Metadata for Point

Smoothing	Yes
State	New York
Location	New York, United States
Latitude	41.512 degrees North
Longitude	74.028 degrees West
Elevation	70 feet
Date/Time	Mon Sep 11 2023 10:55:11 GMT-0400 (Eastern Daylight Time)

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr
1yr	0.33	0.50	0.62	0.81	1.02	1.26	**1yr**	0.88	1.19	1.44	1.76	2.14
2yr	0.39	0.60	0.74	0.98	1.23	1.53	**2yr**	1.06	1.43	1.75	2.14	2.60
5yr	0.46	0.71	0.89	1.19	1.52	1.91	**5yr**	1.31	1.76	2.20	2.69	3.27
10yr	0.51	0.80	1.02	1.38	1.79	2.27	**10yr**	1.55	2.07	2.61	3.21	3.89
25yr	0.59	0.95	1.21	1.67	2.22	2.85	**25yr**	1.92	2.55	3.30	4.06	4.92
50yr	0.68	1.09	1.39	1.95	2.62	3.38	**50yr**	2.26	3.00	3.92	4.83	5.85
100yr	0.77	1.24	1.60	2.27	3.10	4.02	**100yr**	2.68	3.53	4.68	5.77	6.97
200yr	0.87	1.43	1.85	2.65	3.67	4.79	**200yr**	3.16	4.15	5.58	6.88	8.32
500yr	1.05	1.73	2.25	3.27	4.59	6.03	**500yr**	3.96	5.15	7.04	8.69	10.50

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr
1yr	0.29	0.45	0.54	0.73	0.90	1.08	**1yr**	0.78	1.05	1.23	1.56	2.00
2yr	0.37	0.58	0.71	0.96	1.19	1.42	**2yr**	1.02	1.38	1.60	2.05	2.58
5yr	0.42	0.65	0.80	1.10	1.40	1.65	**5yr**	1.21	1.61	1.87	2.41	3.01
10yr	0.47	0.72	0.89	1.24	1.60	1.84	**10yr**	1.38	1.80	2.10	2.71	3.38
25yr	0.54	0.81	1.01	1.45	1.90	2.12	**25yr**	1.64	2.08	2.43	3.06	3.93
50yr	0.60	0.91	1.13	1.62	2.18	2.36	**50yr**	1.88	2.31	2.73	3.42	4.42
100yr	0.67	1.01	1.27	1.83	2.51	2.64	**100yr**	2.17	2.58	3.07	3.82	5.00
200yr	0.76	1.14	1.44	2.09	2.91	2.95	**200yr**	2.51	2.88	3.45	4.29	5.64
500yr	0.90	1.34	1.72	2.50	3.55	3.43	**500yr**	3.06	3.35	4.06	5.01	6.65

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APPENDIX G: GEOTECHNICAL ENGINEERING REPORT (EXCERPT FROM SWPPP PREPARED BY CPL: ARCHITECTURE, ENGINEERING AND PLANNING DATED SEPTEMBER 2021)

Quality Geo Engineering, P.C.

877 Route 4 S – Schuylerville, NY 12871 – Phone (518) 372-4067 – Fax (518) 507-6113

GEOTECHNICAL ENGINEERING REPORT
NEWBURGH ENLARGED CITY SCHOOL DISTRICT
CAREER AND TECHNICAL EDUCATION BUILDING
WEST STREET
NEWBURGH, NEW YORK

PREPARED FOR:
CPL
50 Front Street, Suite 202
Newburgh, New York 12550

PREPARED BY:
Quality Geo Engineering, P.C.
877 Route 4S
Schuylerville, New York 12871
on behalf of QC/QA Laboratories, Inc.

January 6, 2021
Project No. SE20-042

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1.0 INTRODUCTION

This report presents the results of a subsurface exploration program and geotechnical engineering evaluation completed by Quality Geo Engineering, P.C. on behalf of QC/QA Laboratories, Inc., for the proposed Newburgh Enlarged City School District Career and Technology Education building planned on West Street in Newburgh, New York. The subsurface exploration was completed by QC/QA Laboratories, Inc. (QCQA Labs), and the geotechnical engineering evaluation was performed by Quality Geo Engineering, P.C., on behalf of QCQA Labs.

Based on the information provided by CPL, we understand the project will include constructing a new building with associated asphalt pavement parking and drive areas, site retaining walls, and stormwater management areas. Based on the preliminary site plan provided by CPL, we understand the proposed new building is planned to have a finished floor elevation of El. 267 feet and the proposed parking lot areas are planned to have finished grades on the order of approximately El. 264 to 265 feet. We anticipate the proposed site retaining walls will consist of modular block gravity or mechanically stabilized earth style walls.

The project site includes two (2) existing wood framed buildings, which are planned to be demolished. The majority of the site is wooded and undeveloped, however, there is evidence that some portions of the site have been used for dumping fill, leaves, and other debris.

The site is located on the east side of West Street in the City of Newburgh, New York. The approximate location of the project site is shown on the attached Figure No. 1. There is a relatively steep slope along the east side of the site with existing grades sloping downward from west to east on the order of approximately 60 feet.

2.0 SUBSURFACE EXPLORATION

The subsurface exploration program consisted of a total of twenty (20) test borings and thirteen (13) test pits. The test pits were excavated by QCQA Labs on December 2, 2020 and the test borings were drilled by QCQA Labs on December 3rd, 4th, 7th, and 8th, 2020. Twelve (12) test borings were located in the vicinity of the proposed building and were designed as B-1 through B-12. Four (4) test borings were located in proposed pavement areas and were designated as P-1 through P-4. Four (4) test borings were located at stormwater infiltration test areas and were designated as IF-1 through IF-4. The test pits were located in proposed building and pavement areas and were designated as TP-1 through TP-13. The approximate locations of the test borings and test pits are shown on the attached Figure No. 2.

Test pits TP-5, TP-9, and TP-10 through TP-12 were excavated to depths ranging from 9 to 12 feet. The remaining test pits encountered refusal on bedrock at depths ranging from 2 to 9 feet. Test borings B-1 through B-12 were terminated with auger refusal at depths ranging from approximately 3 to 24 feet. Test boring P-2 was terminated in overburden soils at a depth of 10 feet. Test borings P-1, P-3, and P-4 encountered auger refusal at depths ranging from 2.5 to 6 feet. Rock coring was advanced 5 feet into bedrock in test boring P-4. Test boring IF-4 was terminated in overburden soils at a depth of 8 feet. Test borings IF-1 through IF-3 were terminated with auger refusal at depths ranging from 4 to 5.6 feet.

The test pits were excavated using a 9-ton Yanmar mini-excavator. The test borings were made using a Diedrich model D-50 drill rig mounted on a Morooka rubber track all-terrain carrier. The test borings were advanced using hollow stem auger drilling techniques. Split spoon samples and Standard Penetration Tests (SPTs) were taken in the test borings continuously to a depth of up to 10 feet, and at 5 foot intervals thereafter. The split spoon sampling and SPTs were completed in general accordance with *ASTM D 1586 - "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils"*.

The test pit and test boring logs were prepared by a geotechnical specialist based on visual observation of the recovered soil samples and review of the driller's field notes. The soil samples were described based on a visual/manual estimation of the grain size distribution, along with characteristics such as color, relative density, consistency, moisture, etc. The rock core was described based on visual identification of the rock type, along with characteristics such as hardness, bedding planes, fracturing, core recovery and rock quality designation (RQD) value. The test pit and test boring logs are presented in Appendix A, along with general information and a key of terms and symbols used to prepare the logs.

3.0 SUBSURFACE CONDITIONS

3.1 Soil Profile

A surficial layer of topsoil was generally present throughout the site, with the exception of areas where previous grading/filling had apparently occurred. The thickness of the topsoil layer was measured in the test pits ranging from approximately 4 to 7 inches.

An upper layer of existing fill type materials was encountered in test borings B-6, B-7, B-10, B-11, and P-1, and in test pits TP-2, TP-4, TP-5, TP-6, TP-10, and TP-11. The upper fill type materials consisted of brown, dark brown, gray, and gray-brown sand with varying amounts of intermixed gravel, silt, brick fragments, concrete, glass, organics, and/or cobbles/boulders; gray crusher run stone; gray gravel with varying amounts of intermixed sand, silt, clay, organics, asphalt, and/or cobbles; brown-black ash and cinders with zones containing intermixed glass; and wood mulch.

The thickness of the upper existing fill type materials ranged from approximately 3 inches to between 10 and 15 feet below existing grade. The thickness of the existing fill type materials encountered in the test borings and test pits are summarized in the table below.

Test Boring/Test Pit No.	Ground Surface Elevation* (ft.)	Depth of Existing Fill Type Materials (ft.)	Bottom Elevation of Existing Fill Type Materials (ft.)
B-1	268.5	NA	NA
B-2	263.4	NA	NA
B-3	263.3	NA	NA
B-4	264.7	NA	NA
B-5	264.5	NA	NA
B-6	260.0	6	254.0
B-7	261.8	15	246.8
B-8	268.0	NA	NA
B-9	264.4	NA	NA
B-10	262.8	15	247.8
B-11	261.6	4	257.6
B-12	254.6	NA	NA
P-1	267.5	NA	NA
P-2	263.1	8	255.1
P-3	268.1	NA	NA
P-4	264.2	NA	NA
IF-1	270.3	NA	NA
IF-2	269.0	NA	NA
IF-3	257.4	NA	NA
IF-4	236.1	NA	NA
TP-1	270.2	NA	NA
TP-2	267.5	0.25	267.3
TP-3	269.7	NA	NA
TP-4	267.5	2	265.5
TP-5	265.5	3.5	262.0
TP-6	265.3	5	260.3
TP-7	265.8	NA	NA
TP-8	255.8	NA	NA
TP-9	263.3	NA	NA
TP-10	263.1	10	253.1
TP-11	262.7	2.5	260.2
TP-12	268.5	NA	NA
TP-13	266.3	NA	NA

*Existing ground surface elevations were provided by CPL and were rounded to the nearest 0.1 foot.

Indigenous overburden soils were encountered beneath the topsoil and/or existing fill type soils in test borings and test pits. The indigenous soils consisted of brown to dark brown sand with varying amounts of intermixed silt, gravel, rock fragments, organics, and/or cobbles/boulders; brown to brown-black silt with varying amounts of intermixed sand, gravel, clay, organics, and/or cobbles/boulders; and brown to gray gravel with varying amounts of intermixed sand, silt, rock fragments, and/or cobbles.

Standard penetration test (SPT) “N” values obtained within the cohesionless existing fill type materials encountered in the test borings ranged from 3 to greater than 100 indicating the relative density of these materials varied from “very loose” to “very compact”. SPT “N” values obtained in the cohesionless indigenous soils encountered in the test borings ranged from “weight of hammer” to greater than 100 indicating the relative density of these soils varied from “very loose” to “very compact”. We point out that some of the SPT “N” values may be artificially high where the split spoon sampler encountered large gravel particles, cobbles, or boulders.

3.2 Bedrock

The top of weathered bedrock was encountered in test pits TP-1 through TP-4, TP-6, TP-7, TP-8, and TP-13 at depths ranging from approximately 1.5 to 9 feet. Weathered rock fragments were recovered from test borings B-1, B-3, B-6, B-11, IF-2, and IF-3 beginning at depths ranging from 4 to 15 feet. Auger refusal (apparent top of bedrock) was encountered in each test boring, with the exception of test borings P-2 and IF-4, at depths ranging from 2.5 to 24.0 feet. We anticipate that the top of bedrock was encountered at the auger refusal depths. Rock coring was advanced 5.0 feet into bedrock after reaching auger refusal in test boring P-4. The bedrock depths and elevations encountered in the test pits, along with the auger refusal (apparent top of bedrock) depths and elevations encountered in the test borings are summarized in the table below.

Test Boring No.	Ground Surface Elevation* (feet)	Depth to Auger Refusal / Apparent Top of Bedrock (feet)	Elevation to Auger Refusal / Apparent Top of Bedrock (feet)
B-1	268.5	7.0	261.5
B-2	263.4	20.0	243.4
B-3	263.3	8.0	255.3
B-4	264.7	13.0	251.7
B-5	264.5	6.0	258.5
B-6	260.0	15.1	244.9
B-7	261.8	22.0	239.8
B-8	268.0	12.0	256.0
B-9	264.4	16.5	247.9
B-10	262.8	24.0	238.8
B-11	261.6	6.5	255.1
B-12	254.6	3.0	251.6
P-1	267.5	6.0	261.5

P-2	263.1	NA	NA
P-3	268.1	4.0	264.1
P-4	264.2	2.5	261.7
IF-1	270.3	4.0	266.3
IF-2	269.0	4.3	264.7
IF-3	257.4	5.6	251.8
IF-4	236.1	NA	NA
TP-1	270.2	5.0	265.2
TP-2	267.5	6.0	261.5
TP-3	269.7	1.5	268.2
TP-4	267.5	3.5	264.0
TP-5	265.5	NA	NA
TP-6	265.3	9.0	256.3
TP-7	265.8	7.0	258.8
TP-8	255.8	5.0	250.8
TP-9	263.3	NA	NA
TP-10	263.1	NA	NA
TP-11	262.7	NA	NA
TP-12	268.5	NA	NA
TP-13	266.3	2.0	264.3

*Existing ground surface elevations were provided by CPL and were rounded to the nearest 0.1 foot.

The bedrock underlying the site is mapped as Wappinger Group, Copake Formation, Rochdale Formation, Halcyon Lake Dolostone, Briarcliff Dolostone, Pine Plains Formation, and Stissing Formation based on the *Geologic Map of New York*, Hudson-Mohawk Sheet, Map and Chart Series No. 15.

Rock coring was advanced from a depth of 2.5 to 7.5 feet in test boring P-4. The recovered rock core was described as gray medium hard, slightly weathered and moderately fractured Limestone. The core recovery value was 82 percent and the RQD value was 34 percent indicating a “poor” rock mass quality.

3.3 Groundwater Conditions

Free standing water was not encountered in the test borings at the time of drilling. We point out that some of the soil samples recovered from test borings B-9, P-4, and IF-4 were described as “wet” beginning at depths of 8, 2, and 2 feet, respectively, indicating that perched or trapped groundwater conditions may have been present. It is possible that some isolated areas of perched or trapped groundwater conditions could be encountered in the near surface soils in some areas following periods of wet weather. It should be expected that groundwater conditions could vary with changes in soil conditions, precipitation, and seasonal conditions.

4.0 INFILTRATION TESTING

A total of four (4) infiltration tests were performed at the site. The infiltration tests were designated as IF-1 through IF-4 and were conducted at a depth of 4.0 feet. The holes were pre-soaked in advance of testing. Infiltration testing was performed in general accordance with the New York State Department of Environmental Conservation "*Stormwater Management Design Manual*", Appendix D criteria. The infiltration test results are presented in the following table.

Infiltration Test Results					
Infiltration Test No.	Test Depth (feet)	Trial No.	Water Drop (inches)	Elapsed Time (hours)	Infiltration Rate (inches/hour)
IF-1	4	1	7	1	**7**
		2	5	1	**5**
		3	5	1	**5**
		4	4	1	**4**
IF-2	4	1	7	1	**7**
		2	7	1	**7**
		3	6	1	**6**
		4	5	1	**5**
IF-3	4	1	12	1	**12**
		2	12	1	**12**
		3	13	1	**13**
		4	12	1	**12**
IT-4	4	1	0.0	1	**0**
		2			
		3			
		4			

5.0 GEOTECHNICAL RECOMMENDATIONS

5.1 General

Based on the conditions encountered in the test borings and test pits, it is our opinion the primary geotechnical considerations impacting design and construction of the proposed project will be the presence of existing fill type materials and the relatively shallow depth of bedrock in some areas of the site. In our opinion, the proposed new building addition can be supported using conventional spread foundations with slab-on-grade construction, provided our recommendations are implemented.

We anticipate that existing fill type materials will be encountered throughout the proposed building footprint and pavement areas, particularly in the vicinity of test borings B-6, B-7, B-10, B-11, and P-1, and test pits TP-4, TP-5, TP-6, TP-10, and TP-11. The thickness of the existing fill type materials generally ranged from approximately 2 to 15 feet. The existing fill type materials included zones containing ash, cinders, brick, concrete, glass, wood mulch, and other organics. It is possible that existing fill type materials could be left in place beneath proposed pavement areas, provided the subgrades are firm and stable. We recommend all existing fill type materials be removed from within the proposed building footprint and extending horizontally a distance of at least 5 feet beyond the building footprint. We recommend all existing fill materials also be removed from beneath proposed site retaining wall foundations. The resulting excavations should be backfilled with Structural Fill. Recommendations for Structural Fill, along with placement and compaction requirements, are presented in Appendix B.

Based on the preliminary building finished floor elevation of El. 267 feet, it appears that bedrock will likely not be encountered in foundation excavations throughout the majority of the building footprint. However, it is possible that bedrock could be encountered in foundation excavations in some areas. It appears more likely that bedrock will be encountered in the cut excavation for the parking lot at the north end of the site.

If areas of bedrock are encountered in foundation excavations for the proposed new building, we anticipate that the upper foot or two of bedrock may be loosened using a large track-mounted excavator equipped with a hydraulic or pneumatic hammer. We recommend bedrock be removed to a depth of at least 6 inches below the bottom of the building footings. The resulting overexcavation below foundations should be backfilled with Drainage Stone. This will provide a cushion layer which will prevent point loads on the footings and will provide a more uniform bearing surface. Recommendations for Drainage Stone are presented in Appendix B.

It should be expected that blasting will likely be required to loosen the bedrock for general excavation at the north parking lot. Blasting should be performed by a licensed contractor. The blasting program should include pre-blast and post-blast condition surveys on all adjacent properties and utilities to document the condition of existing structures prior to and after completion of blasting operations. Blasting should be controlled to limit the maximum peak particle velocity (PPV) to less than one (1) inch per second (ips) at the nearest adjacent building and/or property limits. In addition, the peak airblast overpressure limit should be controlled to less than 0.014 pounds per square inch (psi) at the nearest building.

We point out that the controlled blasting guidelines described above are intended to prevent damage to existing structures and greatly exceed the threshold at which humans will notice vibration (approximately 0.02 ips). Accordingly, we recommend that blast vibrations be monitored and recorded during each blast event to confirm that the limits recommended above are not exceeded.

The preliminary site plan provided by CPL shows various site retaining walls including along the edge of the top of the slope on the east side of the of the pavement area on the east side of the proposed building and around the parking lot at the north end of the site. We recommend the retaining walls be located such that they are set back at least 5 feet from the edge of the slope, where the slope angle is steeper than 3H:1V, in order to maintain adequate bearing capacity and to prevent undermining of the retaining wall foundations.

It should be expected that isolated areas of perched or trapped groundwater conditions could be encountered in foundation and underground utility excavations. Temporary dewatering will be required to control groundwater conditions during construction. We anticipate that sump and pump methods of temporary dewatering would be adequate to control groundwater during construction and allow the work to proceed “in the dry”.

The overburden soils encountered in the test pits and test borings contained a significant fraction of intermixed silt and are not well suited for re-use as structural fill within the proposed building area or as backfill against foundation walls or site retaining walls. The fine-grained silt soils are sensitive to changes in moisture conditions and will soften and loose strength if they become wet and are exposed to construction activities. We recommend an imported Structural Fill material be used to raise existing site grades within building areas and as backfill against foundation walls and behind site retaining walls. Recommendations for Structural Fill material, along with placement and compaction requirements, are presented in Appendix B.

5.2 Site Preparation

Existing topsoil, trees, vegetation, and building foundations/slabs should be removed from within the proposed new building footprint and pavement areas. Existing fill type materials should be removed from within the proposed building footprint and extending horizontally a distance of 5 feet beyond the building footprint. Following the removal of topsoil, trees, vegetation, fill type materials, existing foundations/slab, and excavation to the design subgrade elevation, the exposed subgrades should be evaluated by a geotechnical engineer during construction. Exposed subgrades in proposed building and pavement areas should be proof rolled using a minimum 7-ton smooth drum roller or a loaded dump truck.

Any areas which appear wet, loose, soft, unstable, or otherwise unsuitable, should be undercut as directed by the geotechnical engineer. Undercut excavations beneath foundations, slab-on-grade and pavement areas should be backfilled with compacted Structural Fill. Recommendations for Structural Fill, along with placement and compaction requirements, are presented in Appendix B.

In our opinion, the existing on-site soils are not well suited for re-use as structural fill beneath building foundations and slab areas. The on-site soils generally contained a significant fraction of silt soils and will be sensitive to changes in moisture. We recommend that imported Structural Fill be used to raise existing grades within the building areas and against foundation walls and against site retaining walls. Placement of all fill and/or backfill within the building and pavement areas should be observed and tested by qualified geotechnical personnel. Recommendations for fill material, placement, and compaction requirements are presented in Appendix B.

Finished grades surrounding the new building and pavement areas should be sloped to direct surface water away from the building, pavement areas, and retaining walls.

5.3 Spread Foundations

It is our opinion the proposed building can be supported using spread foundations. All existing fill type materials must be undercut and removed from beneath proposed foundation bearing grades as recommended in Sections 5.1 and 5.2 above. Spread foundations should bear on undisturbed indigenous soils or on Structural Fill which is placed and compacted in accordance with our recommendations. The exposed soil bearing grades should be observed and evaluated by a geotechnical engineer during construction.

It is possible that isolated areas of bedrock could be encountered in the foundation excavations in some areas. If areas of bedrock are encountered in foundation excavations for the proposed new building, we recommend the bedrock be removed using mechanical means (i.e. a large track-mounted excavator equipped with a hydraulic or pneumatic hammer). We recommend bedrock be removed to a depth of at least 6 inches below the bottom of the building footings. The resulting overexcavation below foundations should be backfilled with Drainage Stone. This will provide a cushion layer which will prevent point loads on the footings and will provide a more uniform bearing surface. Recommendations for Drainage Stone are presented in Appendix B.

All final bearing grades should be firm, stable, and free of loose soil, mud, water, frost, or other deleterious materials. Any soft or otherwise unsuitable soils identified by the geotechnical engineer should be undercut and replaced with Structural Fill or Subbase Stone as directed by the geotechnical engineer. Undercut excavations should extend out horizontally beyond the edge of the foundation a distance equal to the one-half of the depth of the undercut below the foundation. Recommendations for Structural Fill and Subbase Stone material, along with placement and compaction requirements are presented in Appendix B.

We recommend continuous wall foundations be at least 1.5 feet in width and isolated column foundations be at least 2.5 feet square. Interior foundations should be embedded at least 1.5 feet below the top of the interior floor slab in order to develop adequate bearing capacity. Exterior foundations must be embedded a minimum of 4.0 feet below finished exterior grades for frost protection.

Spread foundations, which are designed and constructed in accordance with our recommendations, can be sized using a maximum allowable soil bearing pressure of

3,000 pounds per square foot (psf). The allowable soil bearing pressure is based on a factor of safety of at least 3.0.

It is estimated that spread foundations, which are sized and properly constructed in accordance with our recommendations, will undergo total settlement of less than 3/4 inch, and differential settlements should be less than 1/2 inch.

5.4 Slab-on-Grade

The building at-grade floor slab can be constructed as slab-on-grade following proper site preparation as discussed in Sections 5.1 and 5.2 above. A minimum of 6 inches of Subbase Stone, as described in Appendix B, is recommended directly beneath the floor slab. The floor slab can be designed in accordance with procedures recommended by the Portland Cement Association or the American Concrete Institute, using a modulus of subgrade reaction of 200 pounds per cubic inch at the top of the Subbase Stone layer.

We recommend a vapor barrier be provided beneath interior floor slabs in areas receiving moisture-sensitive flooring in accordance with the American Concrete Institute (ACI) Guide for Concrete Floor and Slab Construction.

It should be understood that exterior slabs and sidewalks constructed upon the site’s soils will heave as frost seasonally penetrates the subgrades. The magnitude of frost heave will vary with many factors resulting in differential movements that could result in tripping hazards. As the ground thaws, the heaved areas may settle back down unevenly, again creating potential tripping hazards. The magnitude of frost heave in sensitive areas, such as near doors and at sidewalk/pavement transitions, can be reduced by constructing the slabs over at least 18 inches of Drainage Stone. The Drainage Stone layer must have an underdrain within it to provide positive drainage to a suitable outlet. Although this may not eliminate all movement associated with frost heave, it should provide adequate protection against excessive differential frost heave during most winters. Recommendations for Drainage Stone material are presented in Appendix B.

5.5 Site Retaining Walls

We anticipate the site retaining walls will consist of modular block gravity or mechanically stabilized earth style systems. We recommend the site retaining walls be located no closer than 5 feet from the top of the slope along the east side of the site where the slope angle is steeper than 3H:1V. We recommend the base row of blocks be directly underlain by a nominal 6-inch thick layer of Drainage Stone. Recommendations for Drainage Stone material are presented in Appendix B. Drainage Stone should be wrapped in a non-woven geotextile separation fabric, such as Mirafi 140N or equivalent.

We recommend the bottom row of site retaining wall blocks be embedded at least 2 feet below existing grade. We recommend site retaining walls be designed using an allowable soil bearing pressure of 1,400 psf. The allowable soil bearing pressure is based on a factor of safety of at least 3.0.

Site retaining walls should be designed to resist lateral earth pressures caused by the load of backfill against the walls and the surcharge effects from permanent or temporary loads. Walls that are restrained against lateral movement should be designed using "at-rest" lateral earth pressures. Walls that are allowed to yield can be designed using "active" lateral earth pressures. The walls should be backfilled with Structural Fill, as described in Appendix B.

The lateral earth pressures can be computed using the following soil parameters where the backfill behind the walls is relatively level:

Recommended Lateral Earth Pressure Parameters:

Soil Angle of Internal Friction – 34 degrees (Structural Fill)
Coefficient of Sliding Friction – 0.60 (CIP concrete over Drainage Stone)
Coefficient of Sliding Friction – 0.50 (Precast concrete over Drainage Stone)
Coefficient of At-Rest Lateral Earth Pressure – 0.44
Coefficient of Active Lateral Earth Pressure – 0.28
Coefficient of Passive Lateral Earth Pressure – 3.54
Total Moist Unit Weight of Soil – 125 pcf

5.6 Retaining Wall Drainage System

Site retaining walls should be constructed with foundation drainage systems to intercept groundwater and relieve potential hydrostatic pressures from acting on the walls. The drainage system should consist of footing under drain pipes and clean crushed stone placed against the back side of the walls.

The footing under drain pipes should consist of 4-inch diameter, slotted or perforated PVC pipes, which are placed at the bottom of the Drainage Stone layer beneath the bottom row of blocks. The Drainage Stone layer must be wrapped in a non-woven geotextile separation fabric, such as Mirafi 140N or equivalent. The under drain pipe should include clean-outs to allow periodic flushing and maintenance of the system. The under drain pipe should discharge to a suitable downslope outlet.

We recommend Drainage Stone be placed directly behind the retaining walls and extending 1 foot beyond the blocks. The remaining area beyond the Drainage Stone should be backfilled with Structural Fill. The Drainage Stone should be separated from the Structural Fill with a non-woven geotextile separation fabric. Recommendations for Drainage Stone and Structural Fill materials are presented in Appendix B.

5.7 Seismic Design Parameters

Based on the soil conditions encountered in the test borings, it is our opinion the site can be classified as **Seismic Site Class "C"** according to the 2020 Building Code of New York State criteria.

The mapped spectral accelerations in the project areas for Site Class "B" were based data obtained from the Applied Technology Council (ATC) web site (www.hazards.atcouncil.org) using latitude 41.5114 and longitude -74.0287 for the project site and ASCE7-16 data. The spectral response accelerations for Site Class "B" are as follows:

- Short Period Response (S_S) - 0.231g
- 1 Second Period Response (S_1) - 0.057g

For design purposes, the spectral response accelerations must be adjusted for site class "C" as follows:

- Short Period Response (S_{MS}) - 0.300g
- 1 Second Period Response (S_{M1}) - 0.085g

The corresponding five percent damped design spectral response accelerations (S_{DS} and S_{D1}) are as follows:

- S_{DS} - 0.200g
- S_{D1} - 0.057g

Based on the soil conditions encountered in the test pits and test borings, it is our opinion the soils underlying the site are not considered susceptible to soil liquefaction or lateral spreading as a result of the design seismic event. It is also our opinion that surface rupture is unlikely to occur at the site as a result of the design seismic event.

5.8 Pavement Section

Existing topsoil, trees, vegetation, foundations and slabs should be removed from within the proposed new pavement areas. It is possible that existing fill type soils may be left in place beneath proposed new pavement areas provided they are firm and stable. The exposed soil subgrade should be proofrolled and evaluated by a geotechnical engineer during construction. The proofrolling should be performed using a minimum 7-ton smooth drum roller, or a loaded dump truck.

Any areas which appear wet, loose, soft, unstable, or otherwise unsuitable, should be undercut as directed by the geotechnical engineer. Undercut excavations should be backfilled with Structural Fill or Subbase Stone. Recommendations for Structural Fill and

Subbase Stone material, along with placement and compaction requirements, are presented in Appendix B.

Proper drainage of the pavement section is required to maximize the pavement longevity. The soil subgrade materials encountered in the test borings included zones of relatively low permeability soils, which will tend to trap and hold surface water as it infiltrates into the ground. We recommend underdrains be incorporated into the pavement section to prevent groundwater from infiltrating into the pavement section Subbase Stone layer. The underdrains should consist of 4-inch diameter perforated plastic pipe surrounded by Drainage Stone, which is wrapped in non-woven geotextile separation fabric. The underdrains should be established approximately 12 inches below the bottom of the Subbase Stone layer and should discharge to a suitable outlet. We recommend underdrains be installed along pavement edges. The soil subgrades should be sloped to direct groundwater to the underdrains.

We recommend materials for the above pavement structure components consist of the following:

A. Asphalt Concrete Top Course - NYSDOT Standard Specifications, 9.5 F3 Top Course (or Type 6 or Type 7 Top Course).

B. Asphalt Concrete Binder Course - NYSDOT Standard Specifications, 25 F9 Binder Course (or Type 3 Binder Course).

C. Asphalt Concrete Base Course – NYSDOT Standard Specifications, 37.5 F9 Base Course (or Type 1 Base Course).

D. Subbase Stone – Should comply with NYSDOT Standard Specifications, 304.12 Type 2 or 304.14 Type 4 Subbase.

E. Drainage Stone – Should comply with NYSDOT Standard Specifications, Section 703-02 Material Designation 703-0201 or 703-0202, Size Designation No. 1 washed gravel or stone.

F. Non-Woven Geotextile Separation Fabric – Non-Woven polypropylene separation geotextile (i.e. Mirafi 140N or approved equivalent).

G. Woven Geotextile Stabilization Fabric - Woven polypropylene stabilization geotextile (i.e., Mirafi 500X or approved equivalent).

Adjacent geotextile panels should have an overlap of at least 18 inches. Construction of the asphaltic concrete courses (i.e., base, binder and top) should be performed in accordance with NYSDOT Standard Specifications Section 400. The base, binder and top courses should be compacted to at least 92 percent of the maximum theoretical density.

The pavement sections recommended below are based on the assumption that the subgrades and pavement sections will be prepared and constructed in accordance with our recommendations.

Parking Areas

- 1.5 inches – Top Course
- 2.5 inches – Binder Course
- 8.0 inches – Subbase Course
- Woven geotextile stabilization fabric

Main Drive & Bus Loop

- 1.5 inches – Top Course
- 2.5 inches – Binder Course
- 3.0 inches – Base Course
- 12.0 inches – Subbase Course
- Woven geotextile stabilization fabric

6.0 CONCLUDING REMARKS

This report was prepared to assist in planning the design and construction of the proposed Newburgh Enlarged City School District Career and Technology Education building planned on West Street in Newburgh, New York. This report has been prepared for specific application to this site and this project only.

The recommendations were prepared based on our understanding of the proposed project, as described herein, and through the application of generally accepted soils and foundation engineering practices. No warranties, expressed or implied, are made by the conclusions, opinions, recommendations, or services provided.

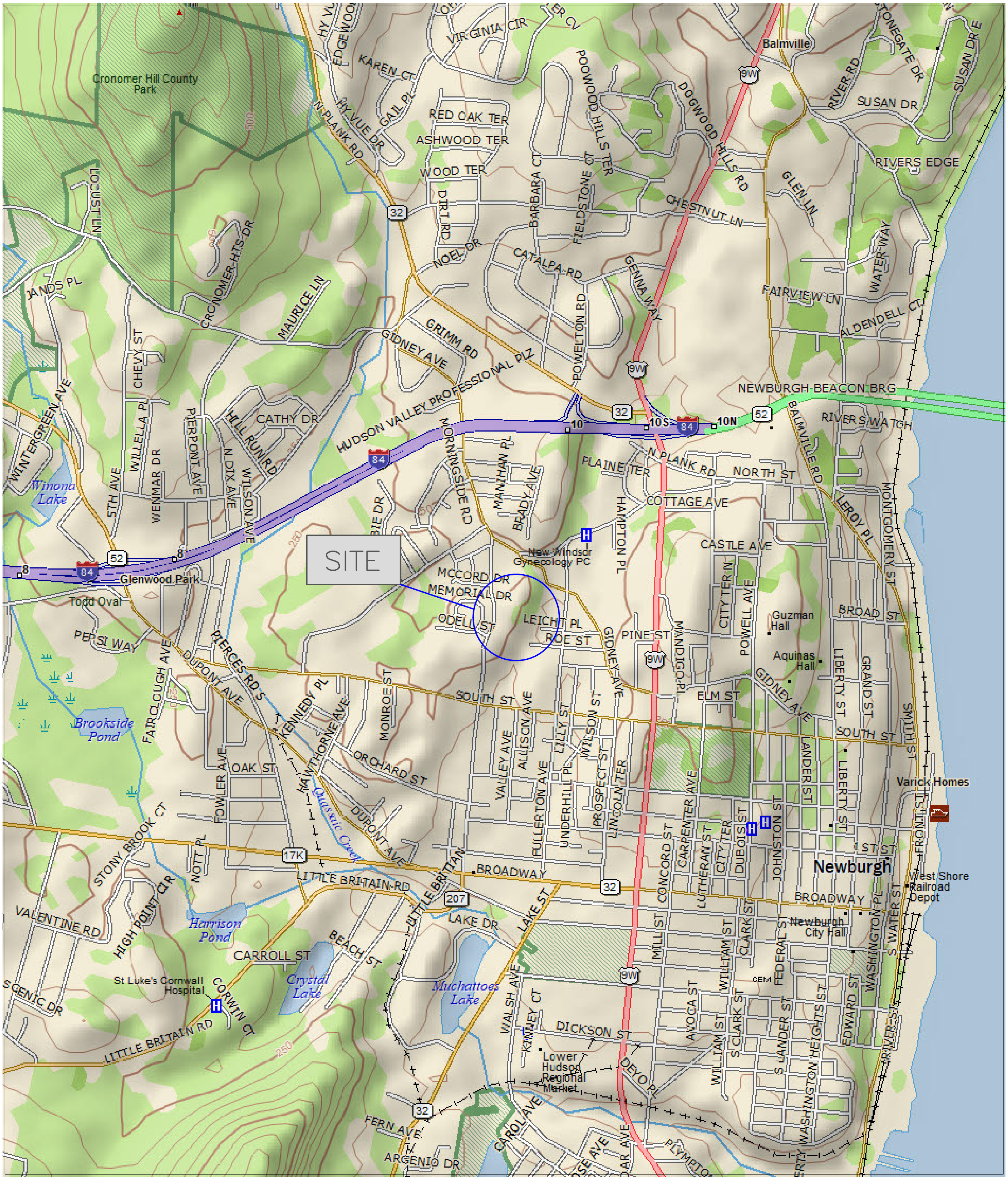
Important information regarding the use and interpretation of this report is presented in Appendix C.

Respectfully Submitted:
Quality Geo Engineering, P.C.

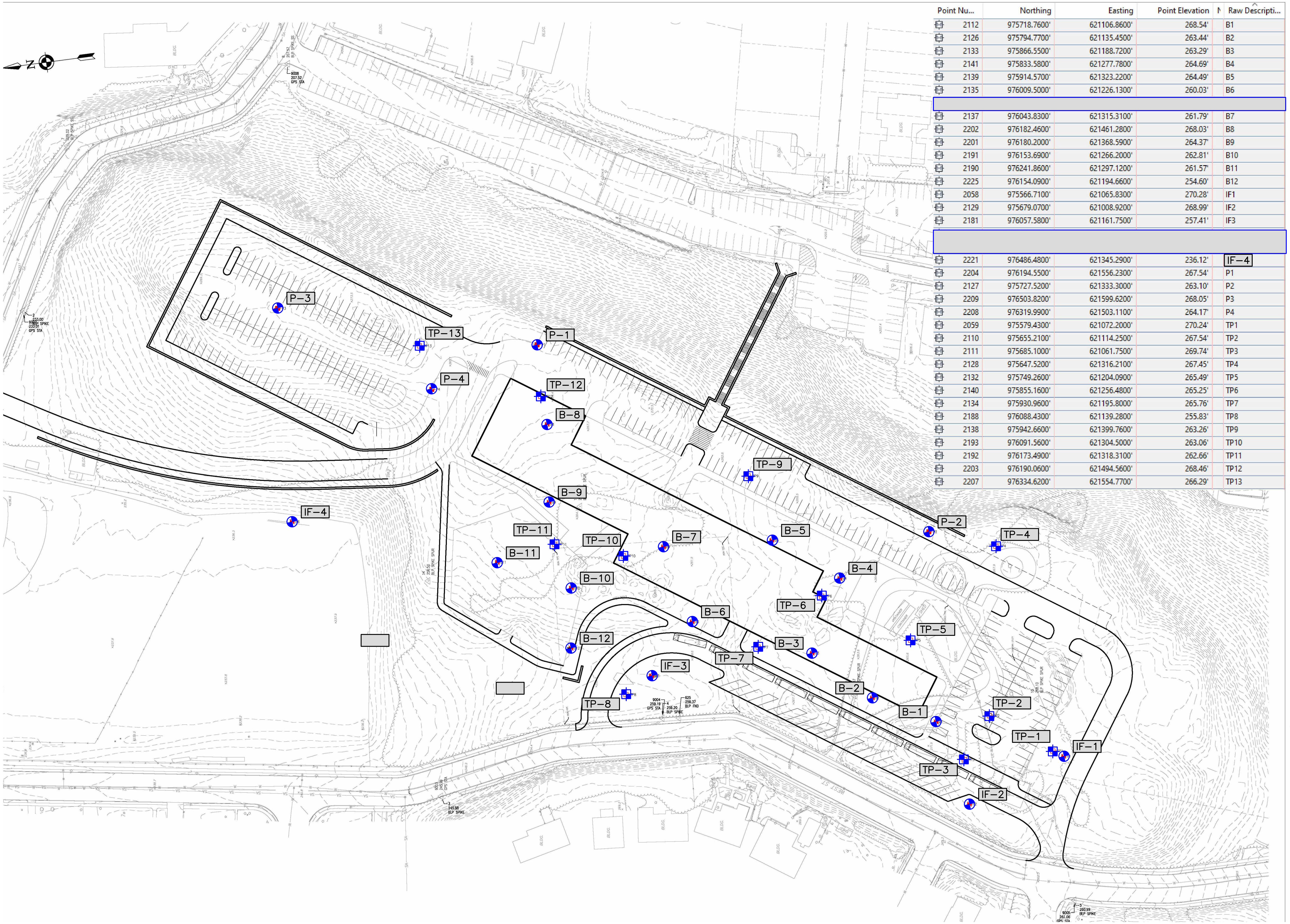
Tod Kobik

Tod M. Kobik, P.E.
President

FIGURES



QUALITY GEO ENGINEERING, P.C. 877 ROUTE 4 S SCHUYLERVILLE, NEW YORK 12871 PHONE (518) 372-4067 FAX (518) 507-6113	SCALE: N.T.S. DRAWN BY: *TMK* DATE: 1/6/21 PROJECT No.: SE20-042 FIGURE No.: 1	SITE LOCATION MAP NEWBURGH ECSD CAREER & TECHNICAL EDUCATION CENTER WEST STREET NEWBURGH, NEW YORK



Point Nu...	Northing	Easting	Point Elevation	N	Raw Descripti...
2112	975718.7600'	621106.8600'	268.54'		B1
2126	975794.7700'	621135.4500'	263.44'		B2
2133	975866.5500'	621188.7200'	263.29'		B3
2141	975833.5800'	621277.7800'	264.69'		B4
2139	975914.5700'	621323.2200'	264.49'		B5
2135	976009.5000'	621226.1300'	260.03'		B6
2137	976043.8300'	621315.3100'	261.79'		B7
2202	976182.4600'	621461.2800'	268.03'		B8
2201	976180.2000'	621368.5900'	264.37'		B9
2191	976153.6900'	621266.2000'	262.81'		B10
2190	976241.8600'	621297.1200'	261.57'		B11
2225	976154.0900'	621194.6600'	254.60'		B12
2058	975566.7100'	621065.8300'	270.28'		IF1
2129	975679.0700'	621008.9200'	268.99'		IF2
2181	976057.5800'	621161.7500'	257.41'		IF3
2221	976486.4800'	621345.2900'	236.12'		IF-4
2204	976194.5500'	621556.2300'	267.54'		P1
2127	975727.5200'	621333.3000'	263.10'		P2
2209	976503.8200'	621599.6200'	268.05'		P3
2208	976319.9900'	621503.1100'	264.17'		P4
2059	975579.4300'	621072.2000'	270.24'		TP1
2110	975655.2100'	621114.2500'	267.54'		TP2
2111	975685.1000'	621061.7500'	269.74'		TP3
2128	975647.5200'	621316.2100'	267.45'		TP4
2132	975749.2600'	621204.0900'	265.49'		TP5
2140	975855.1600'	621256.4800'	265.25'		TP6
2134	975930.9600'	621195.8000'	265.76'		TP7
2188	976088.4300'	621139.2800'	255.83'		TP8
2138	975942.6600'	621399.7600'	263.26'		TP9
2193	976091.5600'	621304.5000'	263.06'		TP10
2192	976173.4900'	621318.3100'	262.66'		TP11
2203	976190.0600'	621494.5600'	268.46'		TP12
2207	976334.6200'	621554.7700'	266.29'		TP13

NOTE: TEST BORING AND TEST PIT LOCATIONS ARE APPROXIMATE.

SCALE: N.T.S.
DRAWN BY: TMK
DATE: 1/6/2021
PROJECT No.: SE20-042
FIGURE No.: 2

NEWBURGH ECSD
CTE BUILDING
WEST STREET
NEWBURGH, NEW YORK

SUBSURFACE EXPLORATION
LOCATION PLAN

QUALITY GEO ENGINEERING, P.C.
877 ROUTE 4S
SCHUYLERVILLE, NEW YORK
PHONE (518) 372-4067
FAX (518) 507-6113

APPENDIX A

SUBSURFACE EXPLORATION LOGS

DATE
START: 12/3/2020
FINISH: 12/3/2020

SHEET 1 OF 1

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES

SUBSURFACE EXPLORATION LOG

BORING NO. **B-1**
PROJ. NO. SE20-042
SURF. ELEV. 268.5'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	1	2	2	3	4	1.3	Brown Loose Fine SAND, Some Silt, Little Gravel, Trace Organics, Dry	
	2	2	4	5	8	9	1.5	Grades To "No" Organics	
5	3	12	24	21	19	45	1.1	Tan/Gray Compact Weathered ROCK FRAGMENTS	
	4	42	100/.1			REF	0.4		REF = Sample Spoon Refusal
								Boring terminated with auger refusal at a depth of 7.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
10									
15									
20									
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/3/2020
FINISH: 12/3/2020
SHEET 1 OF 1

BORING NO. **B-2**
PROJ. NO. SE20-042
SURF. ELEV. 263.4'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	2	3	5	7	8	0.4	Brown Loose Fine SAND, Some Silt, Little Gravel, Little Organics, Dry	
	2	2	3	5	5	8	1.1	Brown Loose SILT, Little Fine Sand, Trace Gravel, Trace Organics, Dry	
5	3	37	17	8	3	25	1.0	Gray Firm GRAVEL/ ROCK Fragments, AND Brown Fine SAND, Little Silt, Dry	
	4	1	2	10	27	12	0.3	Brown Firm Fine SAND AND GRAVEL, Little Silt, Dry	
	5	20	12	5	4	17	0.3	Gray Firm GRAVEL/ROCK Fragments, Little Sand, Dry	
10									
15	6	12	10	14	15	24	1.0	Brown Firm SILT, Little Sand	REF = Sample Spoon Refusal NR = No Recovery
20	7	50/0				REF	NR	Boring terminated with auger refusal at a depth of 20.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/4/2020
FINISH: 12/4/2020

SHEET 1 OF 1

BORING NO. **B-3**
PROJ. NO. SE20-042
SURF. ELEV. 263.3'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	/	1	1	1	4	3	5	1.2	Brown Loose Fine SAND AND SILT, Trace Gravel, Dry	
	/	2	2	3	4	10	7	NR		NR = No Recovery
5	/	3	5	3	4	3	7	0.2	Grades To "Little" Silt, "Little" Gravel	
	/	4	47	45	50/.3		REF	1.0	Tan/Gray Very Compact Weathered ROCK FRAGMENTS	REF = Sample Spoon Refusal
									Boring terminated with auger refusal at a depth of 8.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/4/2020
FINISH: 12/4/2020

SHEET 1 OF 1

BORING NO. **B-4**
PROJ. NO. SE20-042
SURF. ELEV. 264.7'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	9	7	9	9	16	0.5	Gray Firm F-M SAND, Some Gravel, Little Silt, Little Organics, Dry	
	2	11	6	3	5	9	0.3	Gray/Brown, Loose, Grades To "No" Organics	
5	3	24	11	3	2	14	1.0	Brown Firm SILT, Some Fine Sand, Dry	
	4	4	5	8	9	13	0.8	Brown Firm Fine SAND, Some Silt, Dry	
	5	49	100/.3			REF	0.4	Very Compact Grades To "Trace" Rock Fragments	REF = Sample Spoon Refusal NR = No Recovery
10									
	6	50/0				REF	NR	Boring terminated with auger refusal at a depth of 13.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
15									
20									
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE
START: 12/4/2020
FINISH: 12/4/2020

SHEET 1 OF 1

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

BORING NO. **B-5**
PROJ. NO. SE20-042
SURF. ELEV. 264.5'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	/	1	1	1	1	2	2	1.0	Brown Very Loose SILT AND Fine SAND, Little Gravel, Trace Organics, Dry	
	/	2	2	3	3	5	6	1.0	Brown Loose Fine SAND, Little Silt, Little Gravel, Dry	
5	/	3	5	8	7	100/.4	15	0.7	Firm, Grades To "Trace" Silt	NR = No Recovery REF = Sample Spoon Refusal
	/	4	50/0				REF	NR	Boring terminated with auger refusal at a depth of 6.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE: Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/4/2020
FINISH: 12/4/2020
SHEET 1 OF 1

BORING NO. **B-6**
PROJ. NO. SE20-042
SURF. ELEV. 260.0'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building
LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	1	7	5	6	12	1.2	FILL: Dark Brown/Gray Firm F-M SAND, Some Silt, Little Gravel, Dry	
	2	1	6	5	4	11	0.1	Similar	
5	3	1	3	4	12	7	0.2	Loose, Grades To "Some" Gravel, "Little" Brick Fragments, "Trace" Organics	
	4	19	14	12	16	26	1.3	Brown Firm Fine SAND, Little Silt, Little Gravel, Dry	
	5	26	34	50/.2		REF	0.6	Very Compact, Grades To "Fine-Medium" SAND, "Some" Gravel	REF = Sample Spoon Refusal
10									
15	6	50/.1				REF	0.1	Gray Very Compact Rock Fragments, Little Sand	
								Boring terminated with auger refusal at a depth of 15.1 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
20									
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/4/2020
FINISH: 12/4/2020
SHEET 1 OF 1

BORING NO. **B-7**
PROJ. NO. SE20-042
SURF. ELEV. 261.8'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	6	7	18	8	25	1.2	FILL: Gray Firm GRAVEL AND SAND, Little Asphalt	
	2	6	5	4	4	9	0.3	Loose	
5	3	10	9	9	7	18	0.5	Firm, Grades To "No" Asphalt, "Trace" Silt, "Trace" Organics	
	4	8	5	9	3	14		FILL: Brown Firm SILT, Some Sand, Little Gravel, Little Organics	
	5	8	7	7	7	14	0.2	FILL: Gray/Brown Firm GRAVEL, Some Sand, Little Silt	
10									
15	6	8	7	7	4	14	1.6	Gray/Brown Firm SILT, Some Sand, Little Gravel	
									REF = Sample spoon refusal
20	7	17	22	25	100/.3	47	1.6	Gray, Very Compact, Grades to "Little" Fine Sand	NR = No recovery
	8	50/0				REF	NR	Boring terminated with auger refusal at a depth of 22.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE
START: 12/7/2020
FINISH: 12/7/2020

SHEET 1 OF 1

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

BORING NO. **B-8**
PROJ. NO. SE20-042
SURF. ELEV. 268.0'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building
LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	1	1	4	2	5	0.9	Brown Loose SILT, Some Sand, Little Gravel, Little Organics, Dry	
		2	12	100/.3			REF	0.3	Gray/Brown Very Compact GRAVEL, Some Sand, Little Silt, Little Organics, Dry	REF = Sample Spoon Refusal
5		3	8	12	15	25	27	0.7	Brown Firm F-C SAND, Some Silt, Little Gravel, Dry	
		4	15	21	27	31	48	0.4	Very Compact, Grades To "Some" Gravel	
		5	14	8	4	8	12	0.7	Firm, Grades To "AND" SILT, "Trace" Gravel	
10										
									Boring terminated with auger refusal at a depth of 12.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE
START: 12/9/2020
FINISH: 12/9/2020

SHEET 1 OF 1

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

BORING NO. **B-9**
PROJ. NO. SE20-042
SURF. ELEV. 264.4'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	2	5	10	12	15	1.4	Dark Brown Firm Fine SAND, Some Gravel, Little Silt, Little Organics, Dry	
	2	12	10	7	9	17	0.1	Brown, Grades To "No" Organics	
5	3	3	12	14	12	26	1.3	Contains Root Fragments	
	4	12	12	10	5	22	1.0	Grades To "Some" Silt, "No" Gravel	
	5	9	14	12	6	26	1.0	Brown Firm SILT, Some F-M Sand, Wet	
10									
15	6	9	15	100/.2		REF	0.8	Brown Very Compact F-M SAND, Some Silt, Little Gravel, Moist	REF = Sample Spoon Refusal
								Boring terminated with auger refusal at a depth of 16.5 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
20									
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE START: 12/8/2020 FINISH: 12/8/2020 SHEET 1 OF 1	QCQA Labs QC/QA LABORATORIES, INC. DRILLING & TESTING SERVICES **SUBSURFACE EXPLORATION LOG**	BORING NO. **B-10** PROJ. NO. SE20-042 SURF. ELEV. 262.8' G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	1	5	7	6	12	1.3	FILL: Brown Firm Fine SAND, Little Silt, Trace Gravel, Dry	
		2	33	29	30	41	59	1.0	Very Compact, Grades To "Little" Gravel, "Little" Organics	
5		3	14	10	8	7	18	1.5	Dark Brown, Firm, Grades To "Some" Silt, "Trace" Gravel, "Trace" Glass	
		4	6	6	5	5	11	1.3	Dark Gray, Grades To "Fine-Medium" SAND, "No" Glass	
		5	2	2	2	2	4	1.0	Loose, Grades To "Little" Organics	
10										
15		6	12	8	8	7	16	1.6	Brown Firm Fine SAND, Trace Silt, Trace Gravel, Dry	
20		7	9	12	21	33	33	1.7	Compact, Grades To "Little" Silt	
25									Boring terminated with auger refusal at a depth of 24.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

QCQA Labs
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DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/8/2020
FINISH: 12/8/2020

SHEET 1 OF 1

BORING NO. **B-11**
PROJ. NO. SE20-042
SURF. ELEV. 261.6'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	3	5	6	8	11	1.4	FILL: Dark Brown Firm Fine SAND, Little Silt, Little Gravel, Dry	
		2	9	11	10	9	21	1.8	Grades To "Some" Gravel	
5		3	12	100/.1			REF	0.5	Gray Very Compact ROCK FRAGMENTS, Little Sand, Dry	REF = Sample Spoon Refusal
									Boring terminated with auger refusal at a depth of 6.5 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE
START: 12/8/2020
FINISH: 12/8/2020

SHEET 1 OF 1

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SUBSURFACE EXPLORATION LOG

BORING NO. **B-12**
PROJ. NO. SE20-042
SURF. ELEV. 254.6'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	12	24	100/.3		REF	0.5	Brown Very Compact F-C SAND, Some Silt, Some Gravel, Little Organics	REF = Sample Spoon Refusal NR = No Recovery
		2	50/0				REF	NR	Boring terminated with auger refusal at a depth of 3.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
5										
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

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SUBSURFACE EXPLORATION LOG

DATE
START: 12/3/2020
FINISH: 12/3/2020
SHEET 1 OF 1

BORING NO. **P-1**
PROJ. NO. SE20-042
SURF. ELEV. 267.5'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	7	9	6	2	15	0.7	Brown Firm Fine SAND, Some Silt, Little Gravel, Trace Organics, Dry	
	2	3	7	6	4	13	0.9	Grades To "Some" Gravel, "Trace" Silt, "No" Organics	
	3	100/.4				REF	0.2	Very Compact, Grades To "Fine-Coarse" SAND	REF = Sample Spoon Refusal
5									NR = No Recovery
	4	100/0				REF	NR	Boring terminated with auger refusal at a depth of 6.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
10									
15									
20									
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE
START: 12/4/2020
FINISH: 12/4/2020
SHEET 1 OF 1

QCQA Labs
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DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

BORING NO. **P-2**
PROJ. NO. SE20-042
SURF. ELEV. 263.1'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	2	2	3	3	5	0.7	FILL: Brown Loose Fine SAND, Some Silt, Little Gravel, Trace Organics, Dry	
		2	5	4	4	3	8	0.9	Grades To "Some" Concrete	
5		3	2	2	2	2	4	0.7	Grades To "Little" Gravel/Concrete	
		4	1	2	1	2	3	0.6	Very Loose, Grades To "Some" Concrete/Gravel	
		5	1	2	2	2	4	0.7	Brown Loose F-M SAND, Some Silt, Little Gravel, Dry	
10									Boring terminated at a depth of 10.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE: Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

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SUBSURFACE EXPLORATION LOG

DATE
START: 12/7/2020
FINISH: 12/7/2020
SHEET 1 OF 1

BORING NO. **P-3**
PROJ. NO. SE20-042
SURF. ELEV. 268.1'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building
LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	1	1	1	2	2	0.7	Brown Very Loose SILT AND Fine SAND, Little Organics, Dry	
		2	10	12	50/.1		REF	0.2	Very Compact, Grades To "Some" Gravel	REF = Sample Spoon Refusal
									Boring terminated with auger refusal at a depth of 4.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
5										
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

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DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/7/2020
FINISH: 12/7/2020
SHEET 1 OF 1

BORING NO. **P-4**
PROJ. NO. SE20-042
SURF. ELEV. 264.2'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building
LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	1	WH	WH	WH	1	WH	0.2	Brown Very Loose SILT, Some Fine Sand, Little Organics	WH = Weight of hammer and rods REF = Sample spoon refusal
	2	15	50/.1			REF	0.4	Brown F-C SAND, Some Silt, Little Gravel, Wet	
5								Gray Medium Hard LIMESTONE Rock, Slightly Weathered, Moderately Fractured	Run#1, 2.5'-7.5' REC = 82% RQD = 34%
								Boring terminated at a depth of 7.5 feet.	Groundwater was not encountered in bore hole prior to rock coring.
10									
15									
20									
25									
30									
35									
40									

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE
START: 12/3/2020
FINISH: 12/3/2020

SHEET 1 OF 1

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DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

BORING NO. **IF-1**
PROJ. NO. SE20-042
SURF. ELEV. 270.3'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	4	7	8	5	15	1.3	Brown Firm Fine SAND, Some Gravel, Little Silt Dry	
		2	9	100/.4			REF	0.6	Very Compact	REF = Sample Spoon Refusal
		3	100/0				REF	NR		NR = No recovery
									Boring terminated at a depth of 4.0 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
5										
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

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DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

DATE
START: 12/3/2020
FINISH: 12/3/2020
SHEET 1 OF 1

BORING NO. **IF-2**
PROJ. NO. SE20-042
SURF. ELEV. 269.0'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building
LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	3	2	2	2	4	1.1	Brown Loose SILT, Some Fine Sand, Trace Gravel, Trace Organics	
		2	11	8	24	32	32	1.4	Brown Compact Fine SAND, Some Gravel, Little Silt, Dry	REF = Sample Spoon Refusal
5		3	100/.3				REF	0.1	Gray Very Compact Rock Fragments, Some Silt	
									Boring terminated at a depth of 4.3 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

DATE
START: 12/4/2020
FINISH: 12/4/2020

SHEET 1 OF 1

QCQA Labs
QC/QA LABORATORIES, INC.
DRILLING & TESTING SERVICES
SUBSURFACE EXPLORATION LOG

BORING NO. **IF-3**
PROJ. NO. SE20-042
SURF. ELEV. 257.4'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building

LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
		1	WH	WH	WH	WH	WH	0.2	Black Very Loose Topsoil, Some Silt, Some Sand	
		2	1	2	1	2	3	0.3	Brown/ Black Very Loose SILT, Little Sand, Little Gravel, Little Organics	
		3	3	10	21	50/.1	31	1.0	Compact, Grades To "AND" Fine SAND, "No" Organics	
5									Gray Rock Fragments	
									Boring terminated at a depth of 5.6 feet.	Groundwater was not encountered in bore hole upon completion of drilling.
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

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SUBSURFACE EXPLORATION LOG

DATE
START: 12/7/2020
FINISH: 12/7/2020
SHEET 1 OF 1

BORING NO. **IF-4**
PROJ. NO. SE20-042
SURF. ELEV. 236.1'
G.W. DEPTH See Notes

PROJECT: Newburgh CSD
CTE Building
LOCATION: Newburgh, NY

DEPTH (ft.)	SAMPLES	SAMPLE NO.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	REC. (ft.)	SOIL OR ROCK CLASSIFICATION	NOTES
	/	1	1	5	8	8	13	1.7	Brown Firm Fine SAND, Little Silt, Little Gravel, Dry	
	/	2	1	3	7	8	10	1.3	Wet	
5	/	3	10	16	15	16	31	1.4	Compact, Grades To "Some" Gravel	
	/	4	9	12	12	12	24	1.0	Firm Grades To "No" Gravel	
									Boring terminated at a depth of 8.0 feet.	Free standing water was not encountered in bore hole upon completion of drilling.
10										
15										
20										
25										
30										
35										
40										

N = NO. BLOWS TO DRIVE 2-INCH SPLIT SPOON 12-INCHES WITH A 140 LB. PIN WT. FALLING 30-INCHES PER BLOW

CLASSIFICATION: Visual by S. Wolf

DRILLER: J. Leonhardt

DRILL RIG TYPE : Diedrich D-50

METHOD OF INVESTIGATION: ASTM D1586 using 2.25" I.D. Hollow Stem Augers

EXAMPLE KEY TO SUBSURFACE EXPLORATION LOGS

DATE START: XX/XX/XX FINISH: XX/XX/XX SHEET X OF X	QCQA Labs QC/QA LABORATORIES, INC. GEOTECHNICAL ENGINEERING SERVICES	PROJ. NO. XX-XXXX HOLE NO. X-X SURF. ELEV. XXX.X' G.W. DEPTH X.X'

PROJECT: PROJECT NAME
PROJECT NAME

LOCATION: PROJECT LOCATION
PROJECT LOCATION

DEPTH (ft)	SAMPLES	SAMPLE No.	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	RECOVERY (ft)	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	3	3	4	8	7	1.0	3" TOPSOIL Brown Loose SILT, some Sand, trace clay, Moist	Groundwater at 10' upon completion, and 5' 24 hrs. after completion
		2	50/.5				50/.5	NR	Gray SHALE, medium hard, weathered, thin bedded, some fractures	Run#1, 3.5'-6.0' 95% Recovery 50% RQD
5										
1	2	3	4					5	6 7 8	9 10

7 *(numbered features explained on reverse)*

TABLE I

	Split Spoon Sample
	Shelby Tube Sample
	Geoprobe Macro-Core
	Auger or Test Pit Sample
	Rock Core

TABLE II

Identification of soil type is made on basis of an estimate of particle sizes, and in the case of fine grained soils also on basis of plasticity.

Soil Type	Soil Particle Size	
Boulder	>12"	Coarse Grained (Granular)
Cobble	3" - 12"	
Gravel - Coarse	3" - 3/4"	
- Fine	3/4" - #4	
Sand - Coarse	#4 - #10	
- Medium	#10 - #40	
- Fine	#40 - #200	
Silt - Non Plastic (Granular) Clay - Plastic (Cohesive)	<#200	Fine Grained

TABLE III

The following terms are used in classifying soils consisting of mixtures of two or more soil types. The estimate is based on weight of total sample.

Term	Percent of Total Sample
"and"	35 - 50
"some"	20 - 35
"little"	10 - 20
"trace"	less than 10

(When sampling gravelly soils with a standard split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter.)

TABLE IV

The relative compactness or consistency is described in accordance with the following terms:

Granular Soils		Cohesive Soils	
Term	**Blows per Foot, N**	**Term**	**Blows per Foot, N**
Very Loose	0 - 4	Very Soft	0 - 2
Loose	4 - 10	Soft	2 - 4
Firm	10 - 30	Medium	4 - 8
Compact	30 - 50	Stiff	8 - 15
Very Compact	>50	Very Stiff	15 - 30
		Hard	>30

(Large particles in the soils will often significantly influence the blows per foot recorded during the penetration test)

TABLE V

Varved	Horizontal uniform layers or seams of soil(s).
Layer	Soil deposit more than 6" thick.
Seam	Soil deposit less than 6" thick.
Parting	Soil deposit less than 1/8" thick.
Laminated	Irregular, horizontal and angled seams and partings of soil(s).

TABLE VI

Rock Classification Term		Meaning
Hardness	- Soft	Scratched by fingernail
	- Medium Hard	Scratched easily by penknife
	- Hard	Scratched with difficulty by penknife
	- Very Hard	Cannot be scratched by penknife
Weathering	- Very Weathered - Weathered - Sound	Judged from the relative amounts of disintegration, iron staining, core recovery, clay seams, etc.

Rock Classification Term		Meaning	
Bedding	- Laminated	(<1")	Natural breaks in Rock Layers
	- Thin Bedded	(1" - 4")	
	- Bedded	(4" - 12")	
	- Thick Bedded	(12" - 36")	
	- Massive	(>36")	

(Fracturing refers to natural breaks in the rock oriented at some angle to the rock layers)

GENERAL INFORMATION & KEY TO SUBSURFACE LOGS

The Subsurface Logs attached to this report present the general observations and mechanical data collected by the driller at the site, supplemented by classificiation of the material removed from the borings as determined through visual identification by technicians in the laboratory. It is cautioned that the materials removed from the borings represent only a small fraction of the soils at the site and may not be representative of subusurface conditions between and/or away from the boring locations or betweeen the sampled intervals. The data presented on the Subsurface Logs along with the recovered samples provide a basis for estimating the engineering characteristics of the soils at the site. The evaluation must consider all the recorded details and their relative significance to the project. It is common that evaluation of standard subsurface data indicates the need for additional testing and/or sampling to more accurately evaluate the subsurface conditions. Any evaluation of the data presented on the Subsurface Logs must be performed by qualified professionals. The following information defines some of the procedures and terms used on the Subsurface Logs to describe the conditions encountered. The paragraph numbers below correspond to the numbered features identified on the opposite page.

1. The figures in the Depth column define the scale of the Subsurface Log.

2. The Samples column shows a graphical representation of the depth and type of sampling performed. See Table I for descriptions of the symbols used to represent the various types of samples.

3. The Sample No. is used for identification on sample containers and laboratory test reports.

4. Blows on Sampler - shows the results of the "Standard Penetration Test" (SPT), recording the number of blows required to drive a split spoon sampler into the soil. The number of blows required to drive the sampler for each six inch increment is recorded. The first six inches of penetration is considered a seating drive. The sum of the number of blows required for the second and third six inch increments is termed the penetration resistance, N. The outside diameter of the sampler, hammer weight and length of drop are noted at the bottom of the Subsurface Log.

5. Recovery - Shows the length of the recovered sample.

6. All recovered soil samples are reviewed in the laboratory by an engineering technician or geotechnical engineer, unless noted otherwise. Visual descriptions are made on the basis of a combination of the driller's field descriptions and noted observations together with the sample as received in the laboratory. The method of visual classification is based primarily on the Unified Soil Classificiation System (ASTM D 2487) with regard to the particle size and plasticity (See Table No. II), and the Unified Soil Classification group symbols for the soil types are sometimes included with the soil classification. Additionally, the relative portion, by weight, of two or more granular soil types is described in accordance with "Suggested Methods of Test for Identification of Soils" by D.M. Burmister, ASTM Special Technical Publication 479, June 1970, (See Table No. III). Description of the relative soil density or consistency is based upon the penetration records as defined in Table No. IV. The description of the soil moisture is based upon the relative wetness of the soil as recovered and is decribed as dry, moist, wet or saturated. Water introduced into the boring either naturally or during drilling may have affected the moisture condition of the recovered samples. Special terms are used as required to describe soil deposition in greater detail; several such terms are listed in Table V. When sampling gravelly soils with a standard two inch diameter split spoon sampler, the true percentage of gravel is often not recovered due to the relatively small samper diameter. The presence of boulders and large gravel is sometimes, but not necessarily, detected by an evaluation of the sampler blows or through the action of the drill rig as reported by the driller.

7. Rock descriptions are based on review of the recovered rock core samples and the driller's notes. Typical rock classification terms are included in Table VI.

8. The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Solid stratification lines delineate apparent changes in soil type, based upon review of recovered soil samples and the driller's notes. Dashed lines indicate a lesser degree of certainty with respect to either a change in soil type or where such a change may occur.

9. Miscellaneous observations and procedures noted by the driller are shown in this column, including water level observations. It is important to understand that the reliability of the water observations depends upon the soil type (water level does not readily stabilize in a bore hole through fine grained soils), and that any drill water used to advance the boring may have influenced the observations. Typically, the ground water level will fluctuate with seasonal changes in precipitation patterns. One or more perched or trapped water levels may exist in the ground seasonally. Generally, it is prudent to install a groundwater observation well to better define water levels.

10. The length of core run is defined as the length of penetration of the core barrel. Core recovery is the length of core recovered divided by the core run length. The Rock Quality Designation (RQD) is the total length of pieces of recovered core exceeding 4 inches divided by the core run length. The size of the core barrel used is also noted.

QCQA Labs
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DRILLING & TESTING SERVICES

877 Route 4 S
Schuylerville, New York
Phone (518) 372-4067
Fax (518) 507-6113

TEST PIT LOG

DATE: 12/2/20 **TEST PIT NO.:** **TP-1**

PROJECT: Newburgh CSD CTE **PROJECT NO.:** SE20-042

CONTRACTOR: QCQA Labs **GROUND ELEV.:** 270.2'

INSPECTOR: Tod M. Kobik, P.E. **WEATHER:** Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 6"	Dark Brown TOPSOIL	
6" - 5'	Brown SILT, Little Fine-Medium Sand, Trace Gravel, Cobbles/Boulders	
5'	Refusal on Bedrock	Groundwater was not encountered in test pit.

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-2**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	267.5'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 3"	FILL: Gray Crusher Run STONE	
3" - 5'	Brown SILT AND Fine-Medium SAND, Some Gravel, Cobbles/Boulders	
5' - 6'	Gray COBBLES AND BOULDERS	Groundwater was not encountered in test pit.
6'	Refusal on Bedrock	

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-3**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	269.7'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 7"	Topsoil	
7" - 1.5'	Brown SILT, Little Clay, Little Fine-Medium Sand, Little Gravel, Cobbles/Boulders	
1.5' - 3'	Refusal on Bedrock (depth varies)	Groundwater was not encountered in test pit.

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-4**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	267.5'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 2'	FILL: Brown-Gray Fine-Coarse SAND, Some Silt, Some Gravel	
2' - 3.5'	Brown SILT AND Fine-Medium SAND, Some Gravel, Cobbles/Boulders	
3.5'	Refusal on Bedrock	Groundwater was not encountered in test pit.

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-5**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	265.5'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 3.5'	FILL: Brown-Black ASH AND CINDERS, Little Glass	
3.5' - 8'	Brown SILT AND Fine-Medium SAND, Some Gravel, Cobbles/Boulders, Dry	
8' - 10'	Gray Fine-Coarse SAND, Some Gravel, Some Silt, Dry	Groundwater was not encountered in test pit.

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-6**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	265.3'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 3'	FILL: Brown-Gray GRAVEL AND Fine-Coarse SAND, Little Silt	
3' - 5'	FILL: Brown-Black ASH AND CINDERS	
5' - 9'	Brown SILT, Some Fine-Medium Sand, Little Gravel, Cobbles/Boulders, Dry	Groundwater was not encountered in test pit.
9'	Refusal on Bedrock	

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-7**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	265.8'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 4"	Topsoil	
4" - 5.5'	Brown SILT, Some Fine-Medium Sand, Some Gravel, Cobbles/Boulders	
5.5' - 7'	Cobbles/Boulders	Groundwater was not encountered in test pit.
7'	Refusal on Bedrock	

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-8**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	255.8'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 7"	Topsoil	
7" - 5'	Brown Fine-Medium SAND AND SILT, Some Gravel, Cobbles/Boulders	
5'	Refusal on Bedrock	Groundwater was not encountered in test pit.

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-9**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	263.3'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 6"	Topsoil	
6" - 10'	Brown SILT AND Fine-Medium SAND, Little Gravel, Cobbles/Boulders, Dry	Groundwater was not encountered in test pit.

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-10**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	263.1'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 3'	FILL: Brown GRAVEL, Some Sand, Little Silt, Cobbles	
3' - 8'	FILL: Gray GRAVEL AND SILT, Little Fine-Medium Sand, Trace Clay, Cobbles	Groundwater was not encountered in test pit.
8' - 10'	FILL: WOOD MULCH	
10' - 12'	Brown SILT, Little Fine-Medium Sand, Trace Gravel, Cobbles	

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-11**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	262.7'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 5"	Topsoil	
5" - 2.5'	FILL: Brown GRAVEL, Some Fine-Medium Sand, Some Silt Cobbles, Moist	Groundwater was not encountered in test pit.
2.5' - 8.5'	Becomes Gray, Contains Boulders, Moist	
8.5' - 9'	Brown SILT, Some Fine-Medium Sand, Little Gravel, Cobbles	

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-12**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	268.5'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 4"	Topsoil	
4" - 9'	Brown GRAVEL, Some Silt, Some Fine-Medium Sand, Cobbles, Dry	Groundwater was not encountered in test pit.

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TEST PIT LOG

DATE:	12/2/20	**TEST PIT NO.:**	**TP-13**
PROJECT:	Newburgh CSD CTE	**PROJECT NO.:**	SE20-042
CONTRACTOR:	QCQA Labs	**GROUND ELEV.:**	266.3'
INSPECTOR:	Tod M. Kobik, P.E.	**WEATHER:**	Overcast, Cold

EXCAVATION EQUIPMENT: Mini Excavator

DEPTH	SOIL DESCRIPTION	NOTES
0 - 6"	Topsoil	
6" - 2'	Brown SILT, Some Fine-Medium Sand, Little Gravel, Cobbles/Boulders	Groundwater was not encountered in test pit.
2'	Refusal on Bedrock	

APPENDIX B

FILL MATERIAL AND PLACEMENT RECOMMENDATIONS

FILL MATERIAL AND PLACEMENT RECOMMENDATIONS

I. Fill Material Recommendations

A. Subbase Stone

Subbase Stone should consist of a crusher run stone meeting the material and gradation requirements of New York State Department of Transportation (NYSDOT), Standard Specifications, Item 304.12 – Type 2 Subbase Course. Subbase Stone for pavement construction should consist of Item 304.12 – Type 2 or Item 304.14 – Type 4 Subbase Course.

B. Structural Fill

Structural Fill should consist of an imported well graded crusher run stone or bank-run sand and gravel, which is free of clay, expansive shale, organics and friable or deleterious particles. Imported Structural Fill should also conform to the following gradation requirements:

Sieve Size	Percent Finer by Weight
3 inch	100
¼ inch	25-65
No. 40	5-40
No. 200	0-10

C. Drainage Stone

Drainage Stone should consist of a blend of crusher run stone or crushed gravel meeting the material and gradation requirements of ASTM C33 size 57 Coarse Aggregate as follows:

Sieve Size	Percent Finer by Weight
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
No. 40	0-10
No. 8	0-5

Drainage Stone should be wrapped in a non-woven geotextile fabric, such as Mirafi 140 N, or equivalent.

D. General Fill

General Fill may be used for backfill in non-loaded areas outside of foundation, structure, slab-on-grade and paved areas. General Fill may consist of on-site or imported soils, which are free of topsoil, organics, pyritic materials, debris and deleterious materials and are of a moisture content suitable for proper compaction.

II. Fill Placement and Compaction Recommendations

All controlled fill placed beneath foundations, structures, utilities, slab-on-grade and pavement areas should be compacted to a minimum of 95 percent of the maximum dry density as measured by the modified Proctor test (ASTM D1557), or as directed by the geotechnical engineer. Fill placed in non-loaded grass areas can be compacted to a minimum of 90 percent of the maximum dry density (ASTM D1557). Drainage Stone should be compacted with several passes of a steel drum roller or plate tamper (compaction testing is not required for Drainage Stone).

Placement of Structural Fill and Subbase Stone should not exceed a maximum loose lift thickness of 9 inches and should be reduced in conjunction with the compaction equipment used so that the required density is attained. Drainage Stone can be placed in maximum 24 inch thick loose lifts.

Fill should have a moisture content within 2 percent of the optimum moisture content prior to compaction. Subgrades should be properly drained and protected from moisture and frost. Placement of fill on frozen subgrades is not acceptable. It is recommended that all fill placement and compaction be monitored and tested by qualified geotechnical personnel.

III. Quality Assurance Testing

The following minimum laboratory and field quality assurance testing frequencies are recommended to confirm fill material quality and post placement and compaction conditions. These minimum frequencies are based on generally uniform material properties and placement conditions. Should material properties vary or conditions at the time of placement vary (i.e. moisture content, placement and compaction, procedures or equipment, etc.), then additional testing is recommended. Additional testing, if required, should be determined by qualified geotechnical personnel based on evaluation of the actual fill material and construction conditions.

A. Laboratory Testing of Material Properties

- Moisture content (ASTM D-2216) - 1 test per 4000 cubic yards or no less than 2 tests per each material type.
- Grain Size Analysis (ASTM D-422) - 1 test per 4000 cubic yards or no less than 2 tests per each material type.
- Modified Proctor Moisture Density Relationship (ASTM D-1557) 1 test per 4000 cubic yards or no less than 1 test per each material type.

B. Field In-Place Moisture/Density Testing (ASTM D-6938)

- Backfilling along trenches and foundation walls - 1 test per 50 lineal feet per lift.
- Backfilling Isolated Excavations (i.e. column foundations) 1 test per lift.
- Filling in open areas for slab-on-grade and pavement construction - 1 test per 2500 square feet per lift.

APPENDIX C

INFORMATION REGARDING THIS GEOTECHNICAL ENGINEERING REPORT

IMPORTANT INFORMATION REGARDING THIS GEOTECHNICAL ENGINEERING REPORT

Quality Geo Engineering, P.C. (Quality Geo), has endeavored to prepare this report in accordance with generally accepted geotechnical engineering principles and practices on behalf of QC/QA Laboratories, Inc. (QCQA Labs). Geotechnical engineering analyses and evaluations are based partly on judgment and opinion, and are therefore far less exact than other engineering disciplines. Accordingly, Quality Geo believes that providing the report user with information regarding the preparation and limitations of this report will aid in the proper interpretation and implementation of the conclusions and recommendations presented in this report. The following information is provided in an effort to reduce potential geotechnical-related delays, cost over-runs and other problems that can develop during the design and construction process.

SCOPE OF SERVICES: The scope of this report is limited to the specific items identified in QCQA Labs' Proposal for services for this project. The scope of services is limited to a geotechnical engineering evaluation of the conditions disclosed by the subsurface exploration and does not include any geoenvironmental assessment or investigation for the presence, absence or prevention of any hazardous or toxic materials or conditions (or mold) in the soil, groundwater or surface water within or beyond the project site. Unanticipated environmental problems can lead to significant project cost over-runs and QCQA Labs recommends that the Owner retain a geoenvironmental consultant to discuss risk management guidance.

PROJECT-SPECIFIC FACTORS: The conclusions and recommendations presented in this report were prepared based on project-specific factors described in the report, such as the size, loading, type of construction and intended use of the structure; the location of the structure on the site; planned structure elevation(s) and site grading; other planned or existing site improvements, such as access roads, parking lots, underground utilities; and any other pertinent project information. Changes to the project details may alter the factors considered in development of the report conclusions and recommendations. As such, neither Quality Geo nor QCQA Labs shall be responsible nor liable for problems that may develop if we are not consulted regarding any changes to the project-specific factors that were assumed during preparation of the report.

SUBSURFACE CONDITIONS: The subsurface exploration program for this project consisted of sampling only at discrete test locations. Quality Geo has used judgment to infer the subsurface conditions between the discrete test locations. The conclusions and recommendations presented in this report were based on the subsurface conditions disclosed/inferred at and between the discrete test locations at the time the subsurface exploration program was performed. We point out that surface and subsurface conditions at the site are subject to change subsequent to preparation of this report. Such changes may include floods, earthquakes, groundwater fluctuations, and construction activities at the site and/or adjoining properties. It should be understood that the actual subsurface conditions could vary from the conditions inferred by Quality Geo between and away from the discrete test locations, which could be revealed during construction. As such, QCQA Labs should be retained during construction to confirm that the subsurface conditions are consistent with the conditions disclosed by the subsurface exploration program, and to refine our conclusions and recommendations in the event that the subsurface conditions differ from those disclosed by the subsurface exploration program.

USE OF THIS GEOTECHNICAL ENGINEERING REPORT: This report has been prepared for the exclusive use of our client, and any other parties specifically identified in the report, for specific application to the site and project-specific conditions described in the report. This report should not be applied to any other site or project, or for any uses other than those originally intended without our consent.

MISINTERPRETATION OF THIS REPORT: The conclusions and recommendations presented in this report are subject to misinterpretation by the design team and contractors, which can result in costly problems. The risk of misinterpretation by the design team can be reduced by having appropriate members of the design team confer with QCQA Labs regarding the conclusions and recommendations presented in this report prior to completing the plans and specifications. In addition, QCQA Labs should be retained to review pertinent elements of the design team's final plans and specifications prior to bidding to confirm that the recommendations presented in this report have been properly interpreted and applied. The risk of misinterpretation by contractors can be reduced by retaining QCQA Labs to attend prebid and preconstruction conferences, and to provide construction observation.

COMPONENTS OF THIS REPORT: Subsurface exploration logs, figures, tables and any other report components are subject to misinterpretation if they are separated from this report. This may occur if copies of the boring logs or other report components are given to the contractors during the bid preparation process. To minimize this risk, report components should not be separated from the report and only complete copies of this report should be distributed as appropriate.

ALTERATION OF THIS REPORT: It is a violation of Section 7209 Subdivision 2 of the New York State Education Law for any person to alter this report in any way, except under the direction of a licensed professional engineer. Neither QCQA Labs nor Quality Geo shall be liable for any alterations that are made to this report without our knowledge and written consent.

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Orange County, New York														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
Ab—Alden silt loam														
Alden	80	C/D	0-9	Silt loam	ML, OL	A-5, A-7	0- 0- 0	0- 0- 0	85-95-100	75-92-100	60-85-100	35-70-85	40-45-50	5-10-15
			9-36	Silt loam, silty clay loam, very fine sandy loam	CL, CL-ML	A-4, A-6	0- 0- 1	0- 0- 3	85-90-100	75-85-100	60-75-95	35-60-90	20-28-35	5-10-15
			36-60	Gravelly fine sandy loam, loam, silty clay loam	CL, CL-ML, GC, SC	A-2, A-4, A-6	0- 0- 3	0- 2- 5	65-80-95	50-70-92	35-55-90	20-35-85	20-28-35	5-10-15
AC—Alden extremely stony soils														
Alden, extremely stony	75	C/D	0-9	Silt loam	ML, OL	A-5, A-7	1- 5- 8	0- 0- 5	85-95-100	75-92-100	60-85-100	35-70-85	40-45-50	5-10-15
			9-36	Silt loam, silty clay loam, very fine sandy loam	CL, CL-ML	A-4, A-6	0- 0- 1	0- 0- 3	85-90-100	75-85-100	60-75-95	35-60-90	20-28-35	5-10-15
			36-60	Gravelly fine sandy loam, loam, silty clay loam	CL, CL-ML, GC, SC	A-2, A-4, A-6	0- 0- 3	0- 2- 5	65-80-95	50-70-92	35-55-90	20-35-85	20-28-35	5-10-15

Engineering Properties–Orange County, New York														
Map unit symbol and soil name	**Pct. of map unit**	**Hydrologic group**	**Depth**	**USDA texture**	**Classification**		**Pct Fragments**		**Percentage passing sieve number—**				**Liquid limit**	**Plasticity index**
					Unified	**AASHTO**	**>10 inches**	**3-10 inches**	**4**	**10**	**40**	**200**		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
FAC—Farmington silt loam, sloping														
Farmington	75	D	0-8	Silt loam	CL, ML, SC, SM	A-2, A-4, A-6	0- 0- 0	0- 0- 5	85-95-95	75-92-92	50-85-90	30-75-80	20-28-35	3-9 -15
			8-19	Silt loam, loam, gravelly fine sandy loam	CL, GC, GM, ML	A-1, A-2, A-4, A-6	0- 0- 0	0- 2- 5	65-90-95	55-85-92	35-75-90	20-60-80	20-28-35	3-9 -15
			19-23	Unweathered bedrock	—	—	0- 0- 0	0- 0- 0	—	—	—	—	—	—

Engineering Properties–Orange County, New York														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
MdB—Mardin gravelly silt loam, 3 to 8 percent slopes														
Mardin	85	D	0-8	Silt loam, gravelly silt loam, channery silt loam, channery loam	GC-GM, ML, MH	A-4, A-7-5, A-2-4	0- 0- 3	0- 4- 19	43-70-90	41-68-90	33-62-89	28-54-82	27-35-56	6-9 -16
			8-15	Flaggy silt loam, channery loam, silt loam, loam, channery silt loam, gravelly silt loam, gravelly loam	GC-GM, CL	A-4, A-6, A-2-4	0- 0- 3	0- 4- 18	44-71-91	41-69-90	34-61-88	28-54-81	22-27-38	6-9 -15
			15-20	Channery loam, silt loam, loam, channery silt loam, gravelly silt loam, gravelly loam	CL-ML, GM, CL	A-6, A-4, A-2-4	0- 0- 3	0- 4- 18	46-72-91	43-71-91	34-63-88	26-51-77	17-23-32	2-7 -12
			20-72	Very flaggy silt loam, very flaggy loam, very channery loam, very channery silt loam, channery loam, channery silt loam, gravelly loam, gravelly silt loam	GM, CL	A-6, A-1-b	0- 3- 17	3- 6- 40	33-74-82	30-73-81	23-63-80	18-55-73	16-28-35	2-12-17

Engineering Properties–Orange County, New York														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
RMD—Rock outcrop-Farmington complex, hilly														
Rock outcrop	60		0-60	Unweathered bedrock	—	—	0- 0- 0	0- 0- 0	—	—	—	—	—	—
Farmington	30	D	0-6	Silt loam	CL, ML, SC, SM	A-2, A-4, A-6	0- 0- 0	0- 0- 5	85-95-95	75-92-92	50-85-90	30-75-80	20-28-35	3-9 -15
			6-14	Silt loam, loam, gravelly fine sandy loam	CL, GC, GM, ML	A-1, A-2, A-4, A-6	0- 0- 0	0- 2- 5	65-90-95	55-85-92	35-75-90	20-60-80	20-28-35	3-9 -15
			14-23	Unweathered bedrock	—	—	0- 0- 0	0- 0- 0	—	—	—	—	—	—

Data Source Information

Soil Survey Area: Orange County, New York
Survey Area Data: Version 21, Jun 11, 2020

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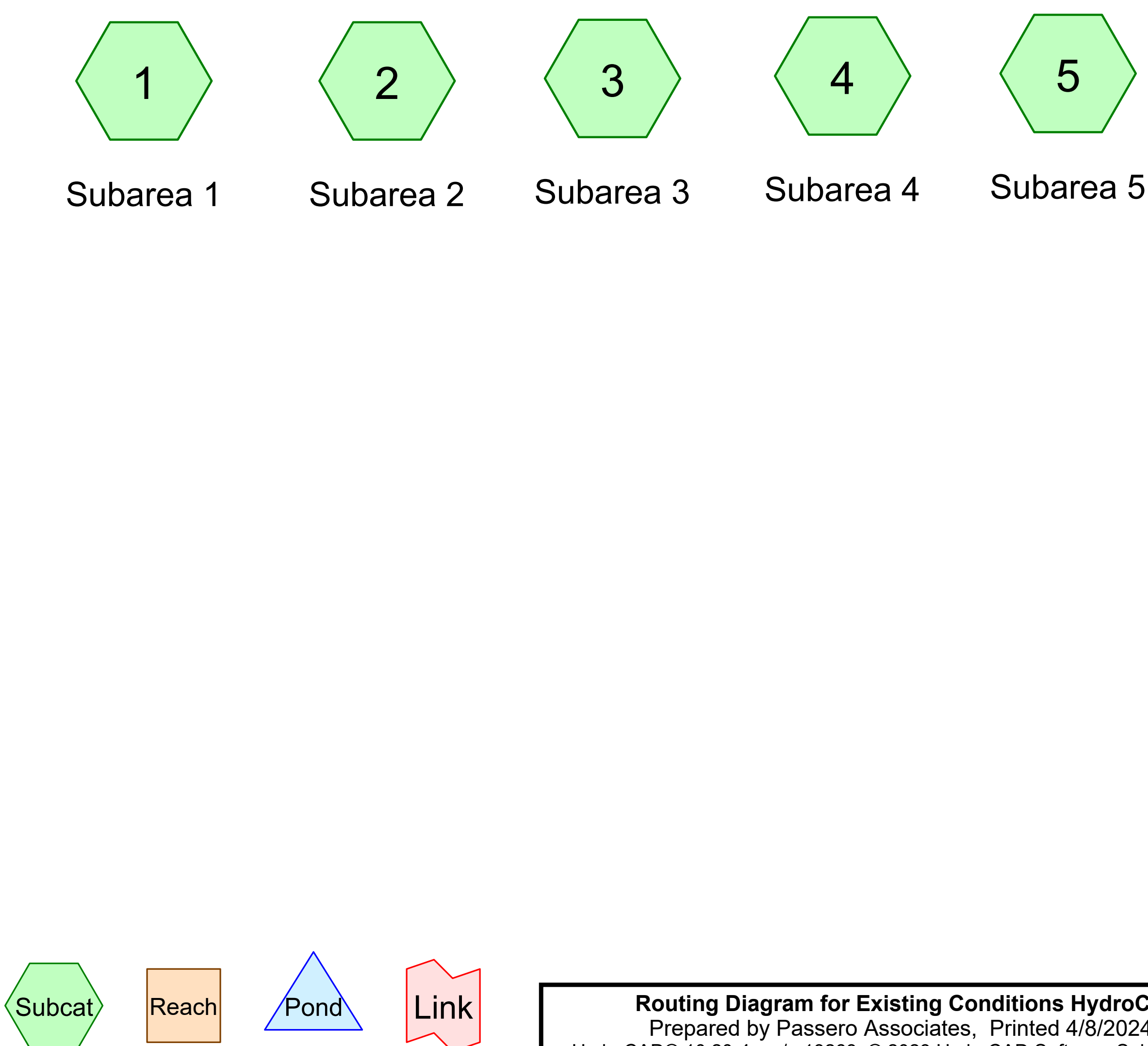
APPENDIX H: EXISTING CONDITIONS HYDROCAD ANALYSIS



Routing Diagram for Existing Conditions HydroCAD
Prepared by Passero Associates, Printed 4/8/2024
HydroCAD® 10.20-4a s/n 13263 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year Event	Type III 24-hr		Default	24.00	1	2.60	2
2	10-Year Event	Type III 24-hr		Default	24.00	1	4.69	2
3	100-Year Event	Type III 24-hr		Default	24.00	1	8.32	2
4	WQv Event	Type III 24-hr		Default	24.00	1	1.35	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.086	80	>75% Grass cover, Good, HSG D (1, 2, 4, 5)
0.404	98	Paved parking, HSG C (1)
0.131	98	Paved parking, HSG D (2, 4, 5)
7.751	77	Woods, Good, HSG D (1, 2, 3, 4, 5)
10.372	**79**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	2.086	0.000	2.086	>75% Grass cover, Good	1, 2, 4, 5
0.000	0.000	0.404	0.131	0.000	0.535	Paved parking	1, 2, 4, 5
0.000	0.000	0.000	7.751	0.000	7.751	Woods, Good	1, 2, 3, 4, 5
0.000	**0.000**	**0.404**	**9.968**	**0.000**	**10.372**	**TOTAL AREA**	

Time span=2.00-40.00 hrs, dt=0.02 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Sim-Route method - Pond routing by Sim-Route method

Subcatchment1: Subarea 1 Runoff Area=7.212 ac 5.60% Impervious Runoff Depth=0.91"
Flow Length=414' Tc=26.5 min CN=79 Runoff=4.37 cfs 0.544 af

Subcatchment2: Subarea 2 Runoff Area=0.766 ac 3.66% Impervious Runoff Depth=0.85"
Flow Length=162' Tc=13.3 min CN=78 Runoff=0.57 cfs 0.054 af

Subcatchment3: Subarea 3 Runoff Area=0.563 ac 0.00% Impervious Runoff Depth=0.80"
Flow Length=61' Slope=0.0300 '/' Tc=12.4 min CN=77 Runoff=0.40 cfs 0.038 af

Subcatchment4: Subarea 4 Runoff Area=0.732 ac 9.56% Impervious Runoff Depth=0.96"
Flow Length=118' Tc=18.7 min CN=80 Runoff=0.55 cfs 0.058 af

Subcatchment5: Subarea 5 Runoff Area=1.099 ac 3.00% Impervious Runoff Depth=0.85"
Flow Length=342' Tc=11.7 min CN=78 Runoff=0.86 cfs 0.078 af

Total Runoff Area = 10.372 ac Runoff Volume = 0.773 af Average Runoff Depth = 0.89"
94.84% Pervious = 9.837 ac 5.16% Impervious = 0.535 ac

Summary for Subcatchment 1: Subarea 1

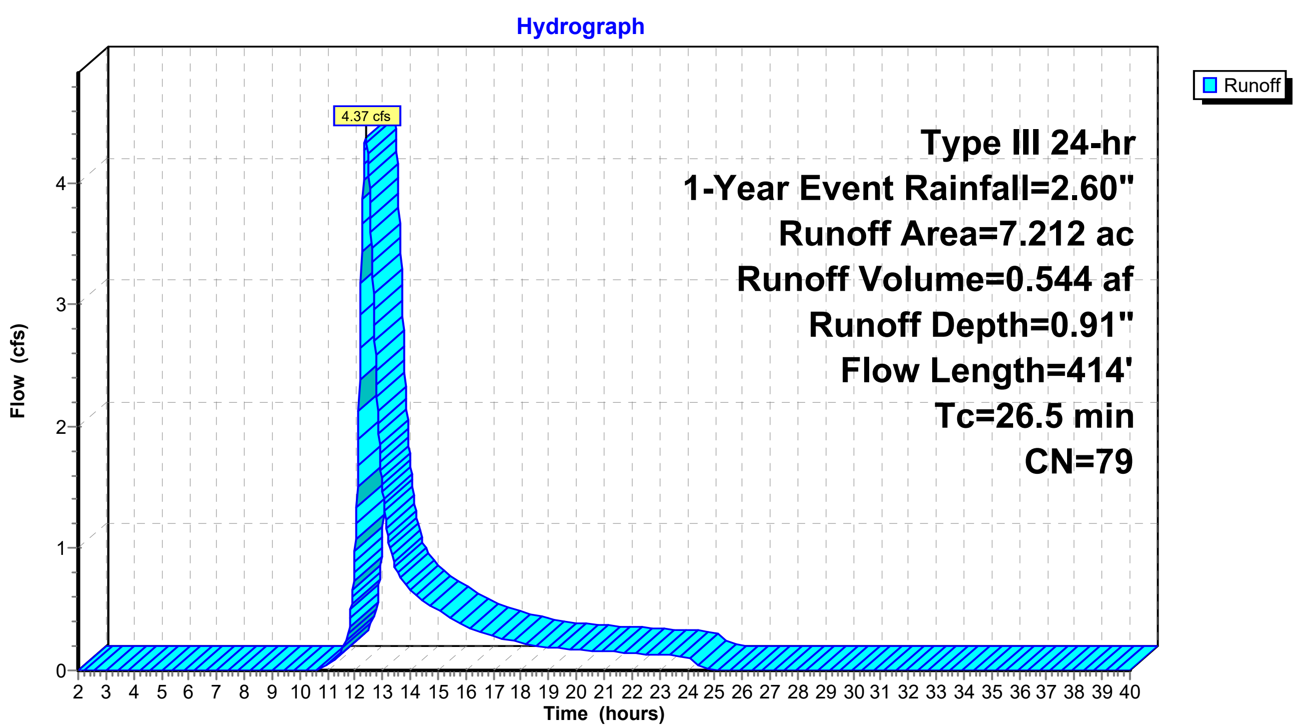
Runoff = 4.37 cfs @ 12.40 hrs, Volume= 0.544 af, Depth= 0.91"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
1.724	80	>75% Grass cover, Good, HSG D
0.404	98	Paved parking, HSG C
5.084	77	Woods, Good, HSG D
7.212	79	Weighted Average
6.808		94.40% Pervious Area
0.404		5.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.6	100	0.0180	0.07		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
3.9	314	0.0730	1.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
26.5	414	Total			

Subcatchment 1: Subarea 1



Summary for Subcatchment 2: Subarea 2

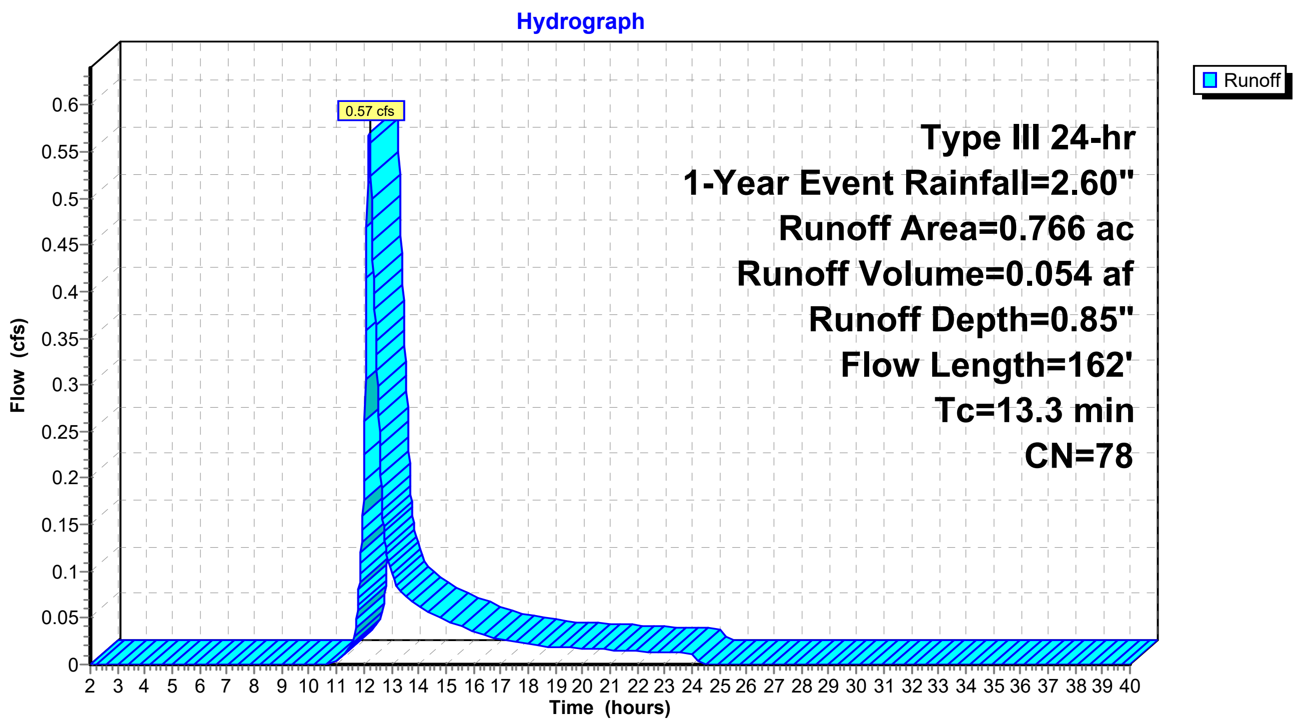
Runoff = 0.57 cfs @ 12.20 hrs, Volume= 0.054 af, Depth= 0.85"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.106	80	>75% Grass cover, Good, HSG D
0.632	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
0.766	78	Weighted Average
0.738		96.34% Pervious Area
0.028		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0950	0.14		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
1.7	62	0.0150	0.61		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
13.3	162	Total			

Subcatchment 2: Subarea 2



Summary for Subcatchment 3: Subarea 3

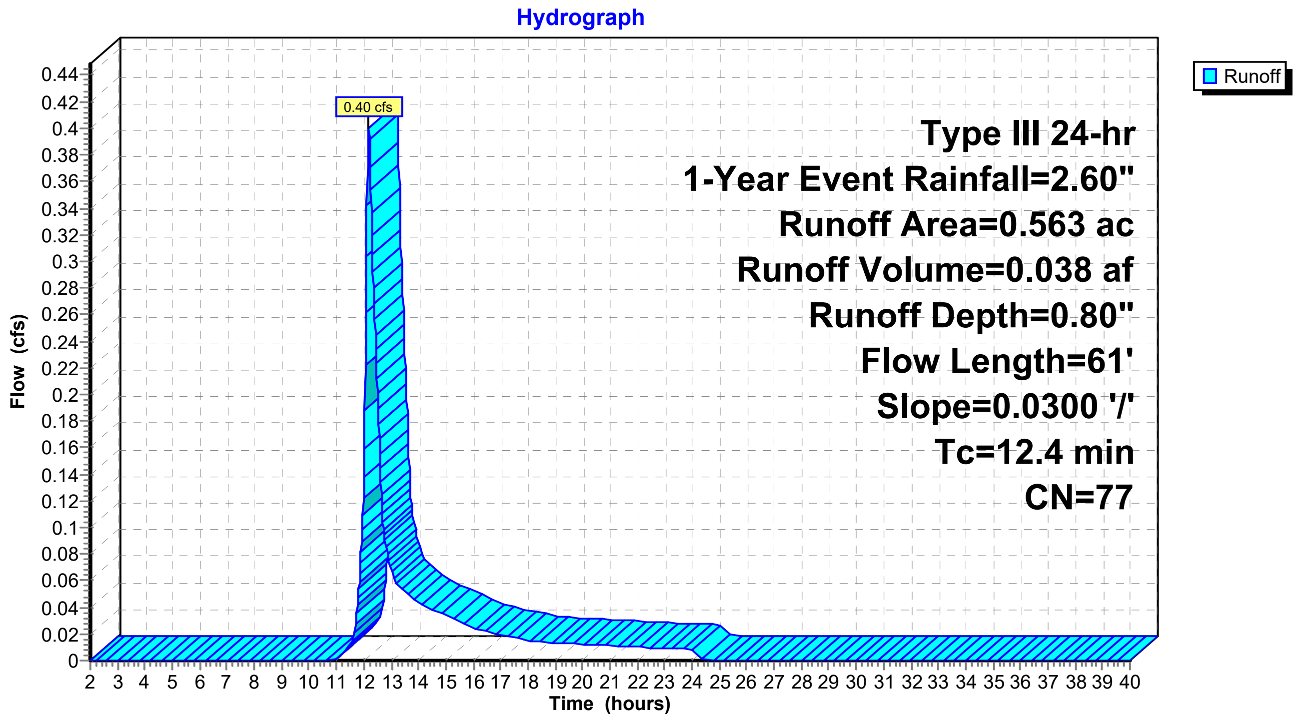
Runoff = 0.40 cfs @ 12.19 hrs, Volume= 0.038 af, Depth= 0.80"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.563	77	Woods, Good, HSG D
0.563		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	61	0.0300	0.08		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"

Subcatchment 3: Subarea 3



Summary for Subcatchment 4: Subarea 4

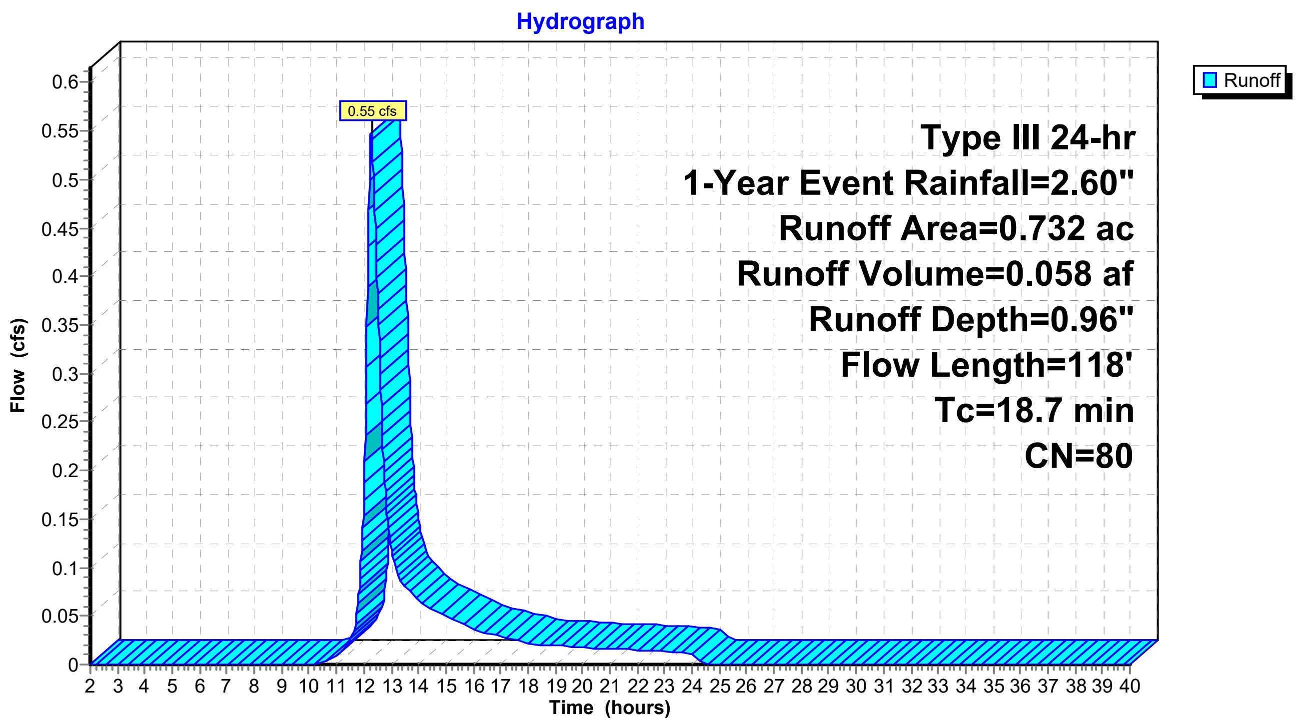
Runoff = 0.55 cfs @ 12.27 hrs, Volume= 0.058 af, Depth= 0.96"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.200	80	>75% Grass cover, Good, HSG D
0.462	77	Woods, Good, HSG D
0.070	98	Paved parking, HSG D
0.732	80	Weighted Average
0.662		90.44% Pervious Area
0.070		9.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	100	0.0300	0.09		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	18	0.0450	1.06		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
18.7	118	Total			

Subcatchment 4: Subarea 4



Summary for Subcatchment 5: Subarea 5

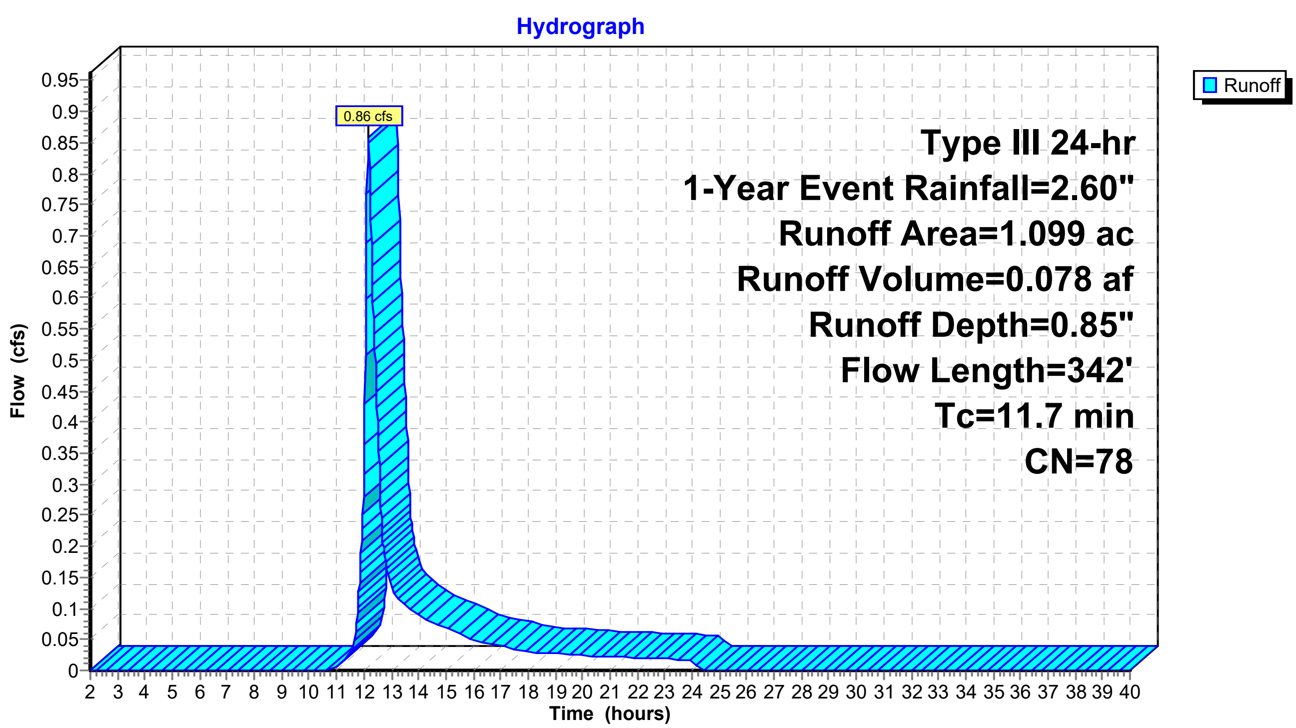
Runoff = 0.86 cfs @ 12.17 hrs, Volume= 0.078 af, Depth= 0.85"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.056	80	>75% Grass cover, Good, HSG D
1.010	77	Woods, Good, HSG D
0.033	98	Paved parking, HSG D
1.099	78	Weighted Average
1.066		97.00% Pervious Area
0.033		3.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.1900	0.19		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
2.9	242	0.0780	1.40		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
11.7	342	Total			

Subcatchment 5: Subarea 5



Time span=2.00-40.00 hrs, dt=0.02 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Sim-Route method - Pond routing by Sim-Route method

Subcatchment1: Subarea 1 Runoff Area=7.212 ac 5.60% Impervious Runoff Depth=2.54"
Flow Length=414' Tc=26.5 min CN=79 Runoff=12.80 cfs 1.525 af

Subcatchment2: Subarea 2 Runoff Area=0.766 ac 3.66% Impervious Runoff Depth=2.45"
Flow Length=162' Tc=13.3 min CN=78 Runoff=1.74 cfs 0.156 af

Subcatchment3: Subarea 3 Runoff Area=0.563 ac 0.00% Impervious Runoff Depth=2.37"
Flow Length=61' Slope=0.0300 '/' Tc=12.4 min CN=77 Runoff=1.26 cfs 0.111 af

Subcatchment4: Subarea 4 Runoff Area=0.732 ac 9.56% Impervious Runoff Depth=2.62"
Flow Length=118' Tc=18.7 min CN=80 Runoff=1.56 cfs 0.160 af

Subcatchment5: Subarea 5 Runoff Area=1.099 ac 3.00% Impervious Runoff Depth=2.45"
Flow Length=342' Tc=11.7 min CN=78 Runoff=2.61 cfs 0.224 af

Total Runoff Area = 10.372 ac Runoff Volume = 2.177 af Average Runoff Depth = 2.52"
94.84% Pervious = 9.837 ac 5.16% Impervious = 0.535 ac

Summary for Subcatchment 1: Subarea 1

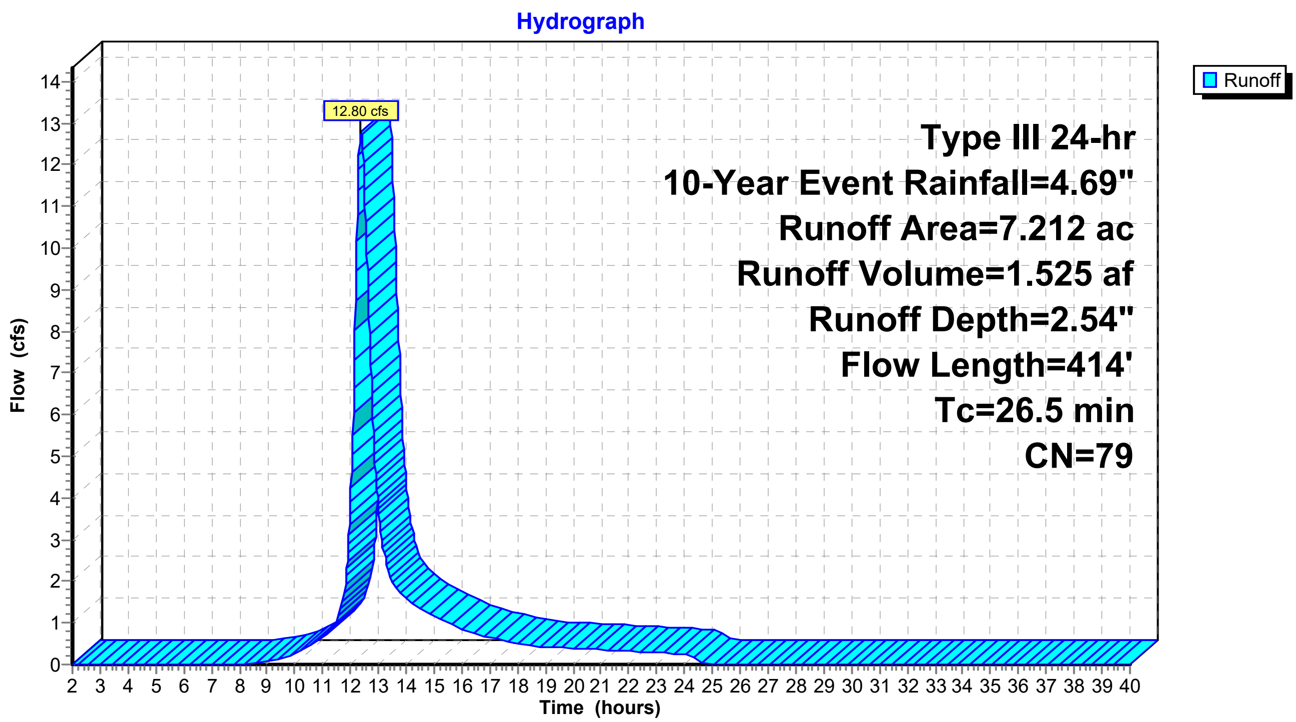
Runoff = 12.80 cfs @ 12.37 hrs, Volume= 1.525 af, Depth= 2.54"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
1.724	80	>75% Grass cover, Good, HSG D
0.404	98	Paved parking, HSG C
5.084	77	Woods, Good, HSG D
7.212	79	Weighted Average
6.808		94.40% Pervious Area
0.404		5.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.6	100	0.0180	0.07		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
3.9	314	0.0730	1.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
26.5	414	Total			

Subcatchment 1: Subarea 1



Summary for Subcatchment 2: Subarea 2

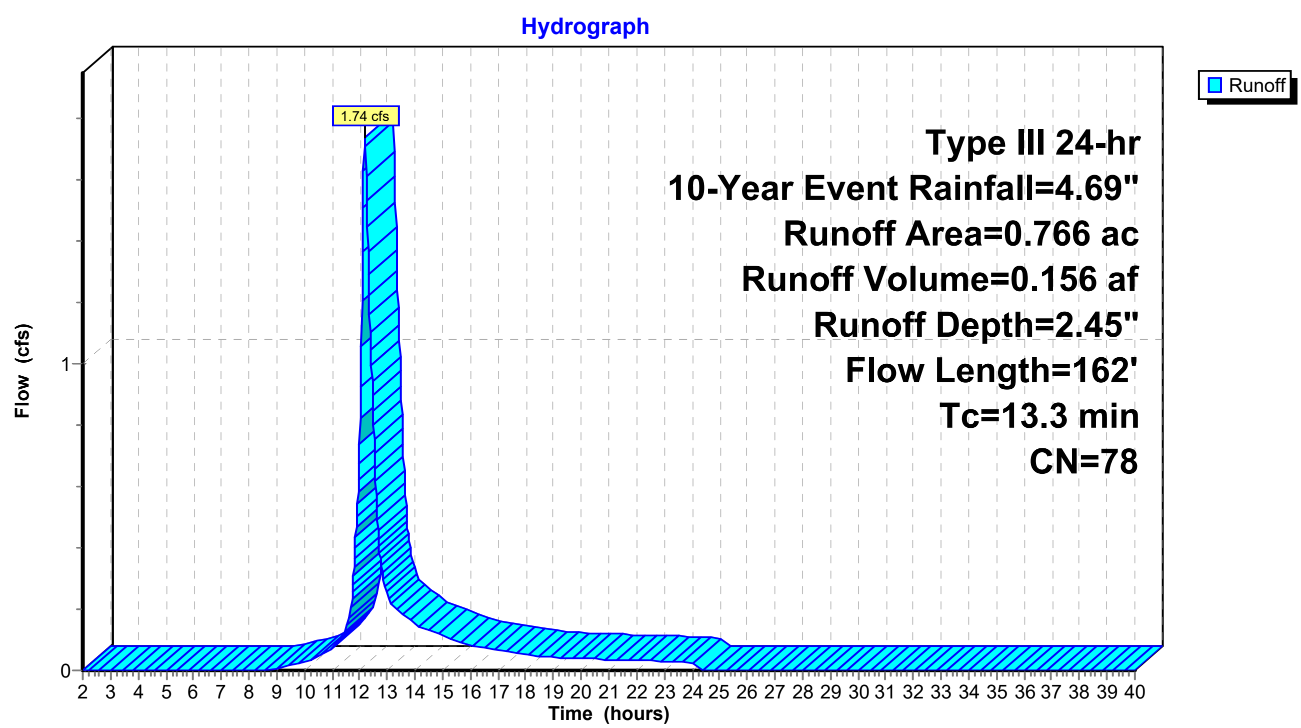
Runoff = 1.74 cfs @ 12.19 hrs, Volume= 0.156 af, Depth= 2.45"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.106	80	>75% Grass cover, Good, HSG D
0.632	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
0.766	78	Weighted Average
0.738		96.34% Pervious Area
0.028		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0950	0.14		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
1.7	62	0.0150	0.61		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
13.3	162	Total			

Subcatchment 2: Subarea 2



Summary for Subcatchment 3: Subarea 3

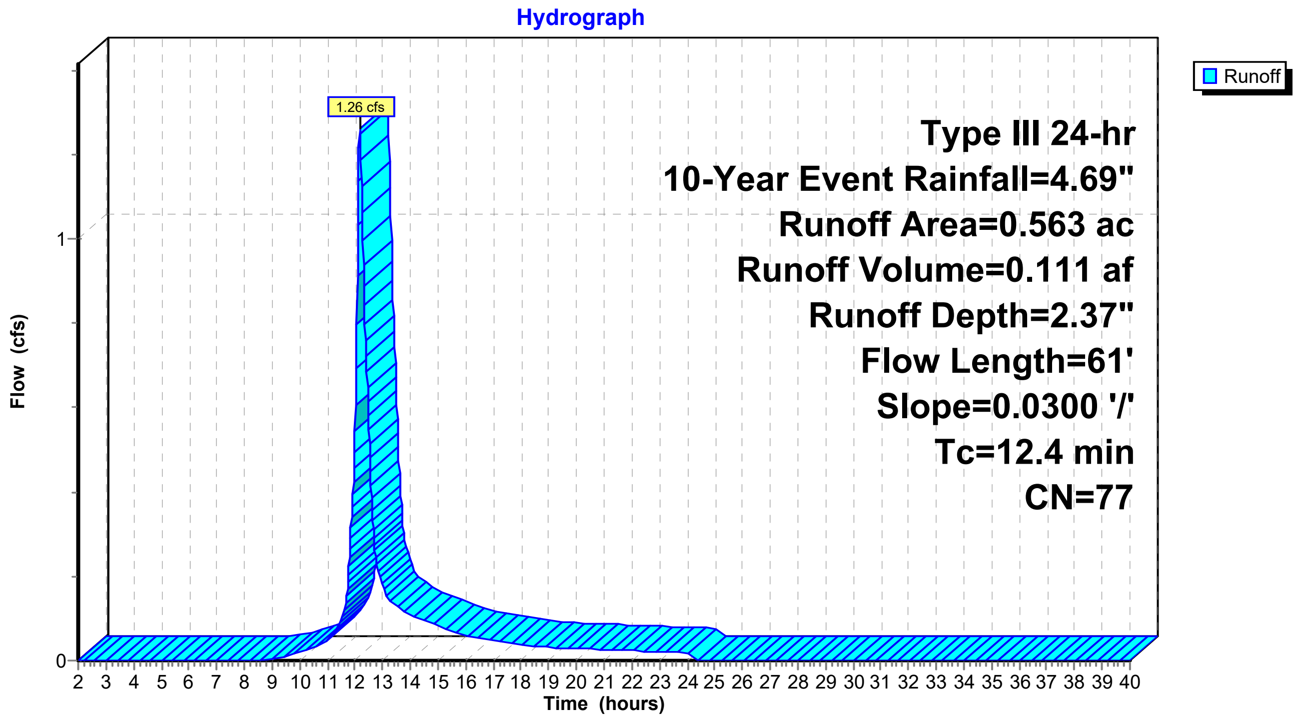
Runoff = 1.26 cfs @ 12.17 hrs, Volume= 0.111 af, Depth= 2.37"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.563	77	Woods, Good, HSG D
0.563		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	61	0.0300	0.08		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"

Subcatchment 3: Subarea 3



Summary for Subcatchment 4: Subarea 4

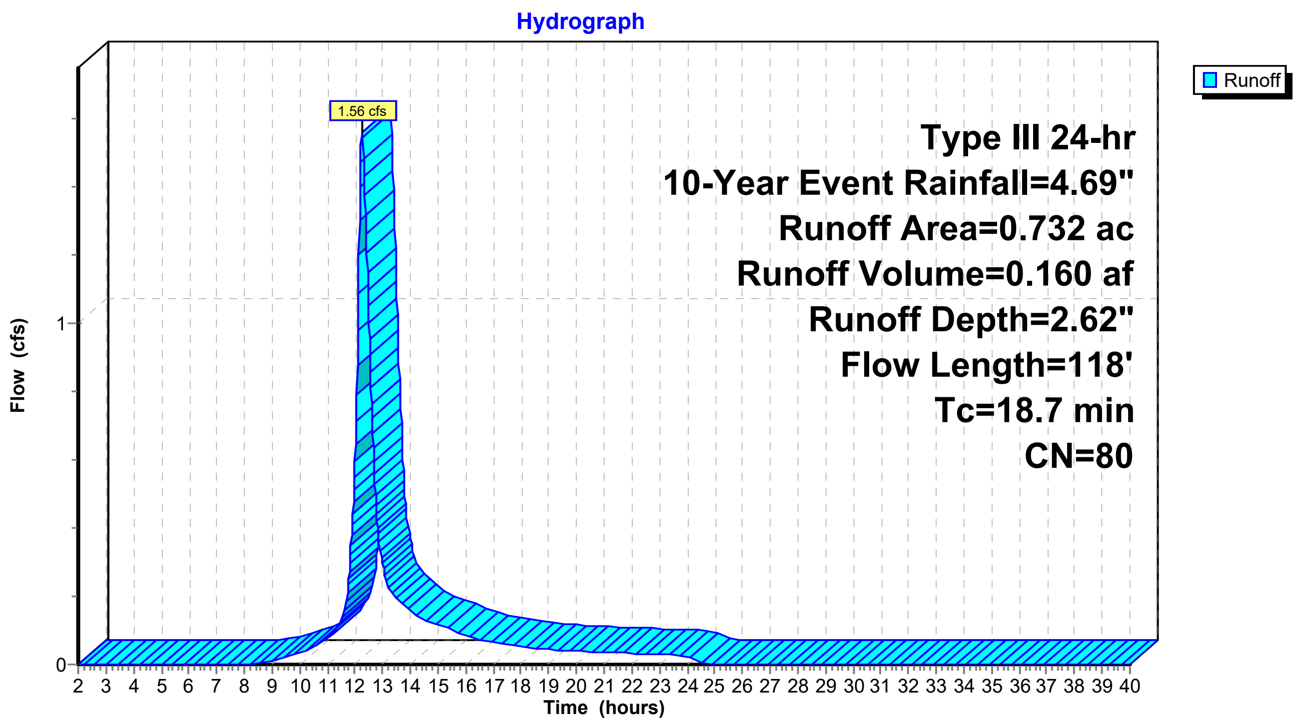
Runoff = 1.56 cfs @ 12.26 hrs, Volume= 0.160 af, Depth= 2.62"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.200	80	>75% Grass cover, Good, HSG D
0.462	77	Woods, Good, HSG D
0.070	98	Paved parking, HSG D
0.732	80	Weighted Average
0.662		90.44% Pervious Area
0.070		9.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	100	0.0300	0.09		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	18	0.0450	1.06		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
18.7	118	Total			

Subcatchment 4: Subarea 4



Summary for Subcatchment 5: Subarea 5

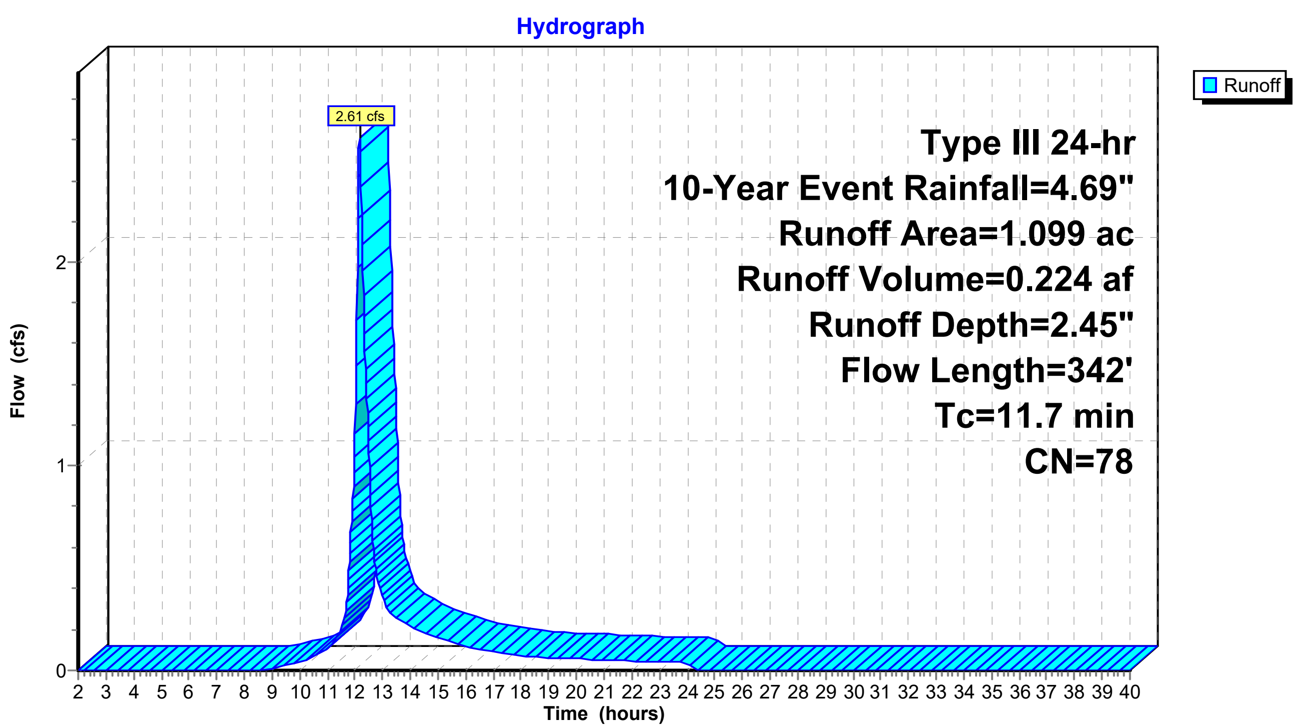
Runoff = 2.61 cfs @ 12.16 hrs, Volume= 0.224 af, Depth= 2.45"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.056	80	>75% Grass cover, Good, HSG D
1.010	77	Woods, Good, HSG D
0.033	98	Paved parking, HSG D
1.099	78	Weighted Average
1.066		97.00% Pervious Area
0.033		3.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.1900	0.19		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
2.9	242	0.0780	1.40		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
11.7	342	Total			

Subcatchment 5: Subarea 5



Time span=2.00-40.00 hrs, dt=0.02 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Sim-Route method - Pond routing by Sim-Route method

Subcatchment1: Subarea 1 Runoff Area=7.212 ac 5.60% Impervious Runoff Depth=5.81"
Flow Length=414' Tc=26.5 min CN=79 Runoff=29.01 cfs 3.490 af

Subcatchment2: Subarea 2 Runoff Area=0.766 ac 3.66% Impervious Runoff Depth=5.69"
Flow Length=162' Tc=13.3 min CN=78 Runoff=4.00 cfs 0.363 af

Subcatchment3: Subarea 3 Runoff Area=0.563 ac 0.00% Impervious Runoff Depth=5.57"
Flow Length=61' Slope=0.0300 '/' Tc=12.4 min CN=77 Runoff=2.96 cfs 0.261 af

Subcatchment4: Subarea 4 Runoff Area=0.732 ac 9.56% Impervious Runoff Depth=5.93"
Flow Length=118' Tc=18.7 min CN=80 Runoff=3.48 cfs 0.361 af

Subcatchment5: Subarea 5 Runoff Area=1.099 ac 3.00% Impervious Runoff Depth=5.69"
Flow Length=342' Tc=11.7 min CN=78 Runoff=6.01 cfs 0.521 af

Total Runoff Area = 10.372 ac Runoff Volume = 4.996 af Average Runoff Depth = 5.78"
94.84% Pervious = 9.837 ac 5.16% Impervious = 0.535 ac

Summary for Subcatchment 1: Subarea 1

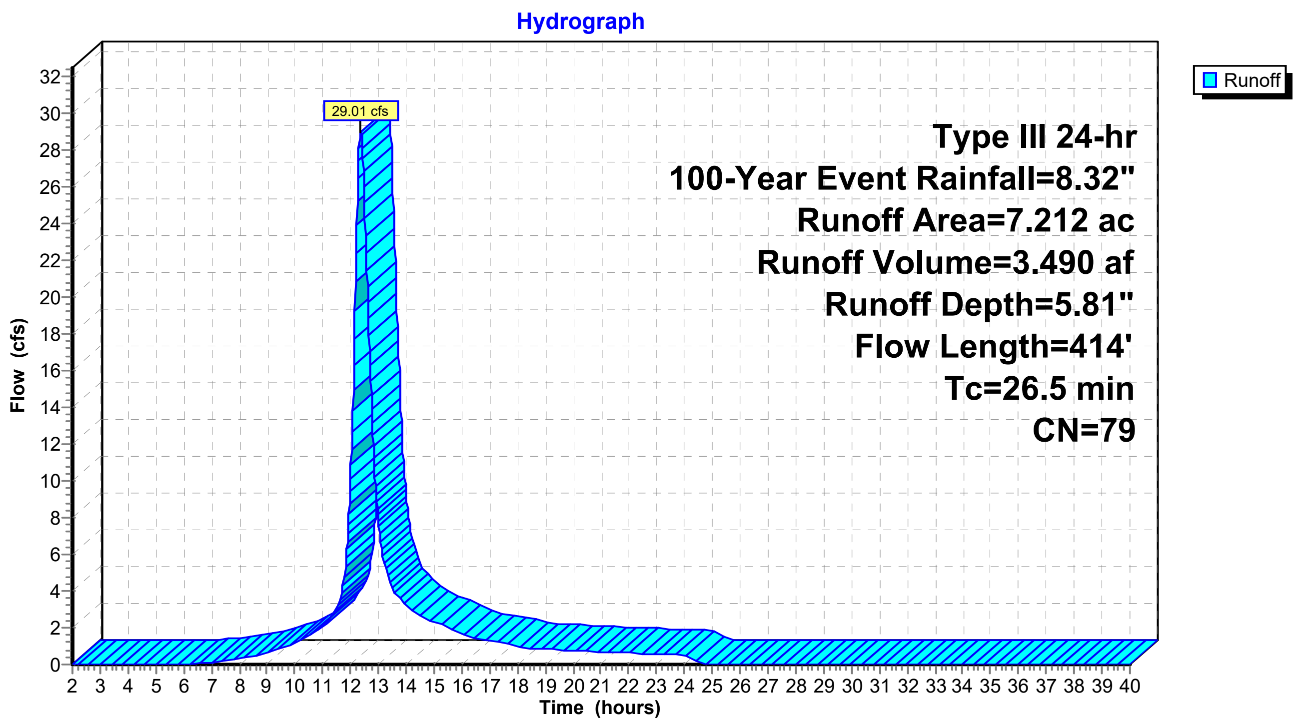
Runoff = 29.01 cfs @ 12.35 hrs, Volume= 3.490 af, Depth= 5.81"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
1.724	80	>75% Grass cover, Good, HSG D
0.404	98	Paved parking, HSG C
5.084	77	Woods, Good, HSG D
7.212	79	Weighted Average
6.808		94.40% Pervious Area
0.404		5.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.6	100	0.0180	0.07		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
3.9	314	0.0730	1.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
26.5	414	Total			

Subcatchment 1: Subarea 1



Summary for Subcatchment 2: Subarea 2

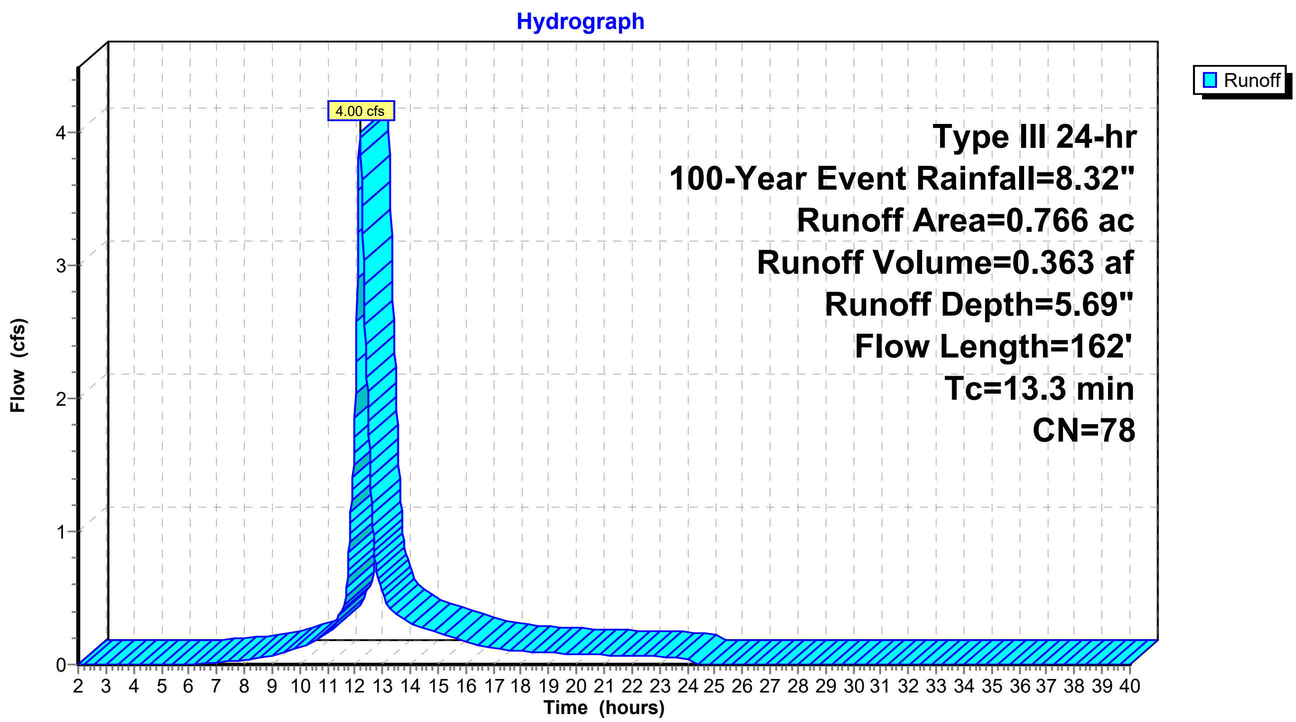
Runoff = 4.00 cfs @ 12.18 hrs, Volume= 0.363 af, Depth= 5.69"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.106	80	>75% Grass cover, Good, HSG D
0.632	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
0.766	78	Weighted Average
0.738		96.34% Pervious Area
0.028		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0950	0.14		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
1.7	62	0.0150	0.61		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
13.3	162	Total			

Subcatchment 2: Subarea 2



Summary for Subcatchment 3: Subarea 3

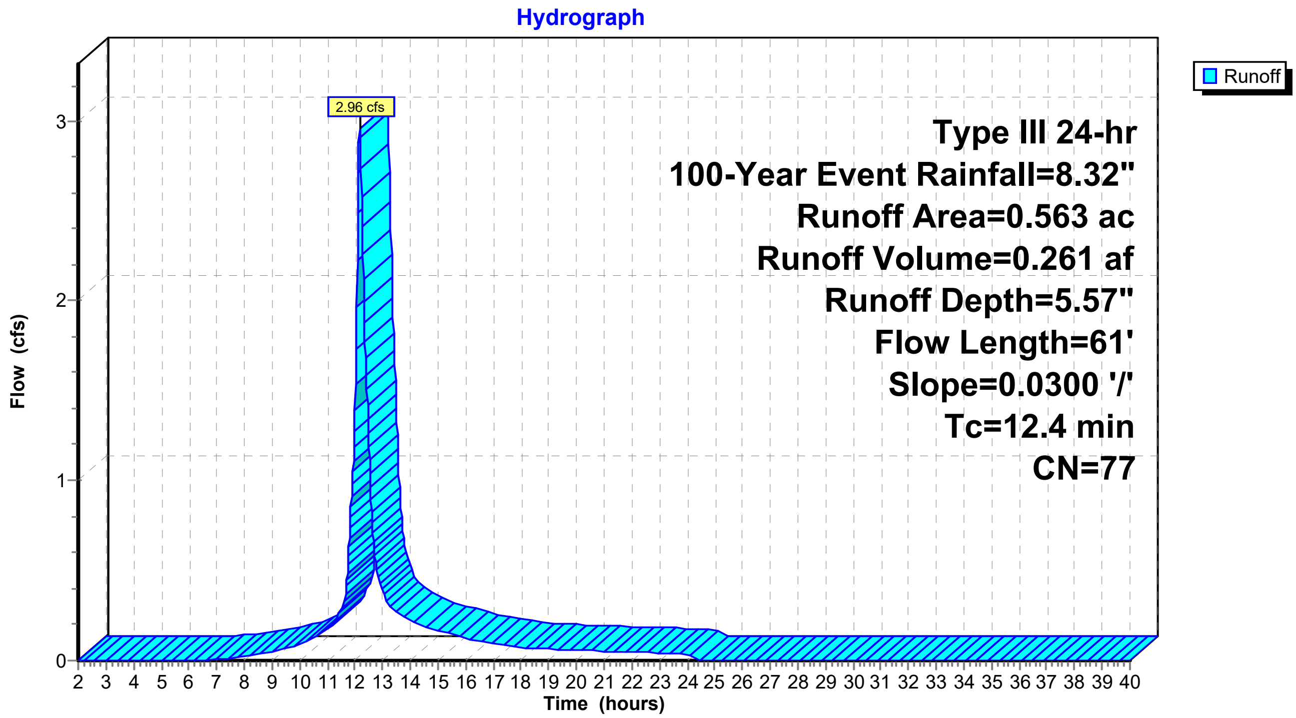
Runoff = 2.96 cfs @ 12.17 hrs, Volume= 0.261 af, Depth= 5.57"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.563	77	Woods, Good, HSG D
0.563		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	61	0.0300	0.08		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"

Subcatchment 3: Subarea 3



Summary for Subcatchment 4: Subarea 4

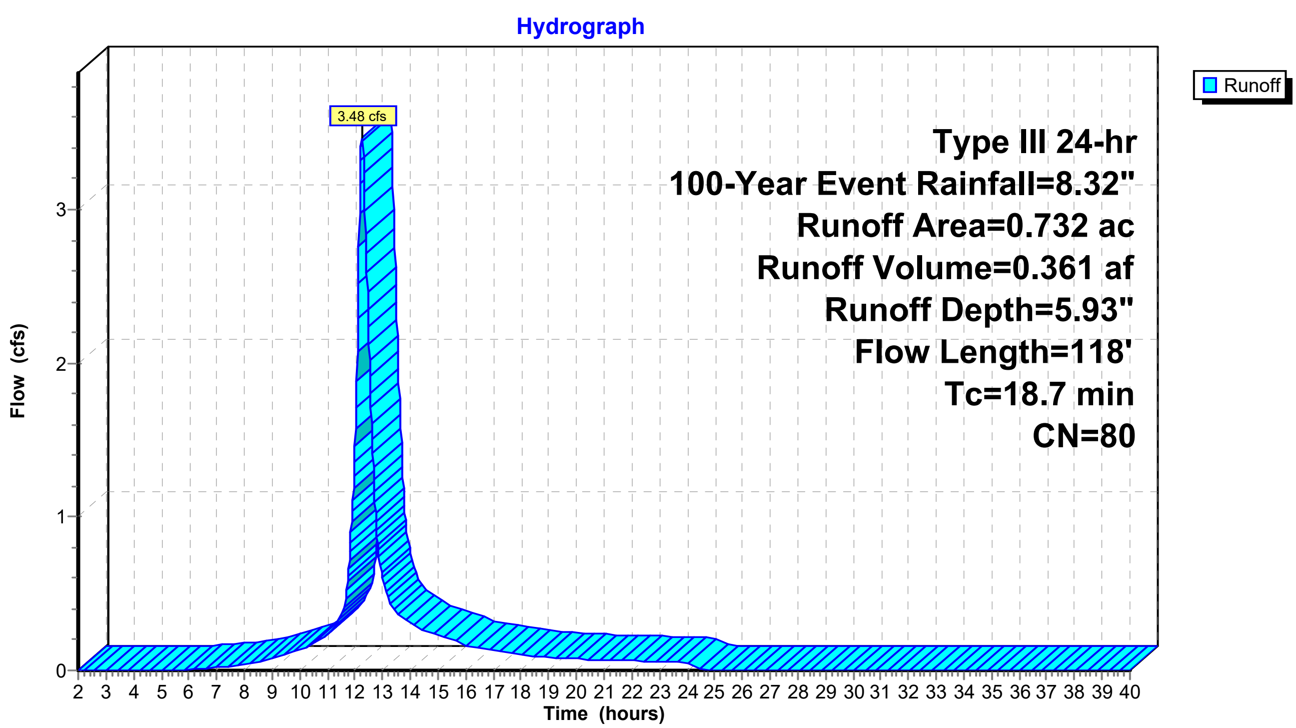
Runoff = 3.48 cfs @ 12.25 hrs, Volume= 0.361 af, Depth= 5.93"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.200	80	>75% Grass cover, Good, HSG D
0.462	77	Woods, Good, HSG D
0.070	98	Paved parking, HSG D
0.732	80	Weighted Average
0.662		90.44% Pervious Area
0.070		9.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	100	0.0300	0.09		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	18	0.0450	1.06		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
18.7	118	Total			

Subcatchment 4: Subarea 4



Summary for Subcatchment 5: Subarea 5

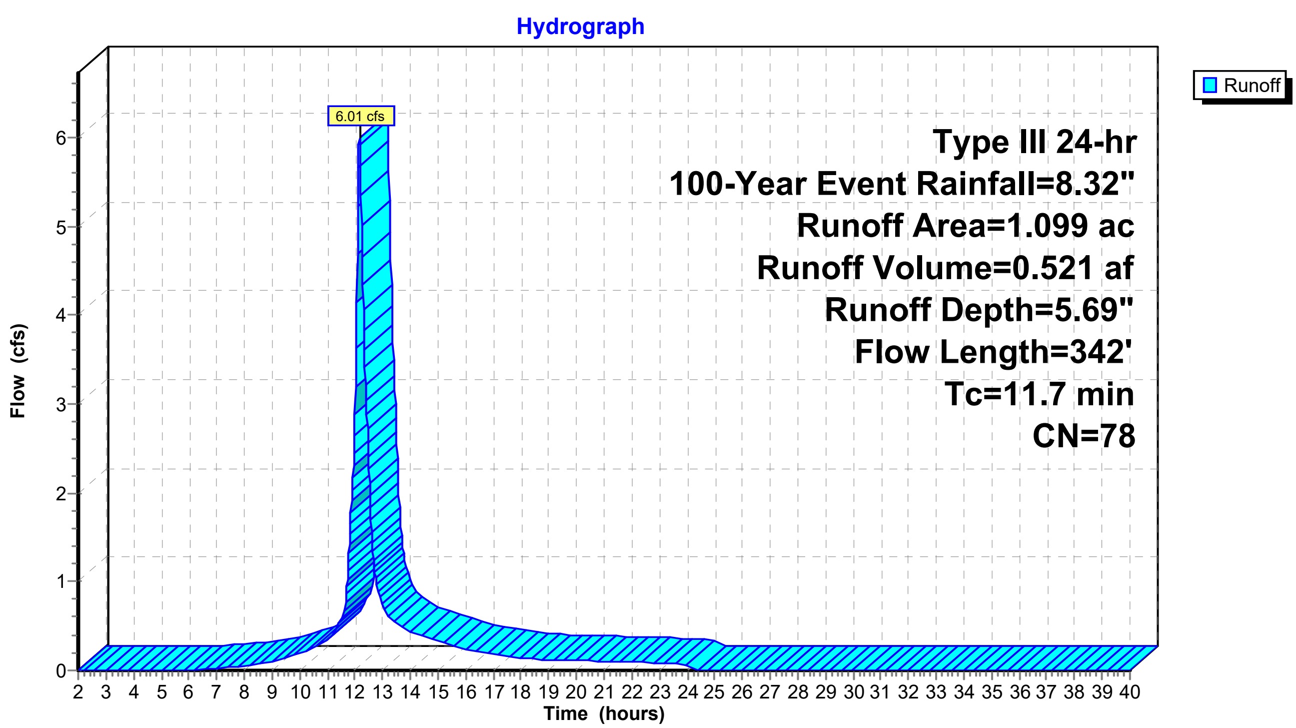
Runoff = 6.01 cfs @ 12.16 hrs, Volume= 0.521 af, Depth= 5.69"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.056	80	>75% Grass cover, Good, HSG D
1.010	77	Woods, Good, HSG D
0.033	98	Paved parking, HSG D
1.099	78	Weighted Average
1.066		97.00% Pervious Area
0.033		3.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.1900	0.19		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
2.9	242	0.0780	1.40		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
11.7	342	Total			

Subcatchment 5: Subarea 5



Time span=2.00-40.00 hrs, dt=0.02 hrs, 1901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Sim-Route method - Pond routing by Sim-Route method

Subcatchment1: Subarea 1 Runoff Area=7.212 ac 5.60% Impervious Runoff Depth=0.19"
Flow Length=414' Tc=26.5 min CN=79 Runoff=0.67 cfs 0.116 af

Subcatchment2: Subarea 2 Runoff Area=0.766 ac 3.66% Impervious Runoff Depth=0.17"
Flow Length=162' Tc=13.3 min CN=78 Runoff=0.07 cfs 0.011 af

Subcatchment3: Subarea 3 Runoff Area=0.563 ac 0.00% Impervious Runoff Depth=0.15"
Flow Length=61' Slope=0.0300 '/' Tc=12.4 min CN=77 Runoff=0.04 cfs 0.007 af

Subcatchment4: Subarea 4 Runoff Area=0.732 ac 9.56% Impervious Runoff Depth=0.22"
Flow Length=118' Tc=18.7 min CN=80 Runoff=0.09 cfs 0.013 af

Subcatchment5: Subarea 5 Runoff Area=1.099 ac 3.00% Impervious Runoff Depth=0.17"
Flow Length=342' Tc=11.7 min CN=78 Runoff=0.10 cfs 0.016 af

Total Runoff Area = 10.372 ac Runoff Volume = 0.163 af Average Runoff Depth = 0.19"
94.84% Pervious = 9.837 ac 5.16% Impervious = 0.535 ac

Summary for Subcatchment 1: Subarea 1

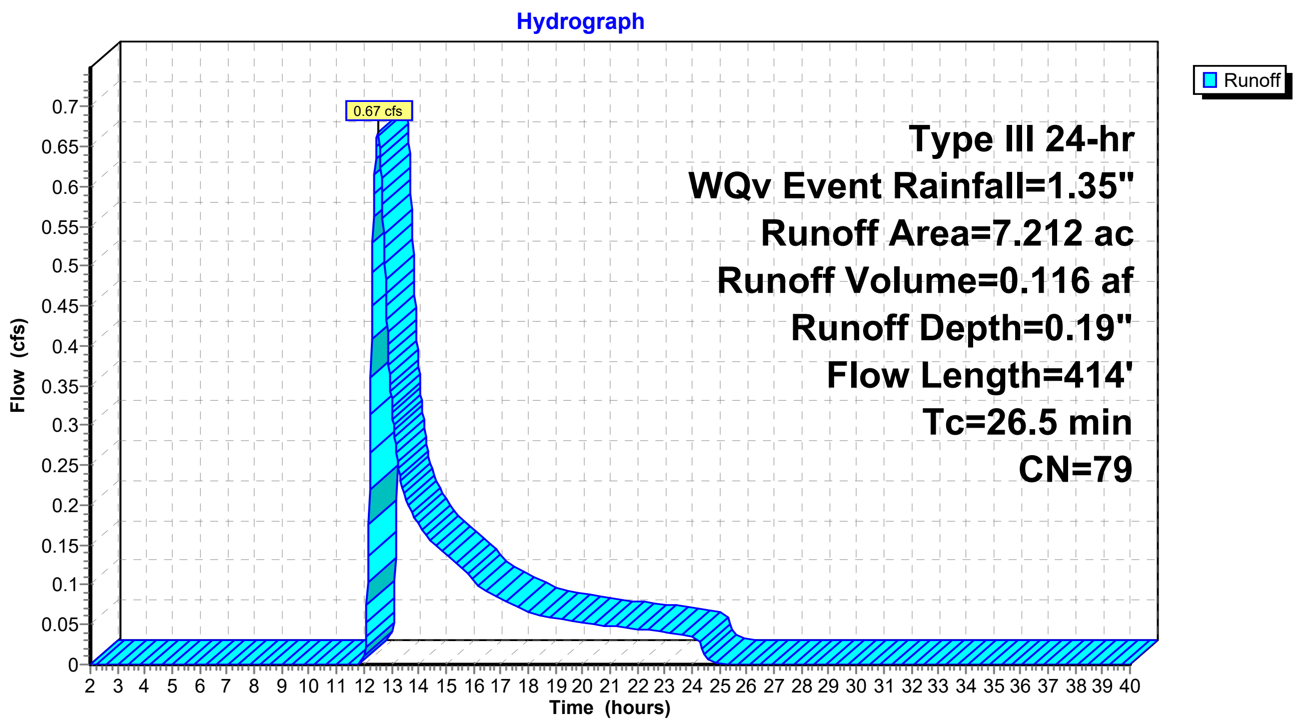
Runoff = 0.67 cfs @ 12.51 hrs, Volume= 0.116 af, Depth= 0.19"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
1.724	80	>75% Grass cover, Good, HSG D
0.404	98	Paved parking, HSG C
5.084	77	Woods, Good, HSG D
7.212	79	Weighted Average
6.808		94.40% Pervious Area
0.404		5.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.6	100	0.0180	0.07		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
3.9	314	0.0730	1.35		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
26.5	414	Total			

Subcatchment 1: Subarea 1



Summary for Subcatchment 2: Subarea 2

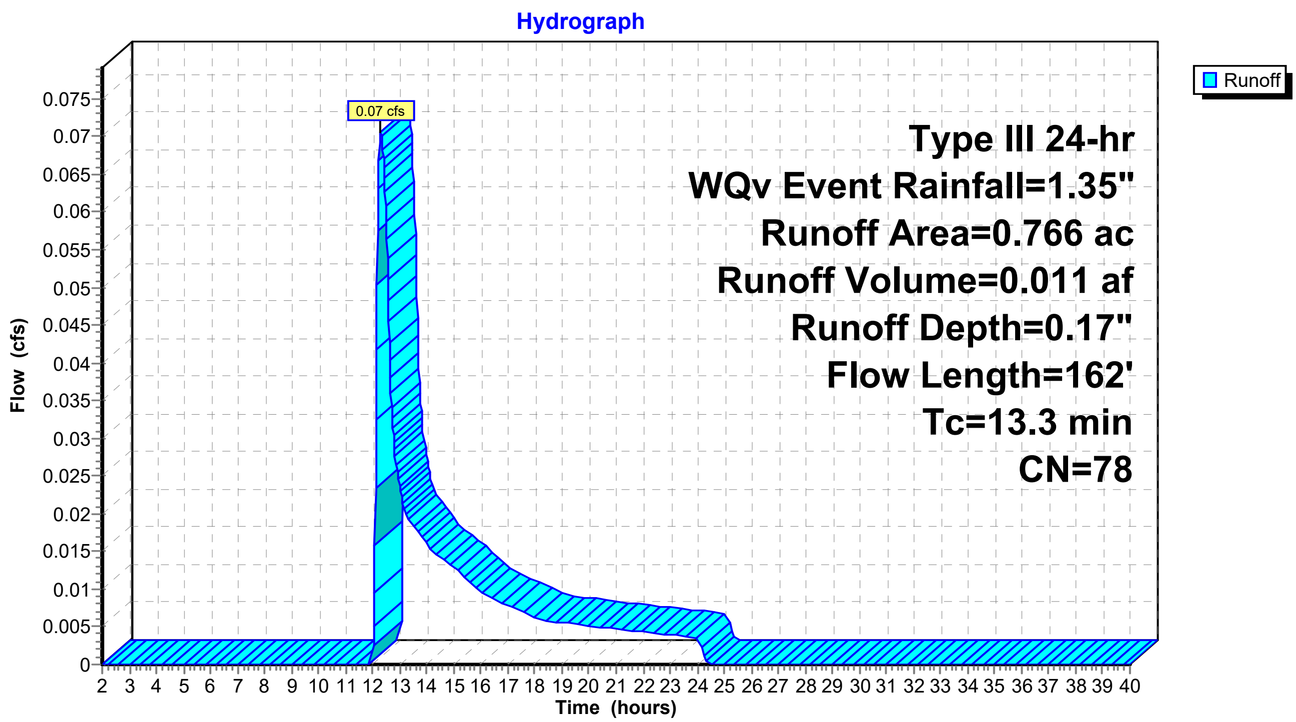
Runoff = 0.07 cfs @ 12.28 hrs, Volume= 0.011 af, Depth= 0.17"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.106	80	>75% Grass cover, Good, HSG D
0.632	77	Woods, Good, HSG D
0.028	98	Paved parking, HSG D
0.766	78	Weighted Average
0.738		96.34% Pervious Area
0.028		3.66% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0950	0.14		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
1.7	62	0.0150	0.61		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
13.3	162	Total			

Subcatchment 2: Subarea 2



Summary for Subcatchment 3: Subarea 3

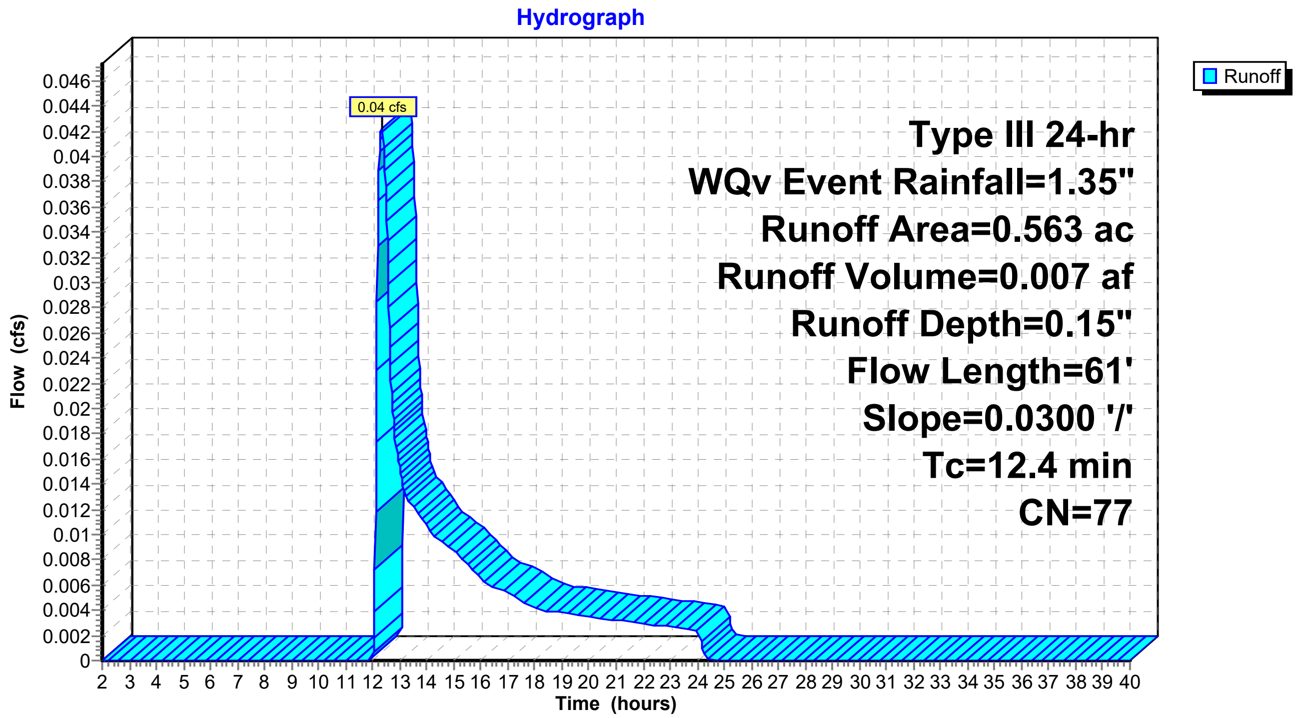
Runoff = 0.04 cfs @ 12.33 hrs, Volume= 0.007 af, Depth= 0.15"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.563	77	Woods, Good, HSG D
0.563		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.4	61	0.0300	0.08		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"

Subcatchment 3: Subarea 3



Summary for Subcatchment 4: Subarea 4

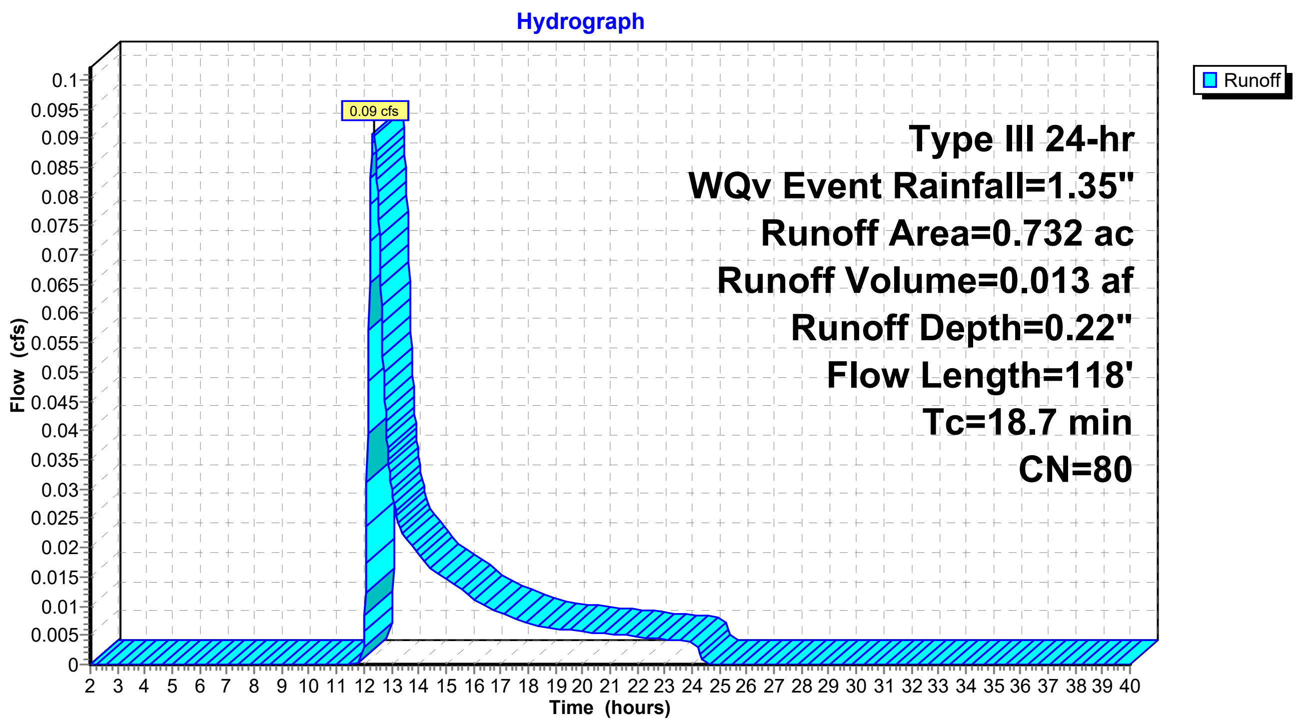
Runoff = 0.09 cfs @ 12.34 hrs, Volume= 0.013 af, Depth= 0.22"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.200	80	>75% Grass cover, Good, HSG D
0.462	77	Woods, Good, HSG D
0.070	98	Paved parking, HSG D
0.732	80	Weighted Average
0.662		90.44% Pervious Area
0.070		9.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	100	0.0300	0.09		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	18	0.0450	1.06		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
18.7	118	Total			

Subcatchment 4: Subarea 4



Summary for Subcatchment 5: Subarea 5

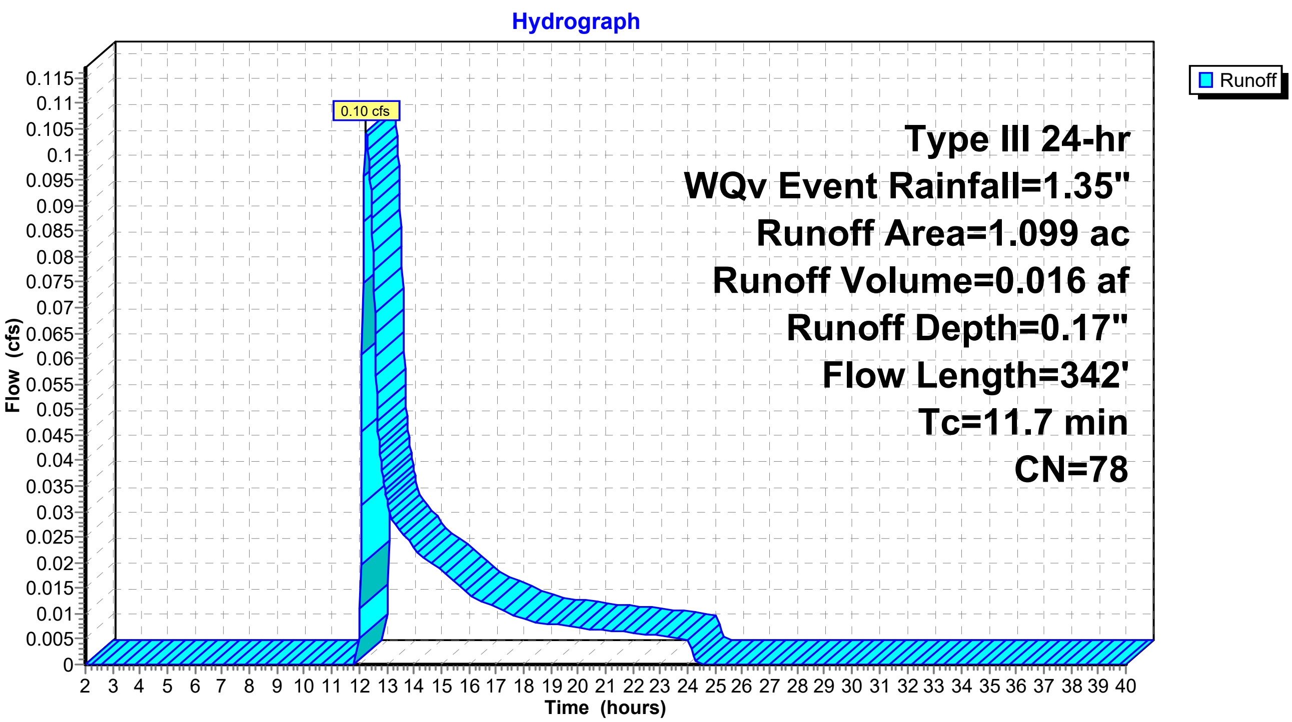
Runoff = 0.10 cfs @ 12.24 hrs, Volume= 0.016 af, Depth= 0.17"
Routed to nonexistent node Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-40.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.056	80	>75% Grass cover, Good, HSG D
1.010	77	Woods, Good, HSG D
0.033	98	Paved parking, HSG D
1.099	78	Weighted Average
1.066		97.00% Pervious Area
0.033		3.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	100	0.1900	0.19		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.15"
2.9	242	0.0780	1.40		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
11.7	342	Total			

Subcatchment 5: Subarea 5



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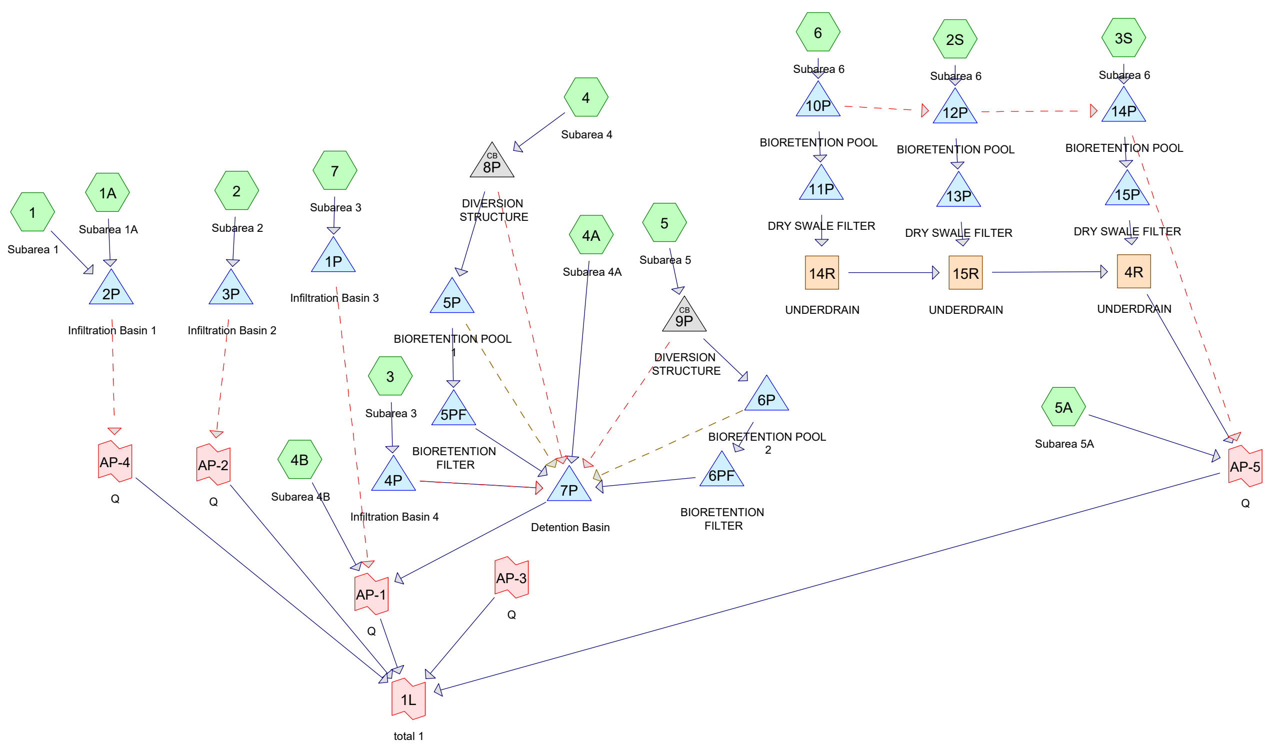
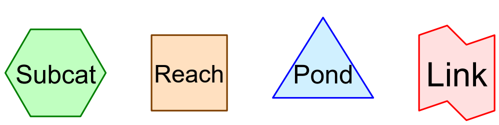
APPENDIX I: PROPOSED CONDITIONS HYDROCAD ANALYSIS





Routing Diagram for Proposed Conditions HydroCAD
Prepared by Passero Associates, Printed 4/10/2024
HydroCAD® 10.20-4a s/n 13263 © 2023 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-Year Event	Type III 24-hr		Default	24.00	1	2.60	2
2	10-Year Event	Type III 24-hr		Default	24.00	1	4.69	2
3	100-Year Event	Type III 24-hr		Default	24.00	1	8.32	2
4	WQv Event	Type III 24-hr		Default	24.00	1	1.35	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
4.603	80	>75% Grass cover, Good, HSG D (1, 1A, 2, 2S, 3, 3S, 4, 4A, 4B, 5, 5A, 6, 7)
5.483	98	Paved parking, HSG C (1, 2, 2S, 3, 3S, 4, 5, 6, 7)
0.356	77	Woods, Good, HSG D (4B, 5A)
10.442	**89**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	4.603	0.000	4.603	>75% Grass cover, Good	1, 1A, 2, 2S, 3, 3S, 4, 4A, 4B, 5, 5A, 6, 7
0.000	0.000	5.483	0.000	0.000	5.483	Paved parking	1, 2, 2S, 3, 3S, 4, 5, 6, 7
0.000	0.000	0.000	0.356	0.000	0.356	Woods, Good	4B, 5A
0.000	**0.000**	**5.483**	**4.959**	**0.000**	**10.442**	**TOTAL AREA**	

Time span=2.00-48.00 hrs, dt=0.02 hrs, 2301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1: Subarea 1 Runoff Area=1.040 ac 79.62% Impervious Runoff Depth=1.97"
Flow Length=100' Slope=0.0080 '/' Tc=14.2 min CN=94 Runoff=1.80 cfs 0.170 af

Subcatchment1A: Subarea 1A Runoff Area=0.205 ac 0.00% Impervious Runoff Depth=0.96"
Tc=6.0 min CN=80 Runoff=0.22 cfs 0.016 af

Subcatchment2: Subarea 2 Runoff Area=0.789 ac 61.98% Impervious Runoff Depth=1.70"
Tc=6.0 min CN=91 Runoff=1.56 cfs 0.112 af

Subcatchment2S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=1.54"
Tc=6.0 min CN=89 Runoff=0.06 cfs 0.005 af

Subcatchment3: Subarea 3 Runoff Area=1.019 ac 78.21% Impervious Runoff Depth=1.97"
Flow Length=592' Tc=10.8 min CN=94 Runoff=1.95 cfs 0.167 af

Subcatchment3S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=1.54"
Tc=6.0 min CN=89 Runoff=0.06 cfs 0.005 af

Subcatchment4: Subarea 4 Runoff Area=1.245 ac 60.80% Impervious Runoff Depth=1.70"
Flow Length=100' Tc=6.0 min CN=91 Runoff=2.46 cfs 0.177 af

Subcatchment4A: Subarea 4A Runoff Area=0.488 ac 0.00% Impervious Runoff Depth=0.96"
Tc=6.0 min CN=80 Runoff=0.53 cfs 0.039 af

Subcatchment4B: Subarea 4B Runoff Area=0.688 ac 0.00% Impervious Runoff Depth=0.96"
Flow Length=178' Tc=6.2 min CN=80 Runoff=0.74 cfs 0.055 af

Subcatchment5: Subarea 5 Runoff Area=2.987 ac 78.00% Impervious Runoff Depth=1.97"
Flow Length=35' Slope=0.0080 '/' Tc=6.2 min CN=94 Runoff=6.62 cfs 0.489 af

Subcatchment5A: Subarea 5A Runoff Area=1.345 ac 0.00% Impervious Runoff Depth=0.91"
Flow Length=279' Tc=22.5 min CN=79 Runoff=0.87 cfs 0.101 af

Subcatchment6: Subarea 6 Runoff Area=0.095 ac 82.11% Impervious Runoff Depth=2.06"
Tc=6.0 min CN=95 Runoff=0.22 cfs 0.016 af

Subcatchment7: Subarea 3 Runoff Area=0.471 ac 35.46% Impervious Runoff Depth=1.33"
Flow Length=574' Tc=7.3 min CN=86 Runoff=0.70 cfs 0.052 af

Reach 4R: UNDERDRAIN Avg. Flow Depth=0.07' Max Vel=3.59 fps Inflow=0.05 cfs 0.025 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.05 cfs 0.025 af

Reach 14R: UNDERDRAIN Avg. Flow Depth=0.04' Max Vel=2.58 fps Inflow=0.02 cfs 0.013 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.02 cfs 0.013 af

Reach 15R: UNDERDRAIN Avg. Flow Depth=0.05' Max Vel=3.18 fps Inflow=0.04 cfs 0.020 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.04 cfs 0.020 af

Pond 1P: Infiltration Basin 3 Peak Elev=258.72' Storage=687 cf Inflow=0.70 cfs 0.052 af
Discarded=0.13 cfs 0.052 af Secondary=0.00 cfs 0.000 af Outflow=0.13 cfs 0.052 af

Pond 2P: Infiltration Basin 1 Peak Elev=261.12' Storage=2,968 cf Inflow=1.96 cfs 0.187 af
Discarded=0.32 cfs 0.187 af Secondary=0.00 cfs 0.000 af Outflow=0.32 cfs 0.187 af

Pond 3P: Infiltration Basin 2 Peak Elev=260.27' Storage=1,114 cf Inflow=1.56 cfs 0.112 af
Discarded=0.40 cfs 0.112 af Secondary=0.00 cfs 0.000 af Outflow=0.40 cfs 0.112 af

Pond 4P: Infiltration Basin 4 Peak Elev=261.04' Storage=2,113 cf Inflow=1.95 cfs 0.167 af
Discarded=0.52 cfs 0.164 af Primary=0.19 cfs 0.003 af Secondary=0.00 cfs 0.000 af Outflow=0.71 cfs 0.167 af

Pond 5P: BIORETENTION POOL 1 Peak Elev=249.55' Storage=1,254 cf Inflow=1.54 cfs 0.166 af
Primary=0.11 cfs 0.109 af Secondary=0.84 cfs 0.045 af Tertiary=0.54 cfs 0.013 af Outflow=1.49 cfs 0.166 af

Pond 5PF: BIORETENTION FILTER Peak Elev=246.63' Storage=693 cf Inflow=0.11 cfs 0.109 af
Outflow=0.09 cfs 0.109 af

Pond 6P: BIORETENTION POOL 2 Peak Elev=257.62' Storage=3,250 cf Inflow=4.54 cfs 0.466 af
Primary=0.26 cfs 0.269 af Secondary=2.74 cfs 0.162 af Tertiary=1.25 cfs 0.034 af Outflow=4.25 cfs 0.466 af

Pond 6PF: BIORETENTION FILTER Peak Elev=254.29' Storage=1,048 cf Inflow=0.26 cfs 0.269 af
Outflow=0.23 cfs 0.269 af

Pond 7P: Detention Basin Peak Elev=240.56' Storage=7,063 cf Inflow=8.95 cfs 0.707 af
Outflow=3.17 cfs 0.707 af

Pond 8P: DIVERSION STRUCTURE Peak Elev=255.18' Inflow=2.46 cfs 0.177 af
Primary=1.54 cfs 0.166 af Secondary=0.92 cfs 0.010 af Outflow=2.46 cfs 0.177 af

Pond 9P: DIVERSION STRUCTURE Peak Elev=258.19' Inflow=6.62 cfs 0.489 af
Primary=4.54 cfs 0.466 af Secondary=2.09 cfs 0.023 af Outflow=6.62 cfs 0.489 af

Pond 10P: BIORETENTION POOL Peak Elev=248.40' Storage=90 cf Inflow=0.22 cfs 0.016 af
Primary=0.03 cfs 0.013 af Secondary=0.17 cfs 0.004 af Outflow=0.20 cfs 0.016 af

Pond 11P: DRY SWALE FILTER Peak Elev=245.58' Storage=90 cf Inflow=0.03 cfs 0.013 af
Outflow=0.02 cfs 0.013 af

Pond 12P: BIORETENTION POOL Peak Elev=246.55' Storage=131 cf Inflow=0.23 cfs 0.008 af
Primary=0.03 cfs 0.007 af Secondary=0.06 cfs 0.001 af Outflow=0.09 cfs 0.008 af

Pond 13P: DRY SWALE FILTER Peak Elev=245.54' Storage=85 cf Inflow=0.03 cfs 0.007 af
Outflow=0.02 cfs 0.007 af

Pond 14P: BIORETENTION POOL Peak Elev=246.30' Storage=65 cf Inflow=0.09 cfs 0.006 af
Primary=0.03 cfs 0.006 af Secondary=0.00 cfs 0.000 af Outflow=0.03 cfs 0.006 af

Pond 15P: DRY SWALE FILTER Peak Elev=245.29' Storage=45 cf Inflow=0.03 cfs 0.006 af
Outflow=0.02 cfs 0.006 af

Link 1L: total 1
Inflow=4.38 cfs 0.889 af
Primary=4.38 cfs 0.889 af

Link AP-1: Q
Inflow=3.46 cfs 0.762 af
Primary=3.46 cfs 0.762 af

Link AP-2: Q
Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link AP-3: Q
Primary=0.00 cfs 0.000 af

Link AP-4: Q
Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Link AP-5: Q
Inflow=0.93 cfs 0.127 af
Primary=0.93 cfs 0.127 af

Total Runoff Area = 10.442 ac Runoff Volume = 1.404 af Average Runoff Depth = 1.61"
47.49% Pervious = 4.959 ac 52.51% Impervious = 5.483 ac

Summary for Subcatchment 1: Subarea 1

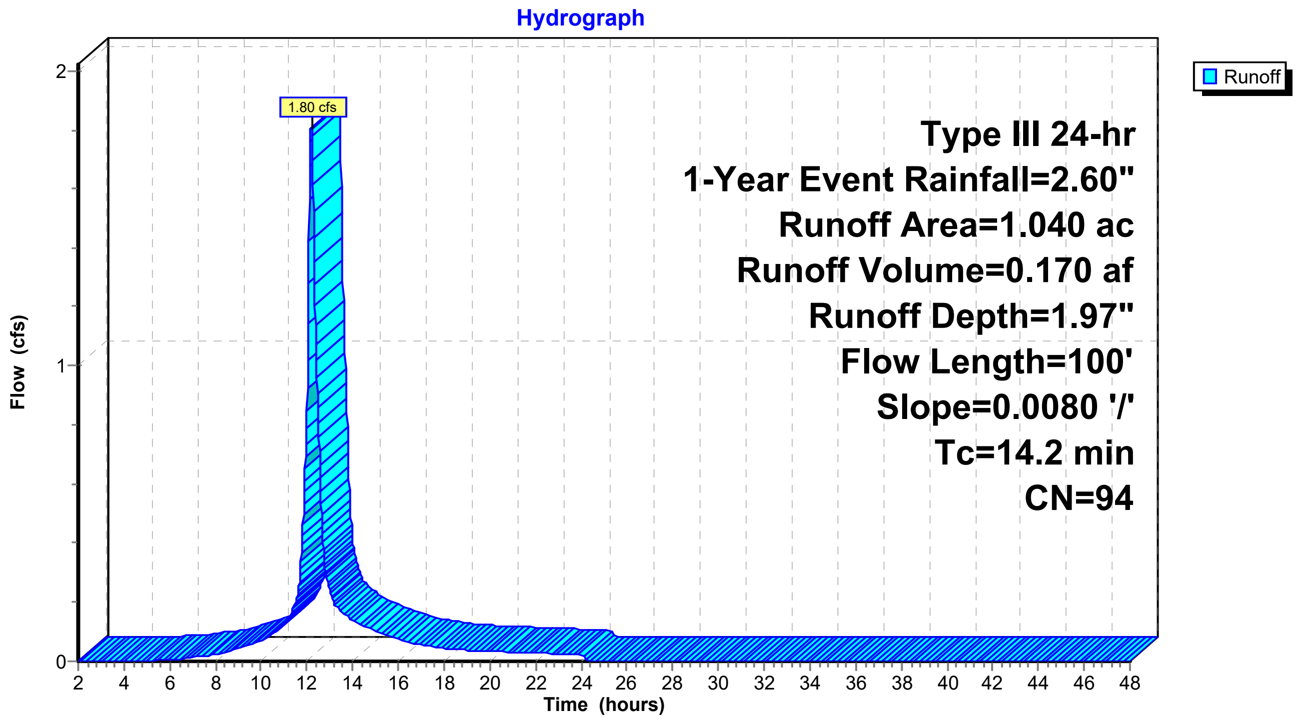
Runoff = 1.80 cfs @ 12.19 hrs, Volume= 0.170 af, Depth= 1.97"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.212	80	>75% Grass cover, Good, HSG D
0.828	98	Paved parking, HSG C
1.040	94	Weighted Average
0.212		20.38% Pervious Area
0.828		79.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	100	0.0080	0.12		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 1: Subarea 1



Summary for Subcatchment 1A: Subarea 1A

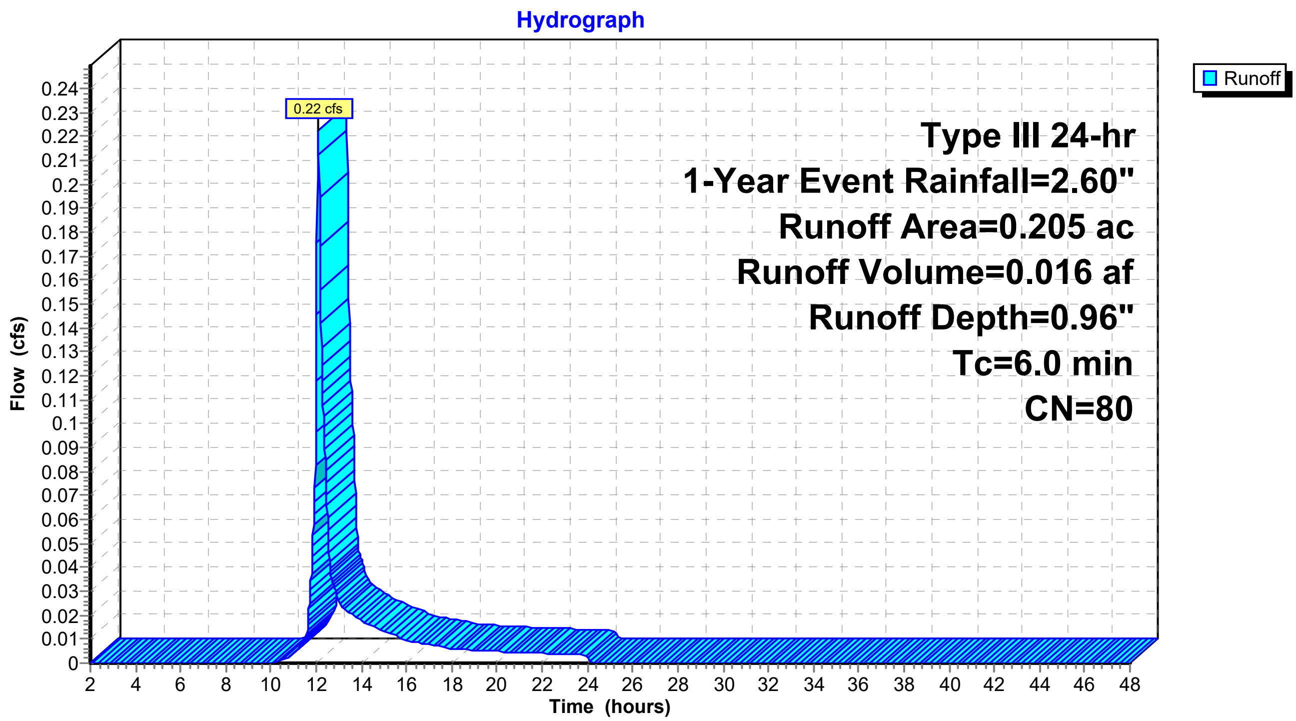
Runoff = 0.22 cfs @ 12.09 hrs, Volume= 0.016 af, Depth= 0.96"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.205	80	>75% Grass cover, Good, HSG D
0.205		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Minimm**

Subcatchment 1A: Subarea 1A



Summary for Subcatchment 2: Subarea 2

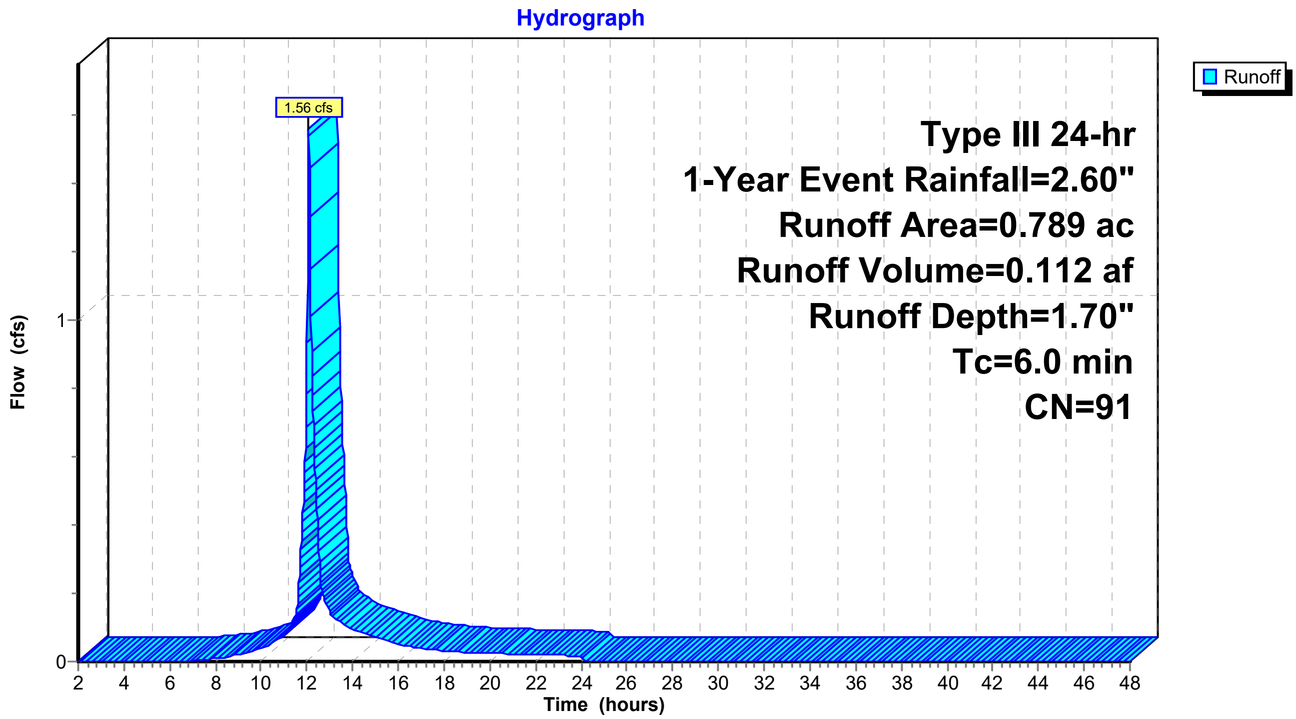
Runoff = 1.56 cfs @ 12.09 hrs, Volume= 0.112 af, Depth= 1.70"
Routed to Pond 3P : Infiltration Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.300	80	>75% Grass cover, Good, HSG D
0.489	98	Paved parking, HSG C
0.789	91	Weighted Average
0.300		38.02% Pervious Area
0.489		61.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MinTC**

Subcatchment 2: Subarea 2



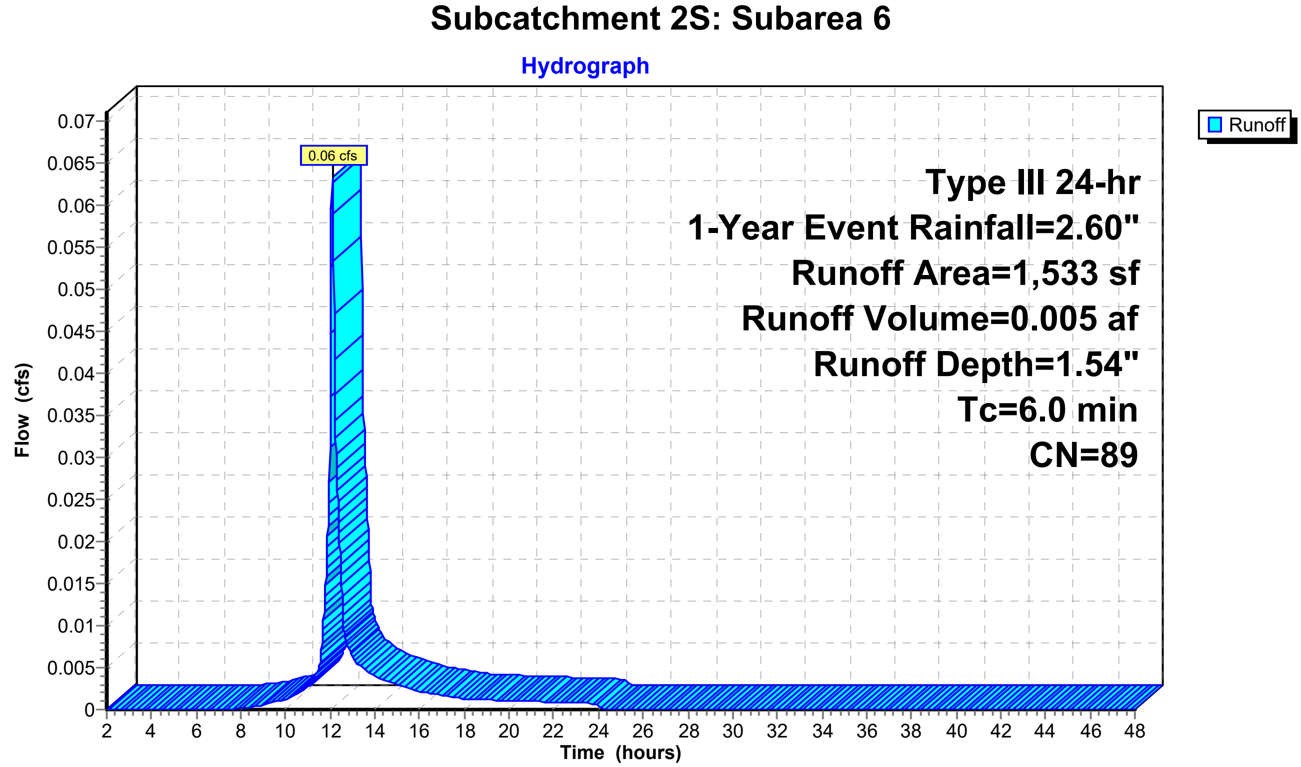
Summary for Subcatchment 2S: Subarea 6

Runoff = 0.06 cfs @ 12.09 hrs, Volume= 0.005 af, Depth= 1.54"
Routed to Pond 12P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**



Summary for Subcatchment 3: Subarea 3

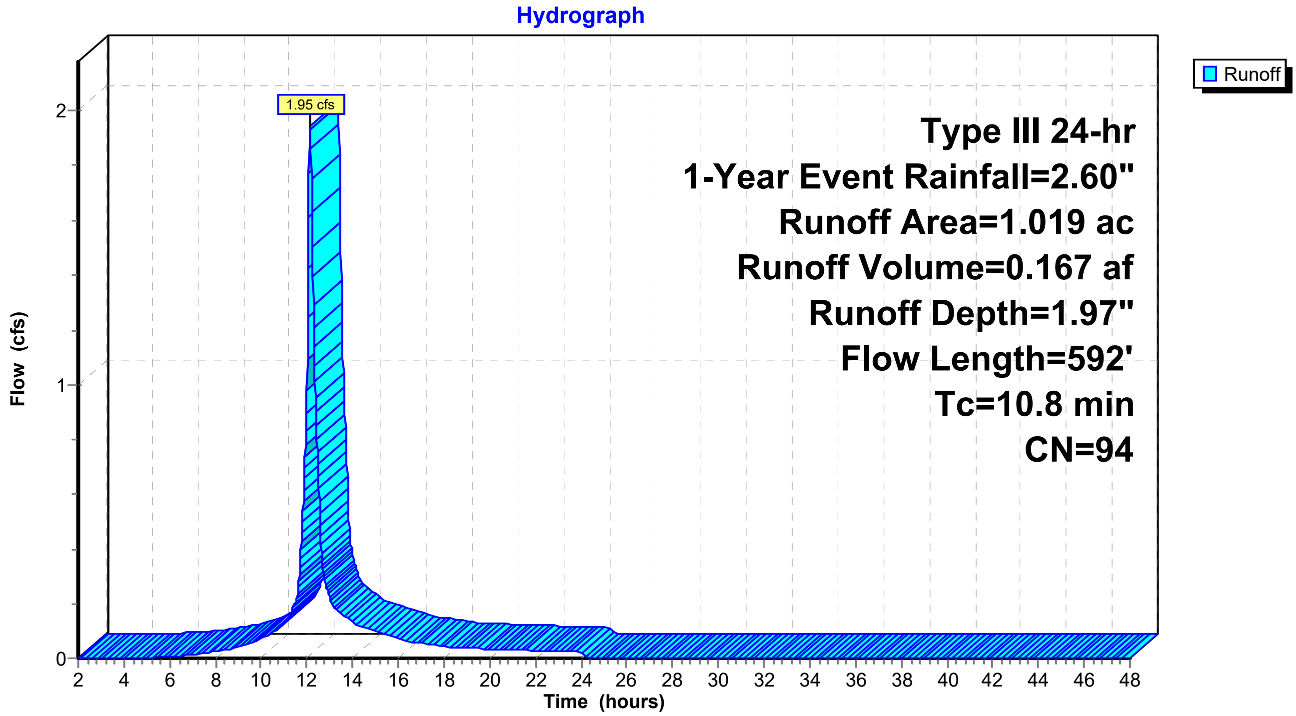
Runoff = 1.95 cfs @ 12.15 hrs, Volume= 0.167 af, Depth= 1.97"
Routed to Pond 4P : Infiltration Basin 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.222	80	>75% Grass cover, Good, HSG D
0.797	98	Paved parking, HSG C
1.019	94	Weighted Average
0.222		21.79% Pervious Area
0.797		78.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	53	0.0100	0.11		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
10.8	592	Total			

Subcatchment 3: Subarea 3



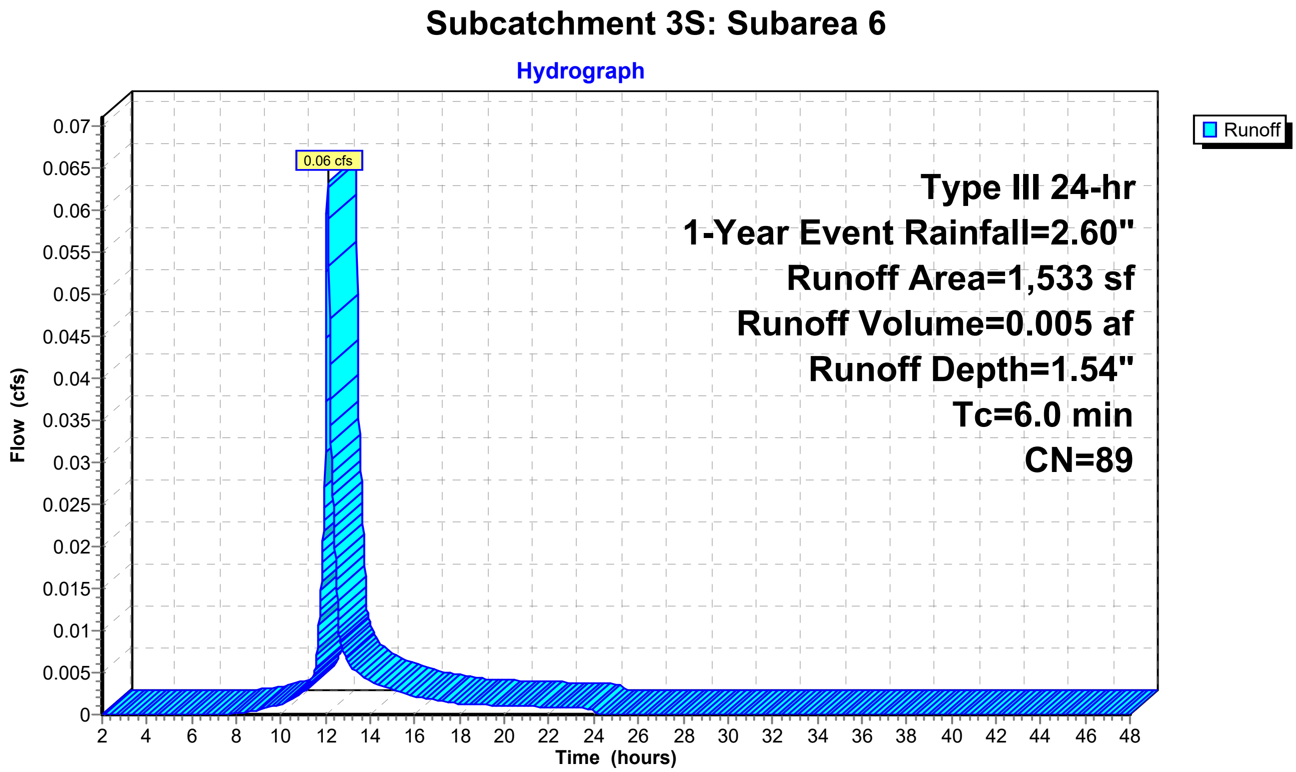
Summary for Subcatchment 3S: Subarea 6

Runoff = 0.06 cfs @ 12.09 hrs, Volume= 0.005 af, Depth= 1.54"
Routed to Pond 14P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**



Summary for Subcatchment 4: Subarea 4

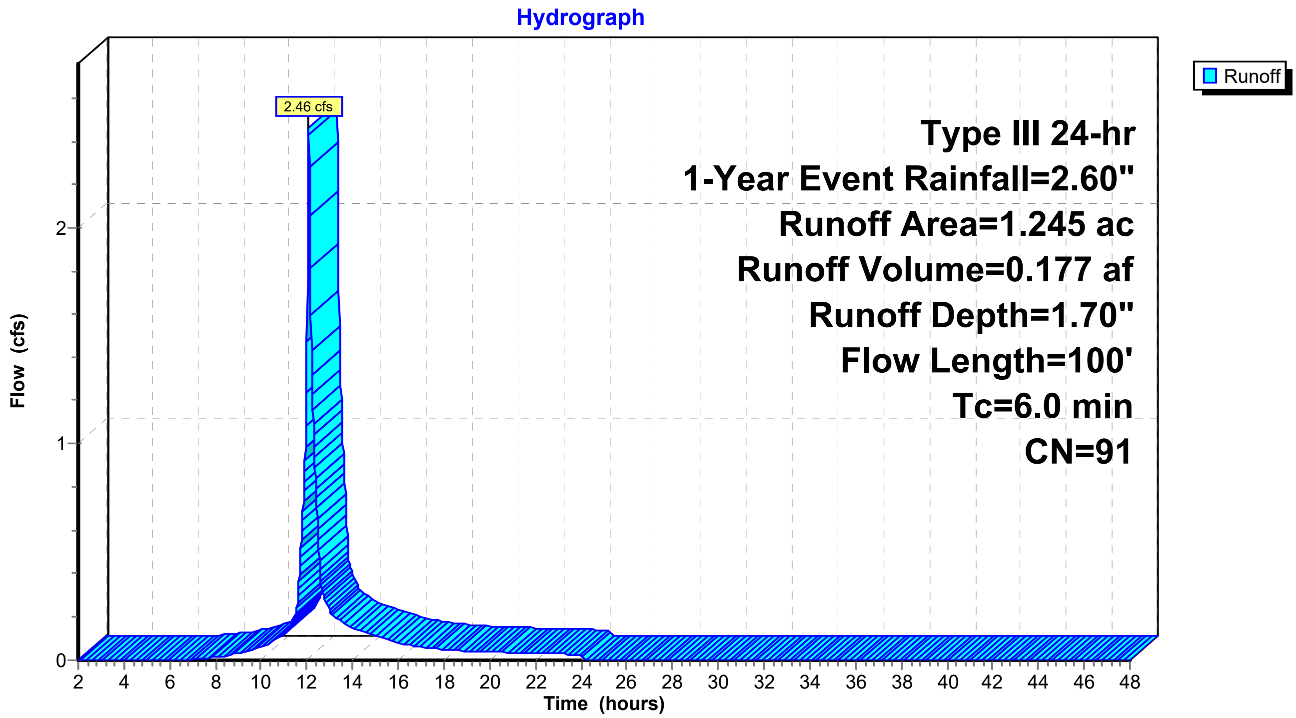
Runoff = 2.46 cfs @ 12.09 hrs, Volume= 0.177 af, Depth= 1.70"
Routed to Pond 8P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.757	98	Paved parking, HSG C
1.245	91	Weighted Average
0.488		39.20% Pervious Area
0.757		60.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	55	0.0900	0.27		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.9	45	0.2500	0.40		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
5.3	100	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4: Subarea 4



Summary for Subcatchment 4A: Subarea 4A

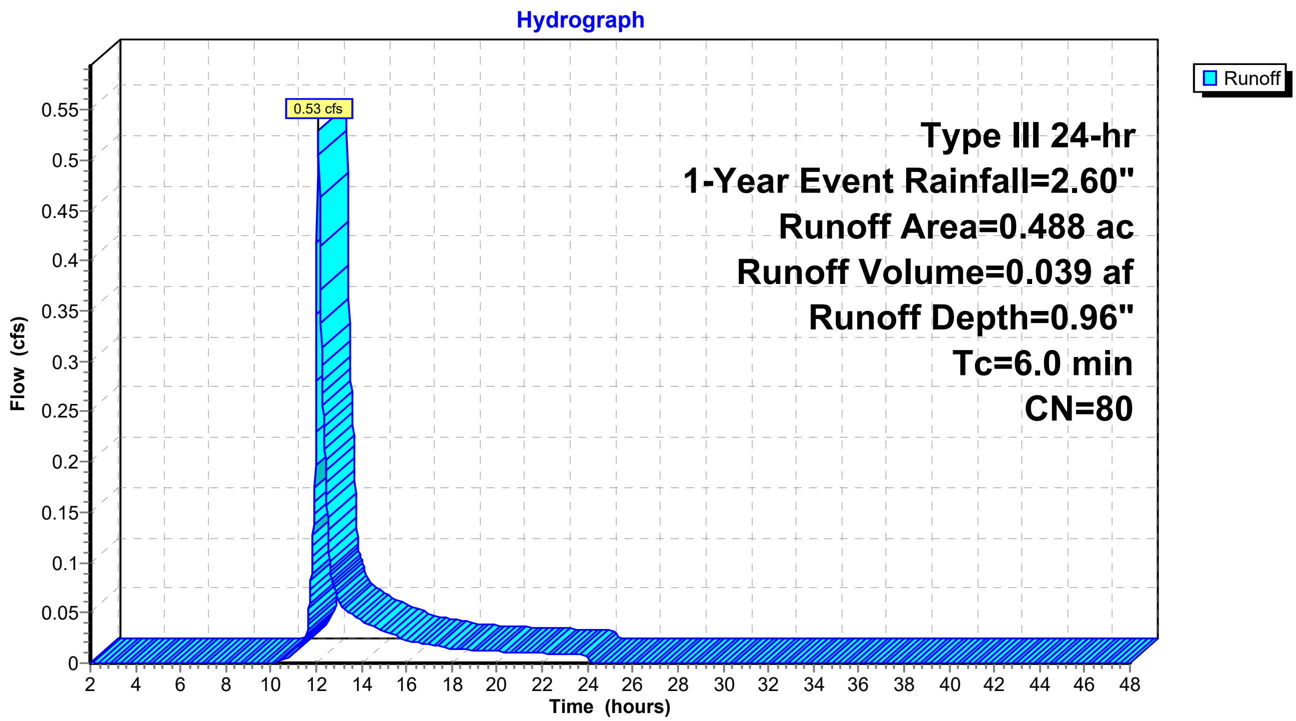
Runoff = 0.53 cfs @ 12.09 hrs, Volume= 0.039 af, Depth= 0.96"
Routed to Pond 7P : Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.488		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 4A: Subarea 4A



Summary for Subcatchment 4B: Subarea 4B

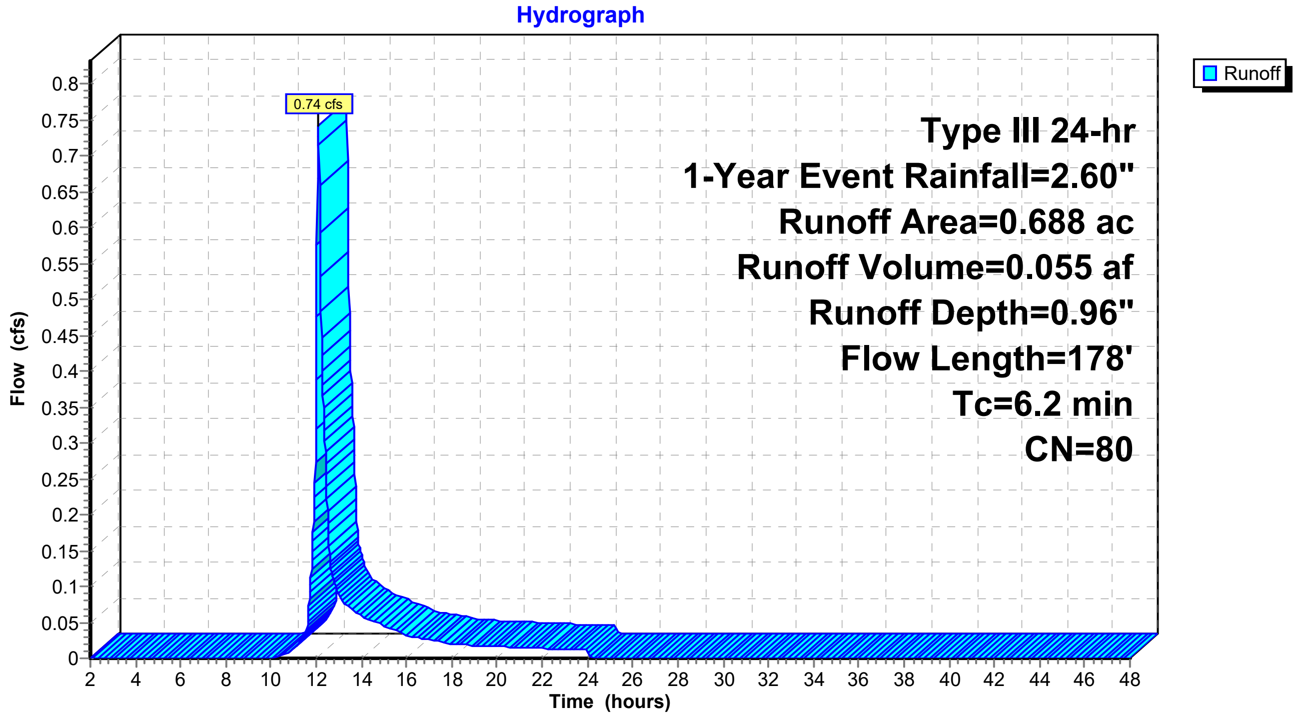
Runoff = 0.74 cfs @ 12.10 hrs, Volume= 0.055 af, Depth= 0.96"
Routed to Link AP-1 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.654	80	>75% Grass cover, Good, HSG D
0.034	77	Woods, Good, HSG D
0.688	80	Weighted Average
0.688		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.8	78	0.0100	1.61		**Shallow Concentrated Flow, Lawn** Unpaved Kv= 16.1 fps
6.2	178	Total			

Subcatchment 4B: Subarea 4B



Summary for Subcatchment 5: Subarea 5

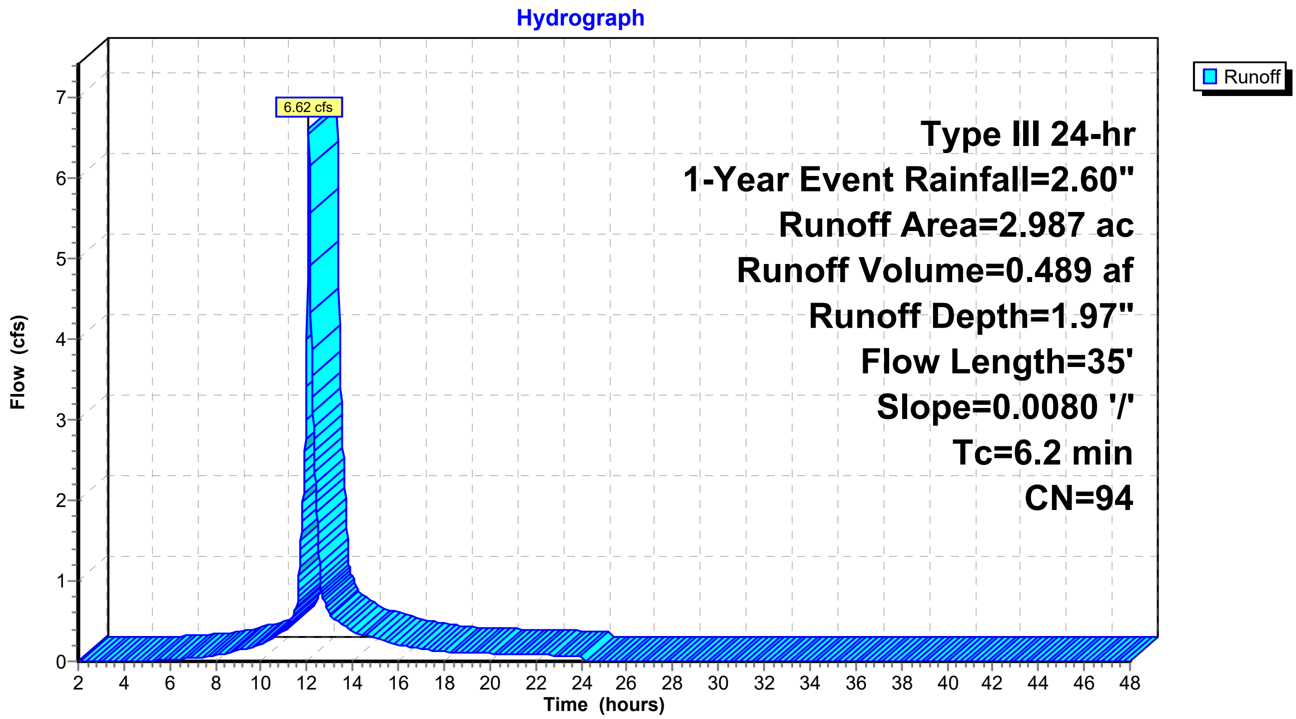
Runoff = 6.62 cfs @ 12.09 hrs, Volume= 0.489 af, Depth= 1.97"
Routed to Pond 9P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.657	80	>75% Grass cover, Good, HSG D
2.330	98	Paved parking, HSG C
2.987	94	Weighted Average
0.657		22.00% Pervious Area
2.330		78.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 5: Subarea 5



Summary for Subcatchment 5A: Subarea 5A

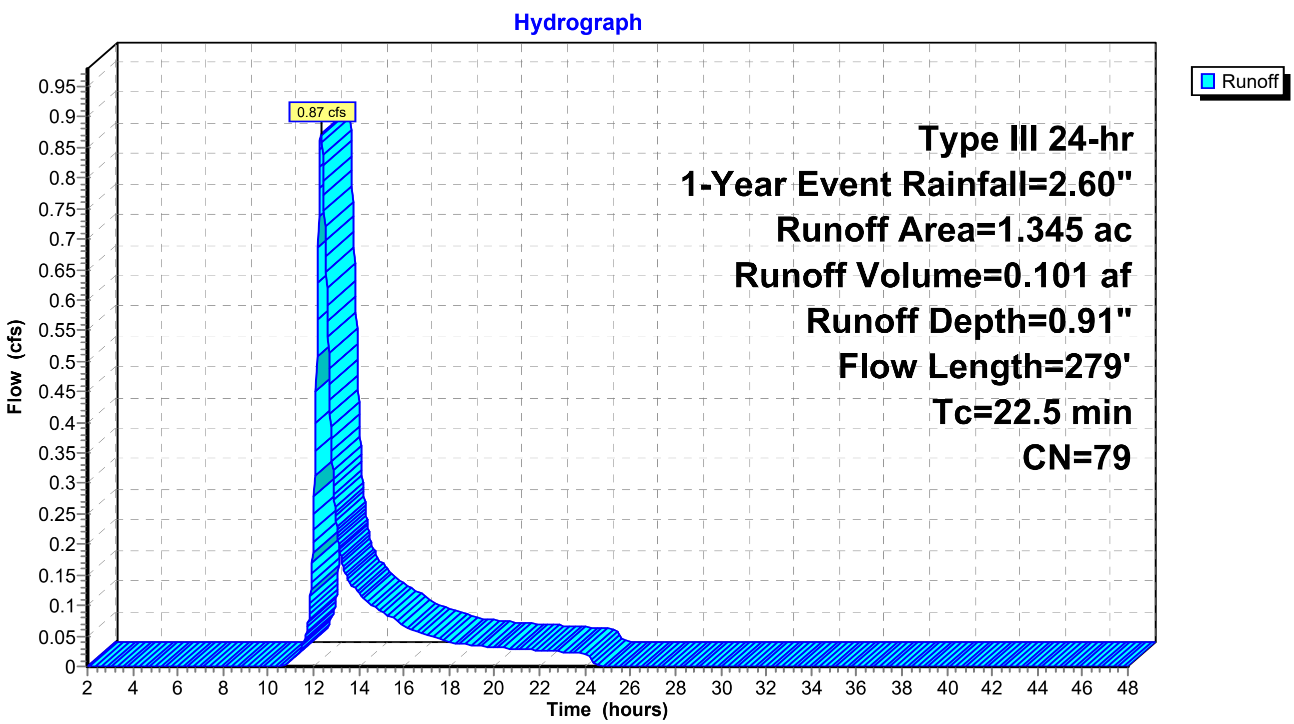
Runoff = 0.87 cfs @ 12.33 hrs, Volume= 0.101 af, Depth= 0.91"
Routed to Link AP-5 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
1.023	80	>75% Grass cover, Good, HSG D
0.322	77	Woods, Good, HSG D
1.345	79	Weighted Average
1.345		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	25	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
11.3	28	0.0080	0.04		**Sheet Flow, woods** Woods: Light underbrush n= 0.400 P2= 3.15"
4.6	46	0.2000	0.17		**Sheet Flow, Brush** Woods: Light underbrush n= 0.400 P2= 3.15"
1.9	180	0.1000	1.58		**Shallow Concentrated Flow, SC Flow** Woodland Kv= 5.0 fps
22.5	279	Total			

Subcatchment 5A: Subarea 5A



Summary for Subcatchment 6: Subarea 6

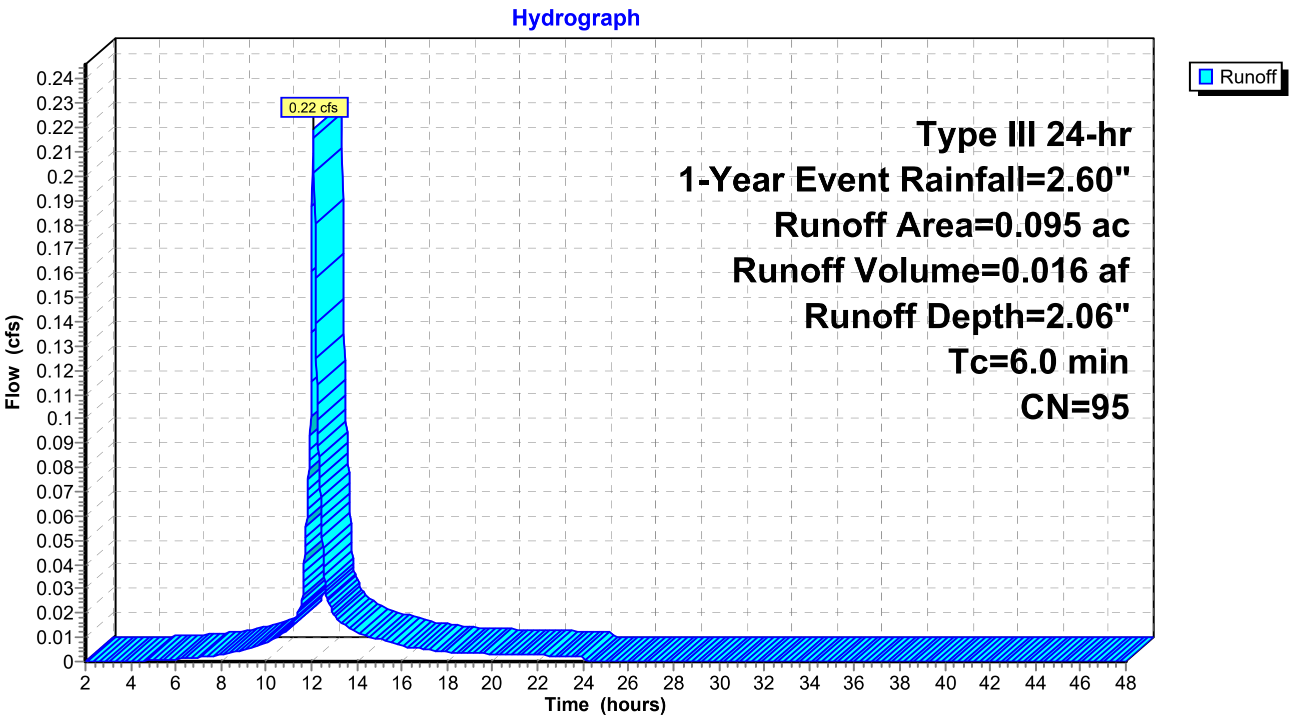
Runoff = 0.22 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 2.06"
Routed to Pond 10P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.017	80	>75% Grass cover, Good, HSG D
0.078	98	Paved parking, HSG C
0.095	95	Weighted Average
0.017		17.89% Pervious Area
0.078		82.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 6: Subarea 6



Summary for Subcatchment 7: Subarea 3

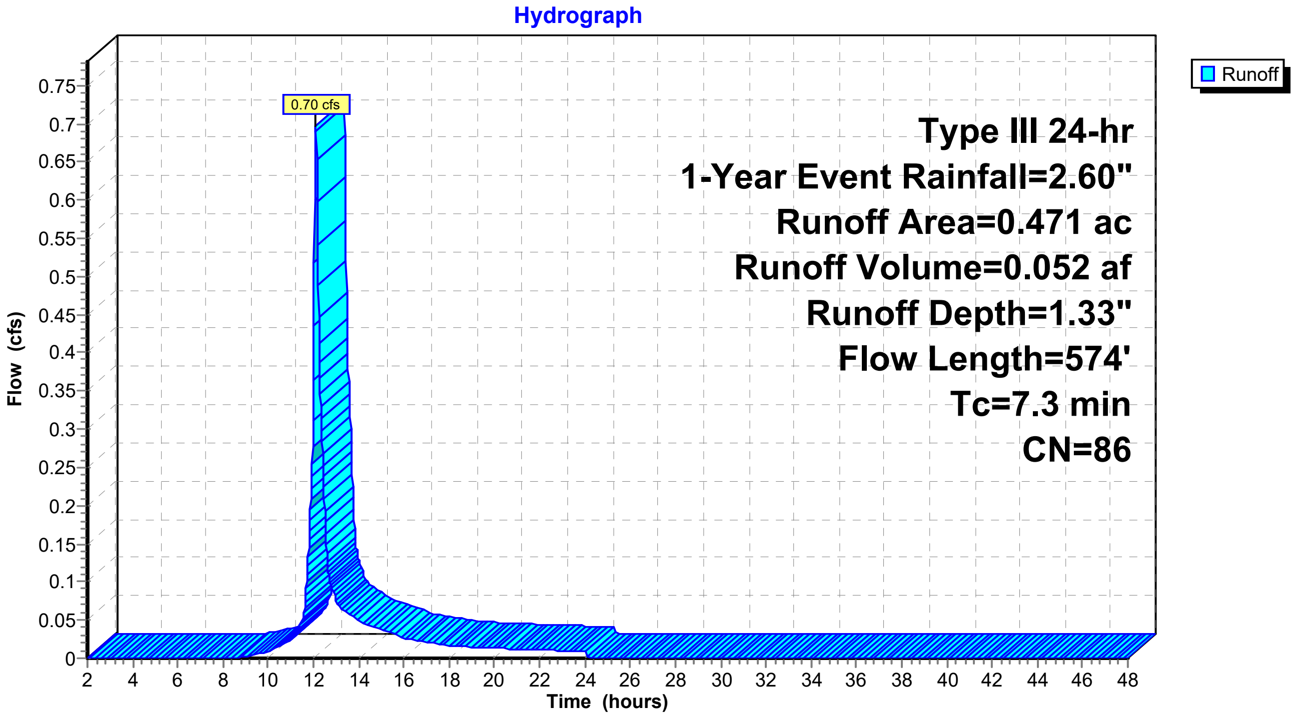
Runoff = 0.70 cfs @ 12.11 hrs, Volume= 0.052 af, Depth= 1.33"
Routed to Pond 1P : Infiltration Basin 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 1-Year Event Rainfall=2.60"

Area (ac)	CN	Description
0.304	80	>75% Grass cover, Good, HSG D
0.167	98	Paved parking, HSG C
0.471	86	Weighted Average
0.304		64.54% Pervious Area
0.167		35.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	35	0.0200	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
7.3	574	Total			

Subcatchment 7: Subarea 3



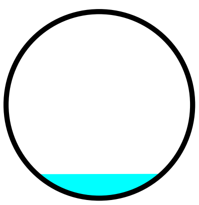
Summary for Reach 4R: UNDERDRAIN

Inflow Area = 0.165 ac, 69.59% Impervious, Inflow Depth = 1.84" for 1-Year Event event
Inflow = 0.05 cfs @ 11.96 hrs, Volume= 0.025 af
Outflow = 0.05 cfs @ 11.96 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min
Routed to Link AP-5 : Q

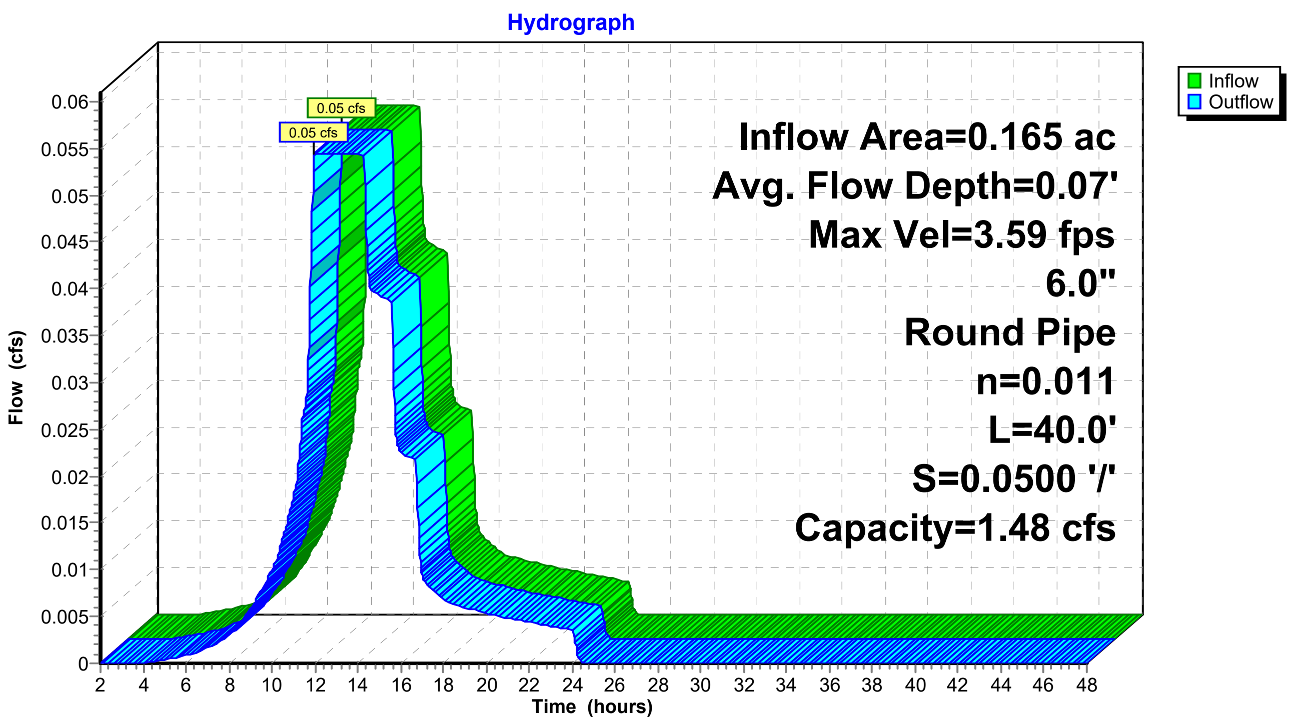
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.59 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.09 fps, Avg. Travel Time= 0.3 min

Peak Storage= 1 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.07' , Surface Width= 0.34'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'



Reach 4R: UNDERDRAIN



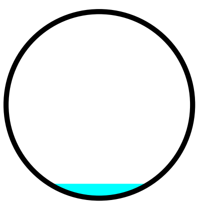
Summary for Reach 14R: UNDERDRAIN

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 1.59" for 1-Year Event event
Inflow = 0.02 cfs @ 11.42 hrs, Volume= 0.013 af
Outflow = 0.02 cfs @ 11.44 hrs, Volume= 0.013 af, Atten= 0%, Lag= 1.2 min
Routed to Reach 15R : UNDERDRAIN

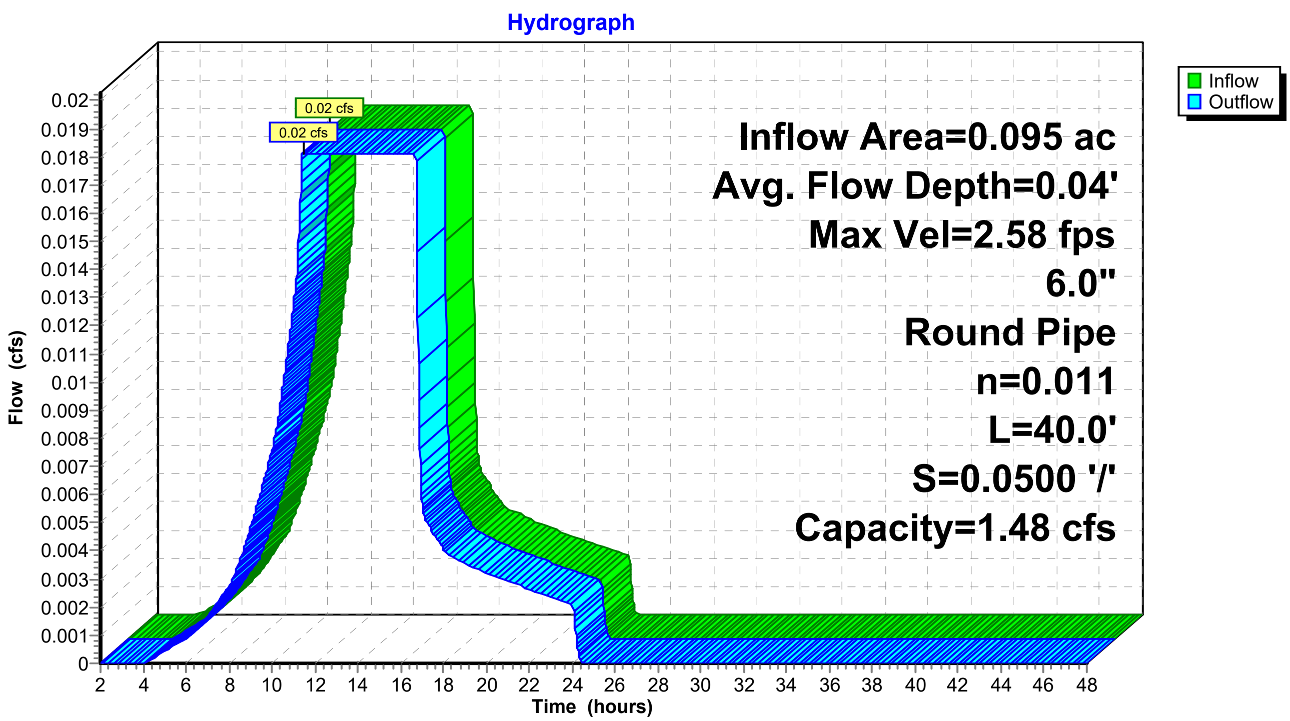
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.58 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.78 fps, Avg. Travel Time= 0.4 min

Peak Storage= 0 cf @ 11.44 hrs
Average Depth at Peak Storage= 0.04' , Surface Width= 0.27'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 244.50', Outlet Invert= 242.50'



Reach 14R: UNDERDRAIN



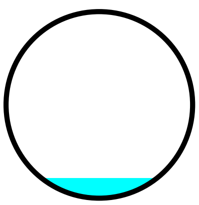
Summary for Reach 15R: UNDERDRAIN

Inflow Area = 0.130 ac, 74.16% Impervious, Inflow Depth = 1.82" for 1-Year Event event
Inflow = 0.04 cfs @ 11.96 hrs, Volume= 0.020 af
Outflow = 0.04 cfs @ 11.96 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 4R : UNDERDRAIN

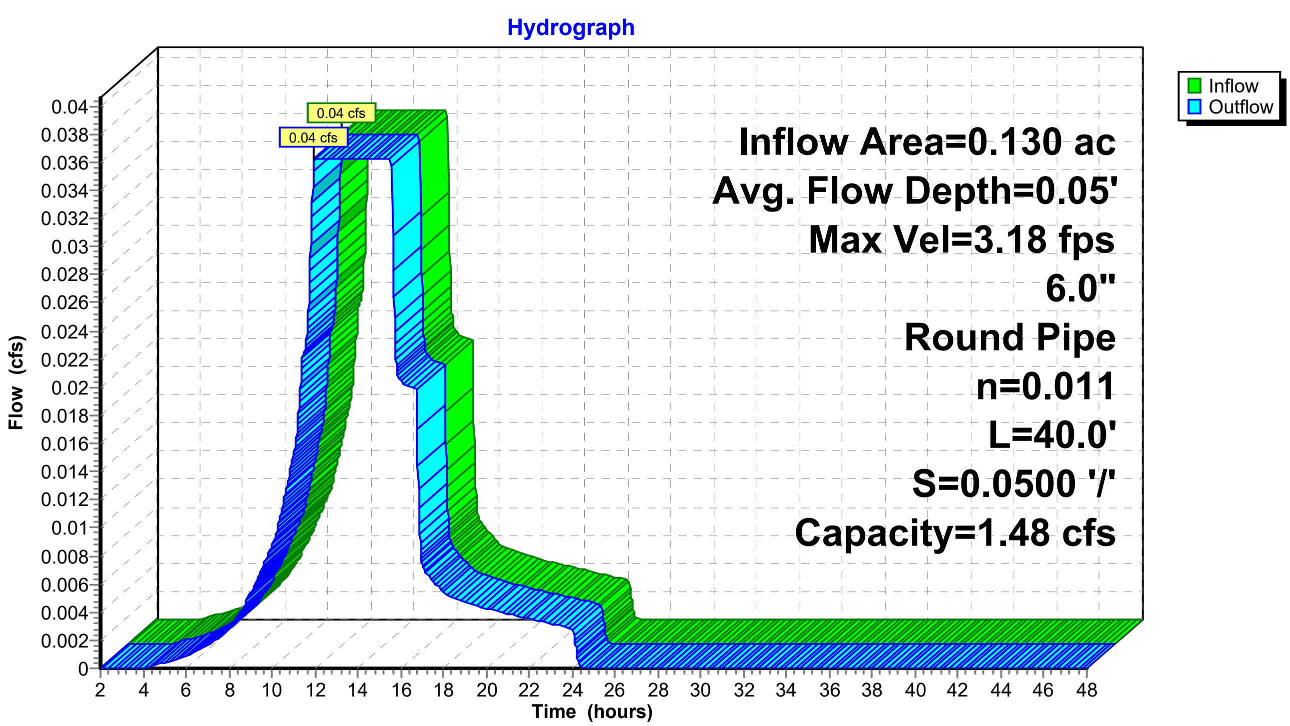
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 0.3 min

Peak Storage= 0 cf @ 11.96 hrs
Average Depth at Peak Storage= 0.05' , Surface Width= 0.31'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'



Reach 15R: UNDERDRAIN



Summary for Pond 1P: Infiltration Basin 3

Inflow Area = 0.471 ac, 35.46% Impervious, Inflow Depth = 1.33" for 1-Year Event event
Inflow = 0.70 cfs @ 12.11 hrs, Volume= 0.052 af
Outflow = 0.13 cfs @ 12.59 hrs, Volume= 0.052 af, Atten= 81%, Lag= 28.7 min
Discarded = 0.13 cfs @ 12.59 hrs, Volume= 0.052 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 258.72' @ 12.59 hrs Surf.Area= 1,160 sf Storage= 687 cf

Plug-Flow detention time= 40.2 min calculated for 0.052 af (100% of inflow)
Center-of-Mass det. time= 40.2 min (873.3 - 833.1)

Volume	Invert	Avail.Storage	Storage Description
#1	258.00'	8,592 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

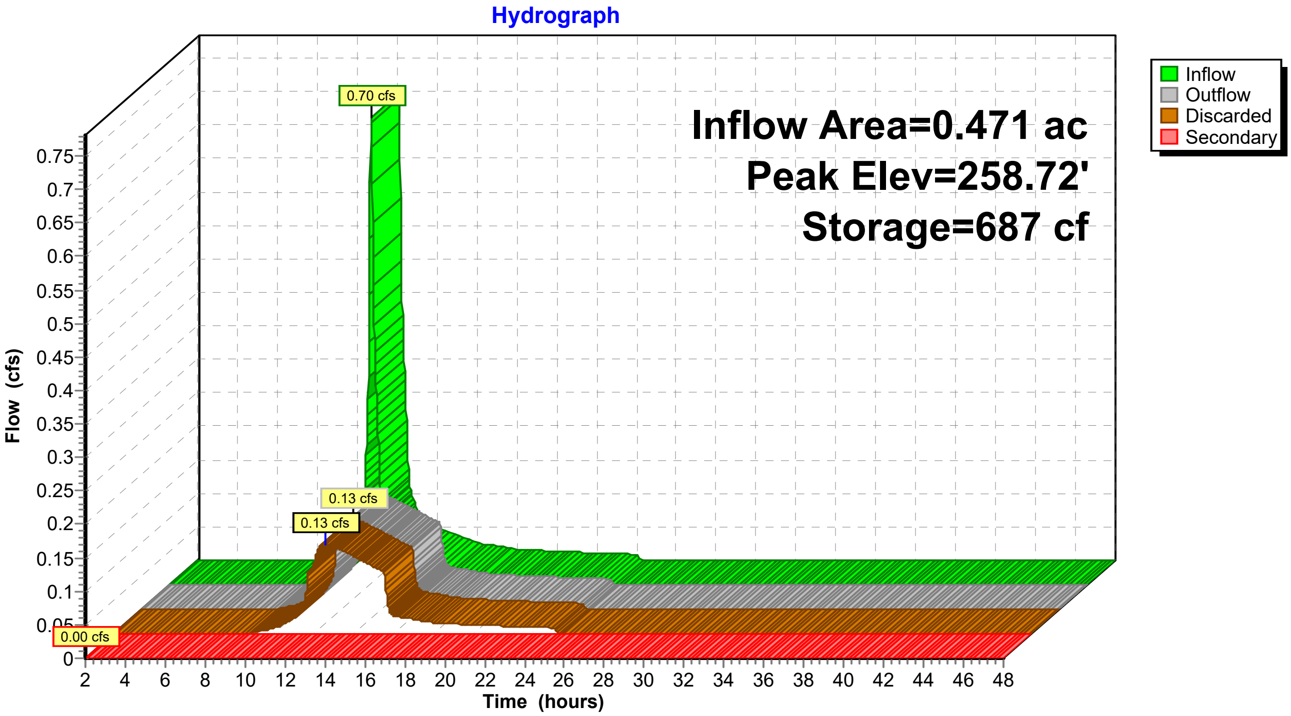
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
258.00	768	159.0	0	0	768
259.00	1,336	214.0	1,039	1,039	2,411
260.00	2,058	260.0	1,684	2,723	4,162
261.00	2,918	302.0	2,476	5,199	6,062
262.00	3,892	340.0	3,393	8,592	8,029

Device	Routing	Invert	Outlet Devices
#1	Discarded	258.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	261.00'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.13 cfs @ 12.59 hrs HW=258.72' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.13 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=258.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Infiltration Basin 3



Summary for Pond 2P: Infiltration Basin 1

Inflow Area = 1.245 ac, 66.51% Impervious, Inflow Depth = 1.80" for 1-Year Event event
Inflow = 1.96 cfs @ 12.18 hrs, Volume= 0.187 af
Outflow = 0.32 cfs @ 12.86 hrs, Volume= 0.187 af, Atten= 84%, Lag= 40.5 min
Discarded = 0.32 cfs @ 12.86 hrs, Volume= 0.187 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-4 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 261.12' @ 12.86 hrs Surf.Area= 3,426 sf Storage= 2,968 cf

Plug-Flow detention time= 82.4 min calculated for 0.187 af (100% of inflow)
Center-of-Mass det. time= 82.4 min (888.8 - 806.3)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	28,403 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

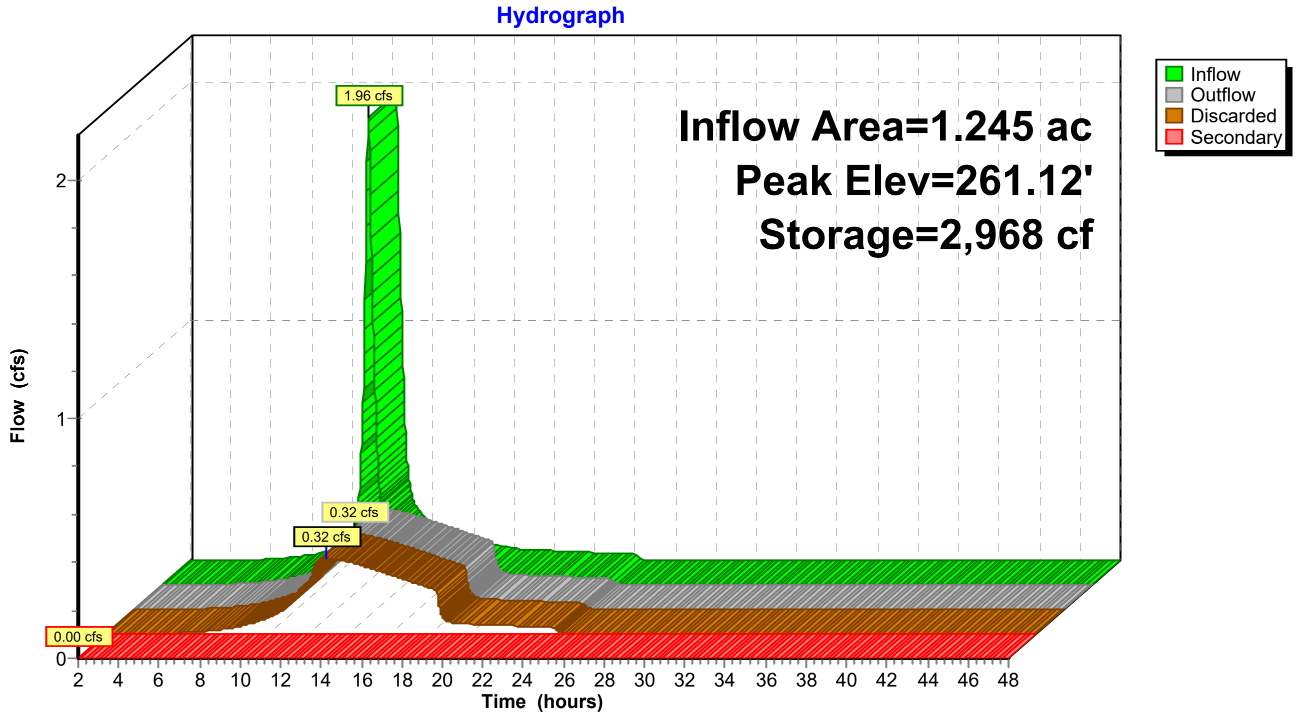
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	1,899	346.0	0	0	1,899
261.00	3,262	444.0	2,550	2,550	8,073
262.00	4,687	481.0	3,953	6,503	10,835
263.00	6,254	534.0	5,452	11,955	15,146
264.00	7,942	571.0	7,081	19,036	18,446
265.50	4,689	396.0	9,367	28,403	31,932

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	263.75'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.32 cfs @ 12.86 hrs HW=261.12' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.32 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Infiltration Basin 1



Summary for Pond 3P: Infiltration Basin 2

Inflow Area = 0.789 ac, 61.98% Impervious, Inflow Depth = 1.70" for 1-Year Event event
Inflow = 1.56 cfs @ 12.09 hrs, Volume= 0.112 af
Outflow = 0.40 cfs @ 12.47 hrs, Volume= 0.112 af, Atten= 75%, Lag= 23.1 min
Discarded = 0.40 cfs @ 12.47 hrs, Volume= 0.112 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-2 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 260.27' @ 12.47 hrs Surf.Area= 4,271 sf Storage= 1,114 cf

Plug-Flow detention time= 17.9 min calculated for 0.112 af (100% of inflow)
Center-of-Mass det. time= 17.9 min (828.4 - 810.5)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	16,256 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

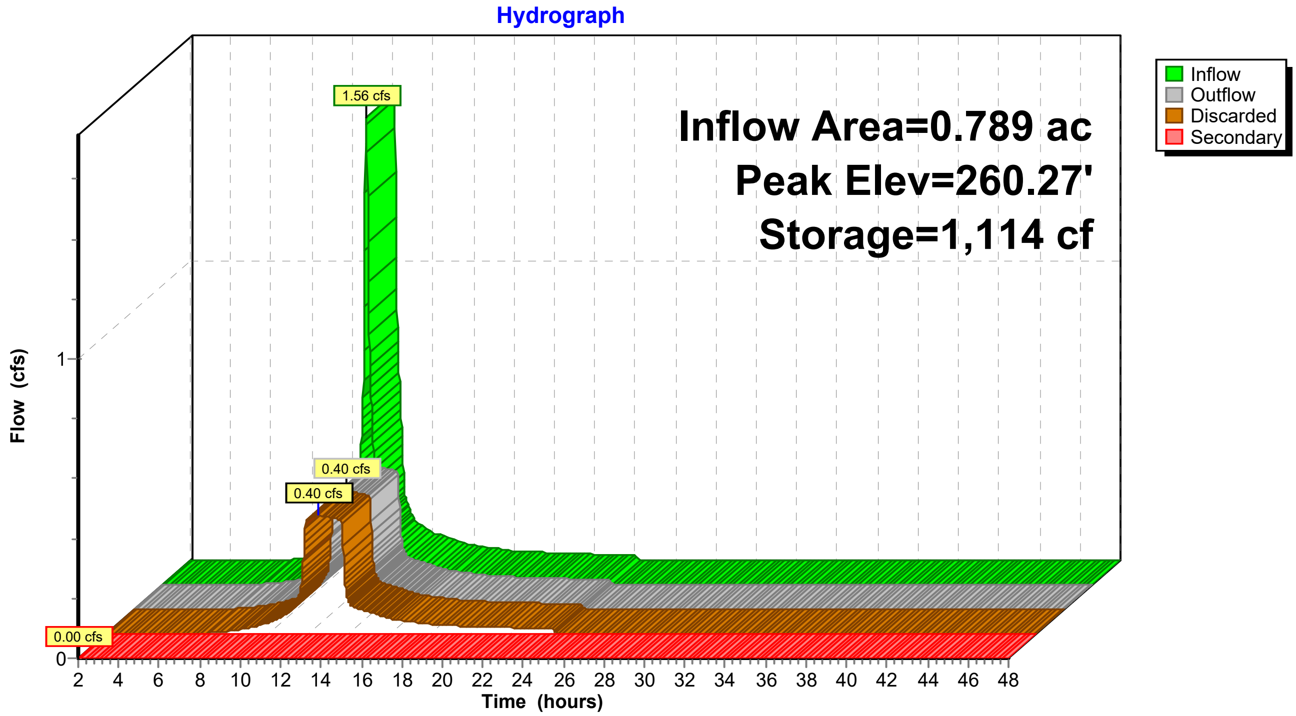
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	4,044	279.0	0	0	4,044
261.00	4,923	304.0	4,476	4,476	5,240
262.00	5,880	330.0	5,394	9,871	6,589
263.00	6,905	353.0	6,386	16,256	7,885

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	262.00'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.40 cfs @ 12.47 hrs HW=260.27' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.40 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Infiltration Basin 2



Summary for Pond 4P: Infiltration Basin 4

Inflow Area = 1.019 ac, 78.21% Impervious, Inflow Depth = 1.97" for 1-Year Event event
Inflow = 1.95 cfs @ 12.15 hrs, Volume= 0.167 af
Outflow = 0.71 cfs @ 12.48 hrs, Volume= 0.167 af, Atten= 64%, Lag= 20.1 min
Discarded = 0.52 cfs @ 12.48 hrs, Volume= 0.164 af
Primary = 0.19 cfs @ 12.48 hrs, Volume= 0.003 af
Routed to Pond 7P : Detention Basin
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 261.04' @ 12.48 hrs Surf.Area= 1,874 sf Storage= 2,113 cf

Plug-Flow detention time= 34.6 min calculated for 0.167 af (100% of inflow)
Center-of-Mass det. time= 34.6 min (833.2 - 798.6)

Volume	Invert	Avail.Storage	Storage Description
#1	259.00'	4,563 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
259.00	377	128.0	0	0	377
260.00	988	176.0	658	658	1,548
261.00	1,829	236.0	1,387	2,046	3,526
262.00	3,276	431.0	2,518	4,563	13,882

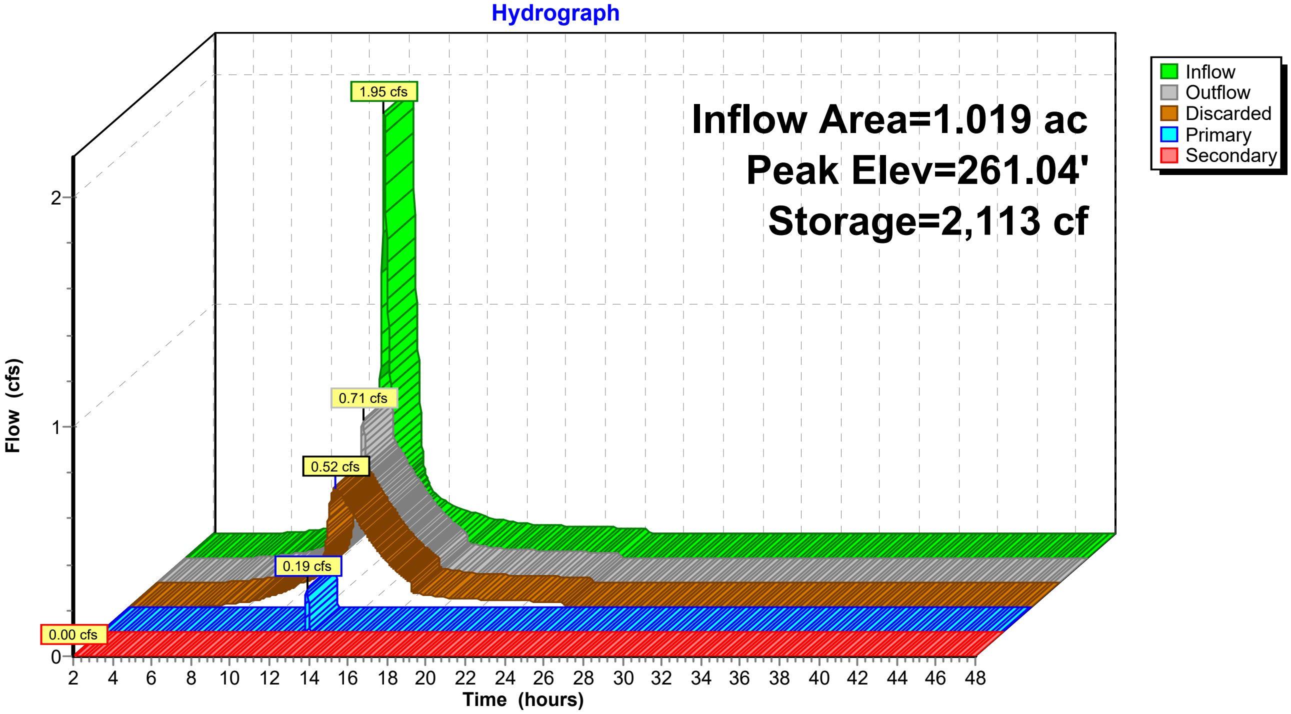
Device	Routing	Invert	Outlet Devices
#1	Discarded	259.00'	**12.000 in/hr Exfiltration over Surface area**
#2	Primary	259.00'	**18.0" Round Culvert** L= 47.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 259.00' / 255.20' S= 0.0809 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	261.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	261.40'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.52 cfs @ 12.48 hrs HW=261.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.18 cfs @ 12.48 hrs HW=261.04' (Free Discharge)
└─**2=Culvert** (Passes 0.18 cfs of 9.65 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 0.18 cfs @ 0.62 fps)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=259.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Infiltration Basin 4



Summary for Pond 5P: BIORETENTION POOL 1

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 1.60" for 1-Year Event event
Inflow = 1.54 cfs @ 12.09 hrs, Volume= 0.166 af
Outflow = 1.49 cfs @ 12.13 hrs, Volume= 0.166 af, Atten= 3%, Lag= 2.5 min
Primary = 0.11 cfs @ 12.13 hrs, Volume= 0.109 af
Routed to Pond 5PF : BIORETENTION FILTER
Secondary = 0.84 cfs @ 12.13 hrs, Volume= 0.045 af
Routed to Pond 7P : Detention Basin
Tertiary = 0.54 cfs @ 12.13 hrs, Volume= 0.013 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 249.55' @ 12.13 hrs Surf.Area= 2,477 sf Storage= 1,254 cf

Plug-Flow detention time= 58.8 min calculated for 0.166 af (100% of inflow)
Center-of-Mass det. time= 58.8 min (874.4 - 815.6)

Volume	Invert	Avail.Storage	Storage Description
#1	249.00'	2,444 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
249.00	2,084	225.0	0	0	2,084
250.00	2,823	249.0	2,444	2,444	3,020

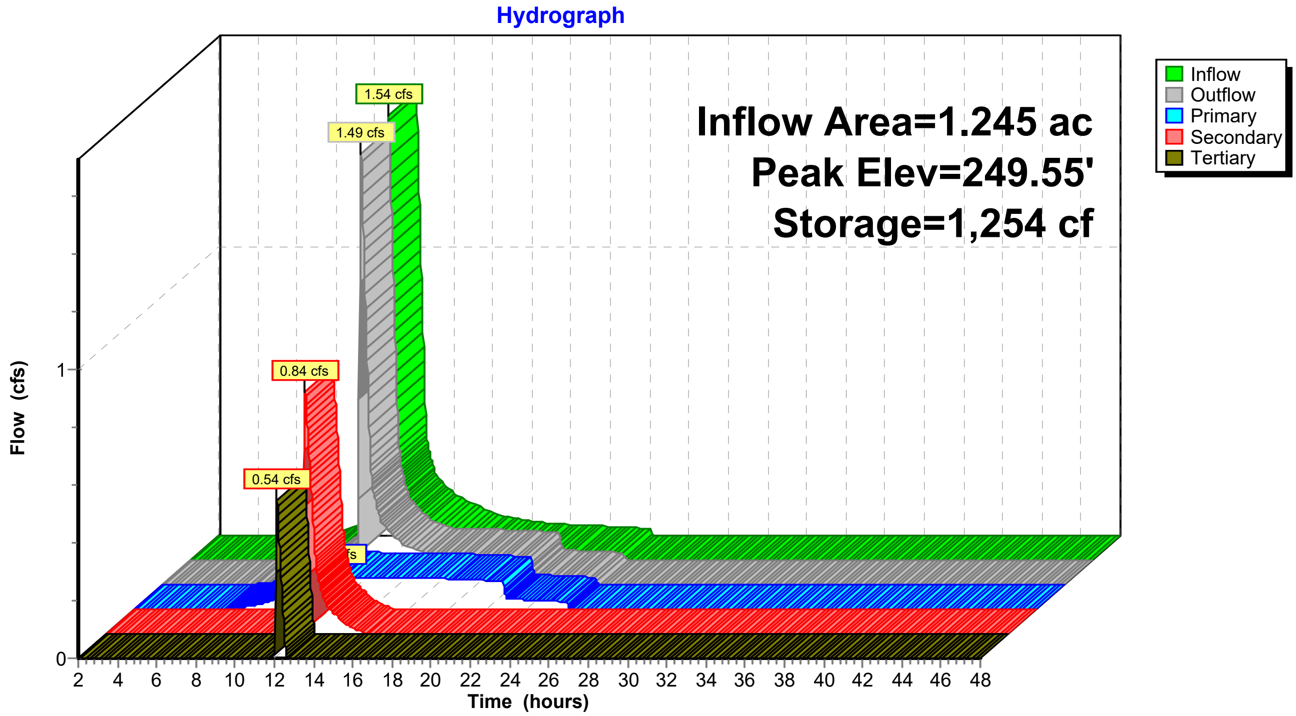
Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	249.45'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	249.50'	**20.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.11 cfs @ 12.13 hrs HW=249.55' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Secondary OutFlow Max=0.83 cfs @ 12.13 hrs HW=249.55' (Free Discharge)
└─**2=Culvert** (Passes 0.83 cfs of 6.06 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 0.83 cfs @ 1.04 fps)

Tertiary OutFlow Max=0.54 cfs @ 12.13 hrs HW=249.55' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.54 cfs @ 0.53 fps)

Pond 5P: BIORETENTION POOL 1



Summary for Pond 5PF: BIORETENTION FILTER

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 1.05" for 1-Year Event event
Inflow = 0.11 cfs @ 12.13 hrs, Volume= 0.109 af
Outflow = 0.09 cfs @ 11.14 hrs, Volume= 0.109 af, Atten= 21%, Lag= 0.0 min
Primary = 0.09 cfs @ 11.14 hrs, Volume= 0.109 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.63' @ 20.84 hrs Surf.Area= 1,965 sf Storage= 693 cf

Plug-Flow detention time= 73.2 min calculated for 0.109 af (100% of inflow)
Center-of-Mass det. time= 73.3 min (1,012.5 - 939.2)

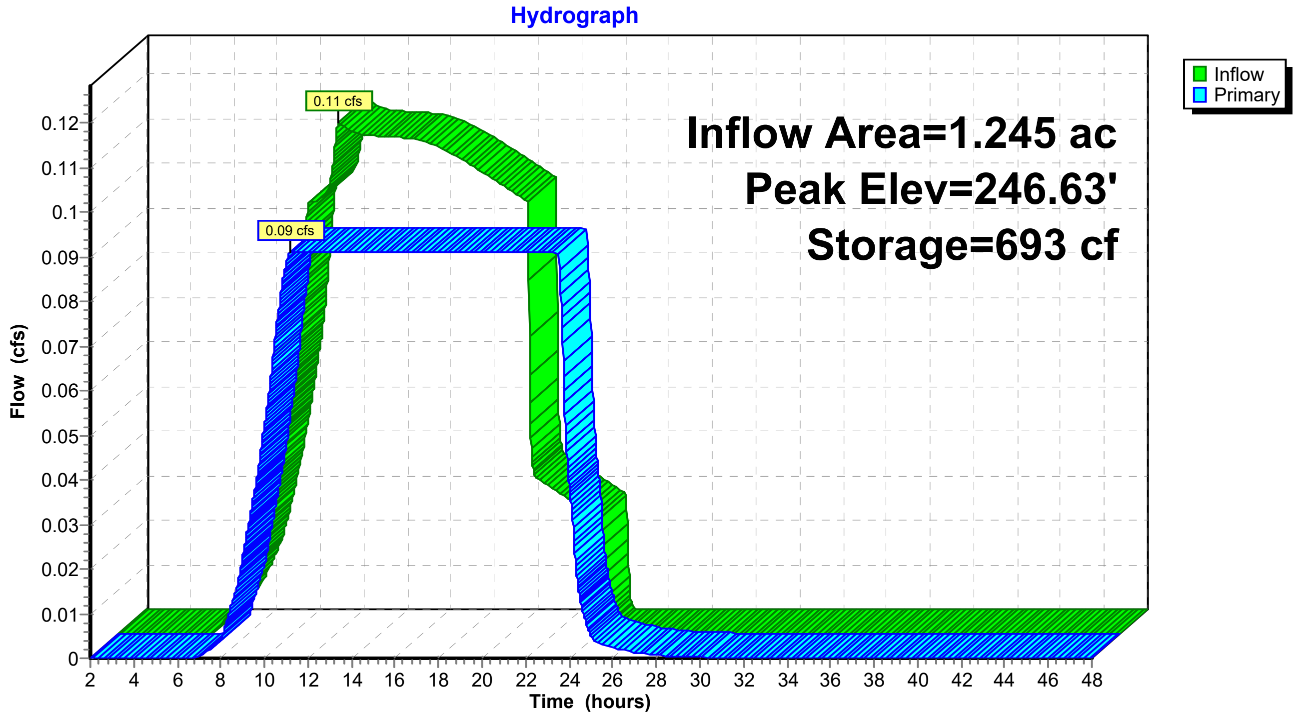
Volume	Invert	Avail.Storage	Storage Description
#1	245.75'	2,555 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 6,386 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.75	1,965	214.0	0	0	1,965
249.00	1,965	214.0	6,386	6,386	2,661

Device	Routing	Invert	Outlet Devices
#1	Primary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	245.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.09 cfs @ 11.14 hrs HW=245.91' (Free Discharge)
└─**1=Culvert** (Passes 0.09 cfs of 0.11 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 5PF: BIORETENTION FILTER



Summary for Pond 6P: BIORETENTION POOL 2

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 1.87" for 1-Year Event event
Inflow = 4.54 cfs @ 12.09 hrs, Volume= 0.466 af
Outflow = 4.25 cfs @ 12.13 hrs, Volume= 0.466 af, Atten= 6%, Lag= 2.8 min
Primary = 0.26 cfs @ 12.13 hrs, Volume= 0.269 af
Routed to Pond 6PF : BIORETENTION FILTER
Secondary = 2.74 cfs @ 12.13 hrs, Volume= 0.162 af
Routed to Pond 7P : Detention Basin
Tertiary = 1.25 cfs @ 12.13 hrs, Volume= 0.034 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 257.62' @ 12.13 hrs Surf.Area= 5,571 sf Storage= 3,250 cf

Plug-Flow detention time= 48.5 min calculated for 0.466 af (100% of inflow)
Center-of-Mass det. time= 48.5 min (846.3 - 797.8)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	5,437 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
257.00	4,885	362.0	0	0	4,885
258.00	6,009	386.0	5,437	5,437	6,362

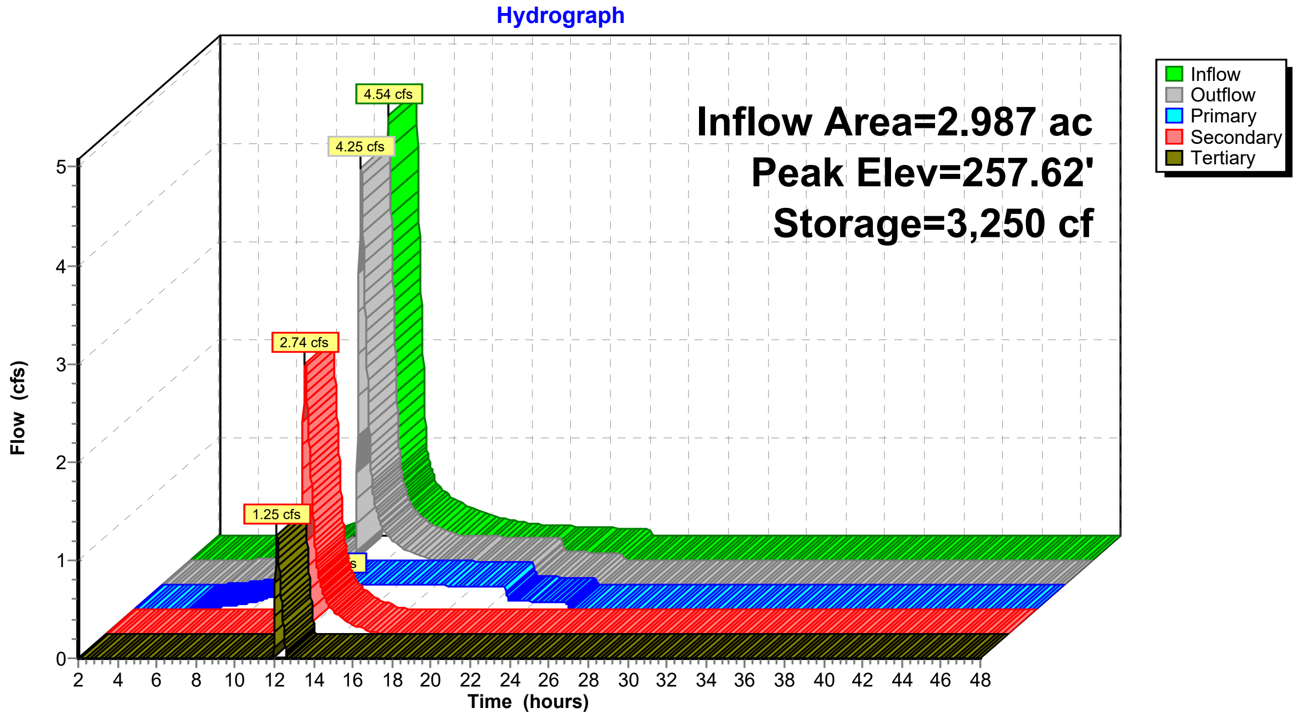
Device	Routing	Invert	Outlet Devices
#1	Primary	257.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	257.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	257.50'	**12.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.26 cfs @ 12.13 hrs HW=257.62' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.26 cfs)

Secondary OutFlow Max=2.73 cfs @ 12.13 hrs HW=257.62' (Free Discharge)
└─**2=Culvert** (Passes 2.73 cfs of 6.94 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 2.73 cfs @ 1.54 fps)

Tertiary OutFlow Max=1.25 cfs @ 12.13 hrs HW=257.62' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 1.25 cfs @ 0.83 fps)

Pond 6P: BIORETENTION POOL 2



Summary for Pond 6PF: BIORETENTION FILTER

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 1.08" for 1-Year Event event
Inflow = 0.26 cfs @ 12.13 hrs, Volume= 0.269 af
Outflow = 0.23 cfs @ 11.98 hrs, Volume= 0.269 af, Atten= 12%, Lag= 0.0 min
Primary = 0.23 cfs @ 11.98 hrs, Volume= 0.269 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 254.29' @ 20.94 hrs Surf.Area= 4,885 sf Storage= 1,048 cf

Plug-Flow detention time= 58.2 min calculated for 0.269 af (100% of inflow)
Center-of-Mass det. time= 58.6 min (972.8 - 914.2)

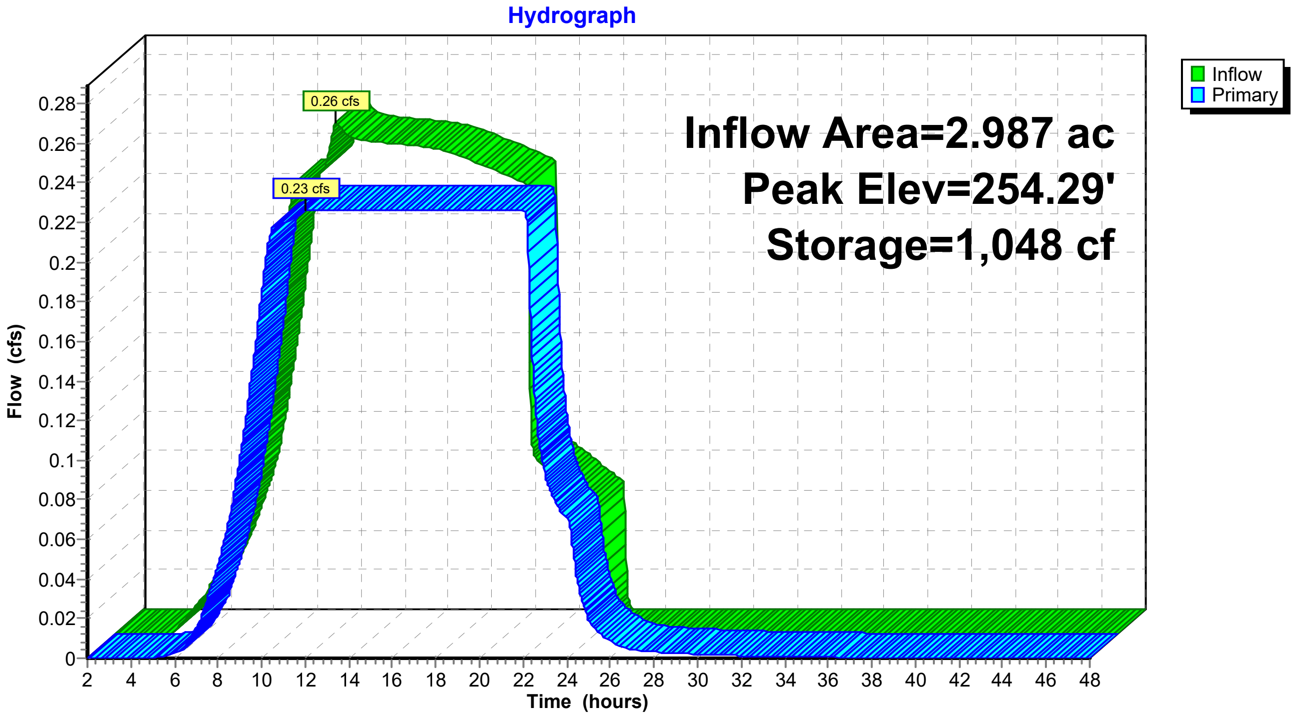
Volume	Invert	Avail.Storage	Storage Description
#1	253.75'	6,351 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 15,876 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.75	4,885	363.0	0	0	4,885
257.00	4,885	363.0	15,876	15,876	6,065

Device	Routing	Invert	Outlet Devices
#1	Primary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	253.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.23 cfs @ 11.98 hrs HW=254.01' (Free Discharge)
└─**1=Culvert** (Passes 0.23 cfs of 0.28 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 6PF: BIORETENTION FILTER



Summary for Pond 7P: Detention Basin

Inflow Area = 5.739 ac, 67.68% Impervious, Inflow Depth = 1.48" for 1-Year Event event
Inflow = 8.95 cfs @ 12.10 hrs, Volume= 0.707 af
Outflow = 3.17 cfs @ 12.45 hrs, Volume= 0.707 af, Atten= 65%, Lag= 21.0 min
Primary = 3.17 cfs @ 12.45 hrs, Volume= 0.707 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 240.56' @ 12.45 hrs Surf.Area= 5,370 sf Storage= 7,063 cf

Plug-Flow detention time= 63.7 min calculated for 0.707 af (100% of inflow)
Center-of-Mass det. time= 63.2 min (944.1 - 880.9)

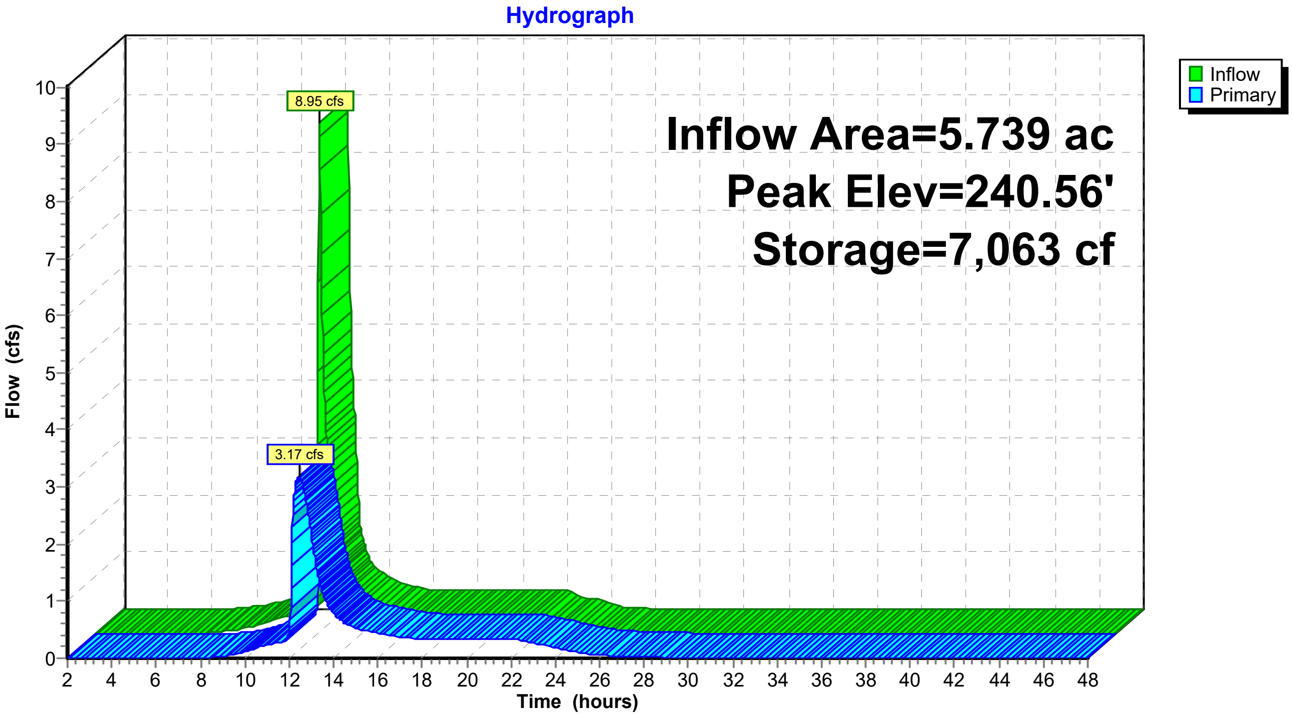
Volume	Invert	Avail.Storage	Storage Description
#1	239.00'	43,611 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
239.00	3,719	242.0	0	0	3,719
240.00	4,746	270.0	4,222	4,222	4,888
241.00	5,883	297.0	5,304	9,526	6,139
242.00	7,115	321.0	6,489	16,016	7,359
243.00	8,454	347.0	7,775	23,791	8,781
244.00	9,894	373.0	9,165	32,955	10,314
245.00	11,437	398.0	10,656	43,611	11,895

Device	Routing	Invert	Outlet Devices
#1	Primary	239.00'	**18.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 239.00' / 238.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	239.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	239.55'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	240.60'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	244.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.17 cfs @ 12.45 hrs HW=240.56' (Free Discharge)
└─**1=Culvert** (Passes 3.17 cfs of 7.67 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.08 cfs @ 5.51 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 2.09 cfs @ 4.18 fps)
  ├─**4=Orifice/Grate** (Controls 0.00 cfs)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Pond 7P: Detention Basin



Summary for Pond 8P: DIVERSION STRUCTURE

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 1.70" for 1-Year Event event
Inflow = 2.46 cfs @ 12.09 hrs, Volume= 0.177 af
Outflow = 2.46 cfs @ 12.09 hrs, Volume= 0.177 af, Atten= 0%, Lag= 0.0 min
Primary = 1.54 cfs @ 12.09 hrs, Volume= 0.166 af
Routed to Pond 5P : BIORETENTION POOL 1
Secondary = 0.92 cfs @ 12.09 hrs, Volume= 0.010 af
Routed to Pond 7P : Detention Basin

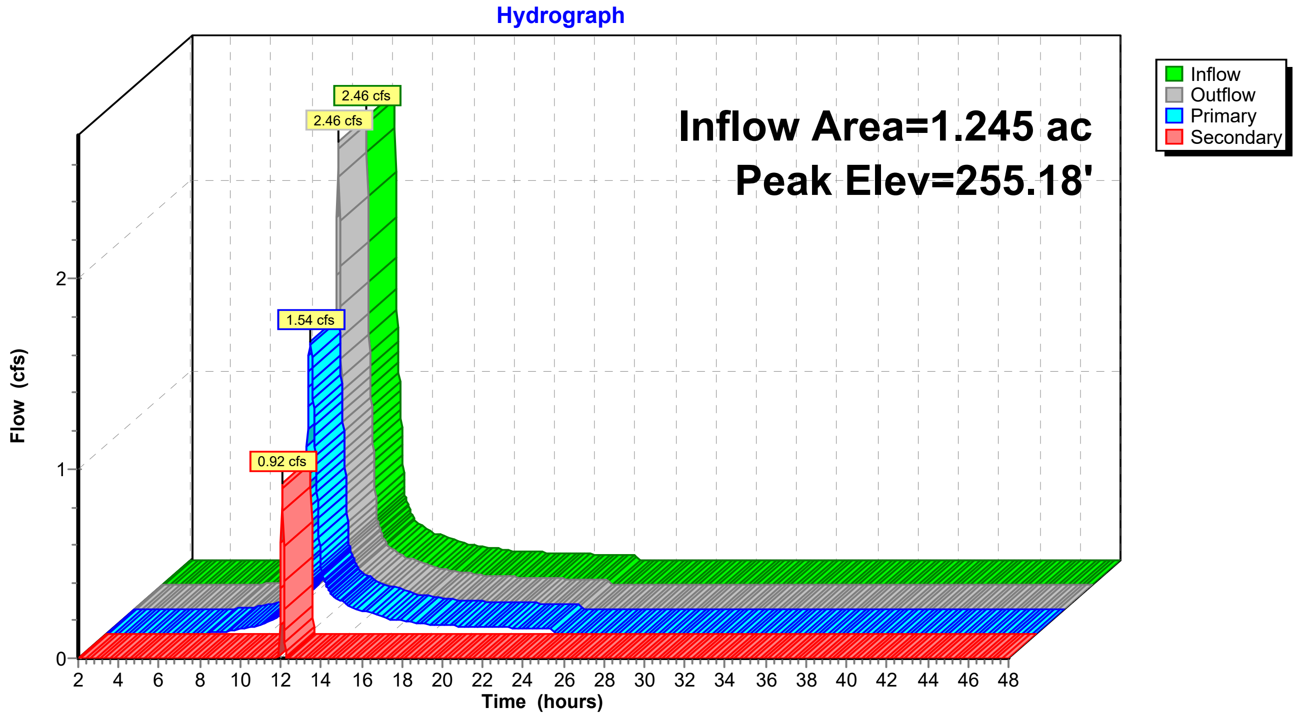
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 255.18' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	254.00'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.00' / 251.50' S= 0.0625 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.35 sf
#2	Secondary	254.75'	**18.0" Round Culvert** L= 90.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.75' / 249.00' S= 0.0639 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=1.54 cfs @ 12.09 hrs HW=255.17' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.54 cfs @ 4.41 fps)

Secondary OutFlow Max=0.91 cfs @ 12.09 hrs HW=255.17' (Free Discharge)
└─**2=Culvert** (Inlet Controls 0.91 cfs @ 2.21 fps)

Pond 8P: DIVERSION STRUCTURE



Summary for Pond 9P: DIVERSION STRUCTURE

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 1.97" for 1-Year Event event
Inflow = 6.62 cfs @ 12.09 hrs, Volume= 0.489 af
Outflow = 6.62 cfs @ 12.09 hrs, Volume= 0.489 af, Atten= 0%, Lag= 0.0 min
Primary = 4.54 cfs @ 12.09 hrs, Volume= 0.466 af
Routed to Pond 6P : BIORETENTION POOL 2
Secondary = 2.09 cfs @ 12.09 hrs, Volume= 0.023 af
Routed to Pond 7P : Detention Basin

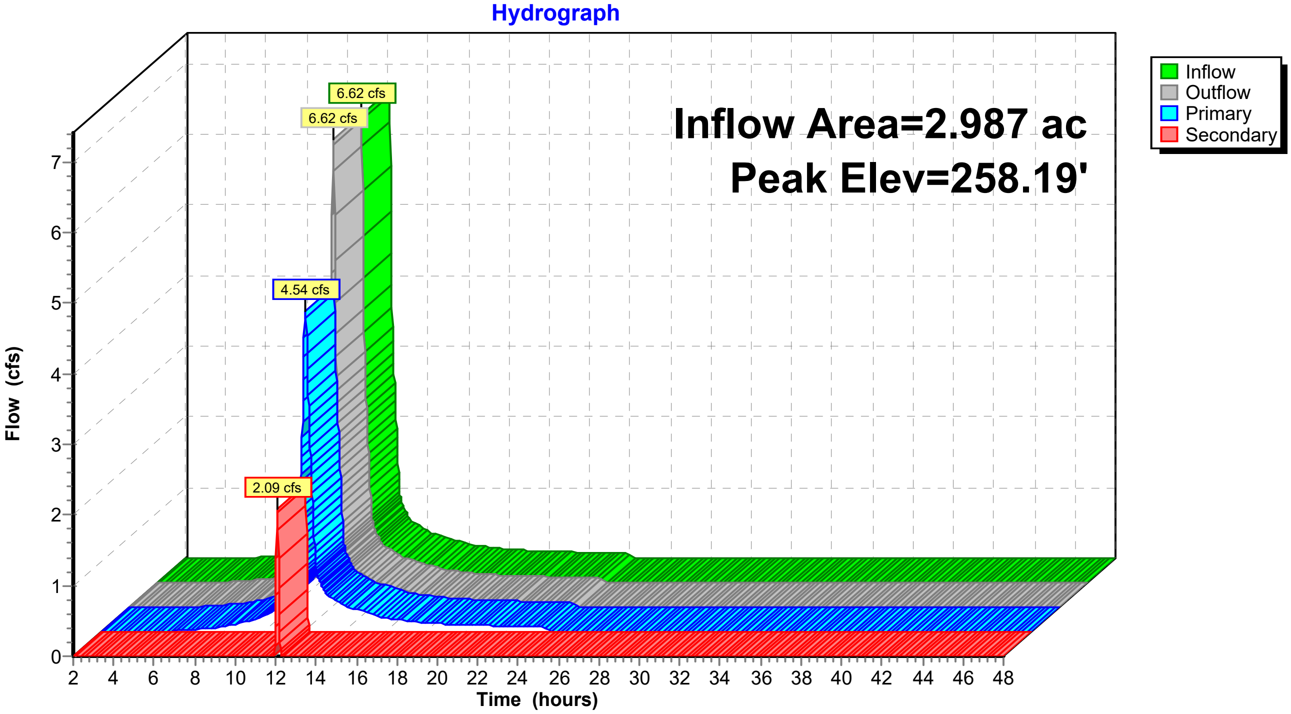
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 258.19' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	256.25'	**12.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 256.25' / 255.75' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	257.30'	**12.0" Round Culvert** L= 175.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 257.30' / 246.00' S= 0.0646 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=4.52 cfs @ 12.09 hrs HW=258.18' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.52 cfs @ 5.75 fps)

Secondary OutFlow Max=2.06 cfs @ 12.09 hrs HW=258.18' (Free Discharge)
└─**2=Culvert** (Inlet Controls 2.06 cfs @ 2.82 fps)

Pond 9P: DIVERSION STRUCTURE



Summary for Pond 10P: BIORETENTION POOL

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 2.06" for 1-Year Event event
Inflow = 0.22 cfs @ 12.08 hrs, Volume= 0.016 af
Outflow = 0.20 cfs @ 12.12 hrs, Volume= 0.016 af, Atten= 7%, Lag= 2.0 min
Primary = 0.03 cfs @ 12.12 hrs, Volume= 0.013 af
Routed to Pond 11P : DRY SWALE FILTER
Secondary = 0.17 cfs @ 12.12 hrs, Volume= 0.004 af
Routed to Pond 12P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 248.40' @ 12.12 hrs Surf.Area= 262 sf Storage= 90 cf

Plug-Flow detention time= 11.3 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 11.3 min (798.9 - 787.6)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

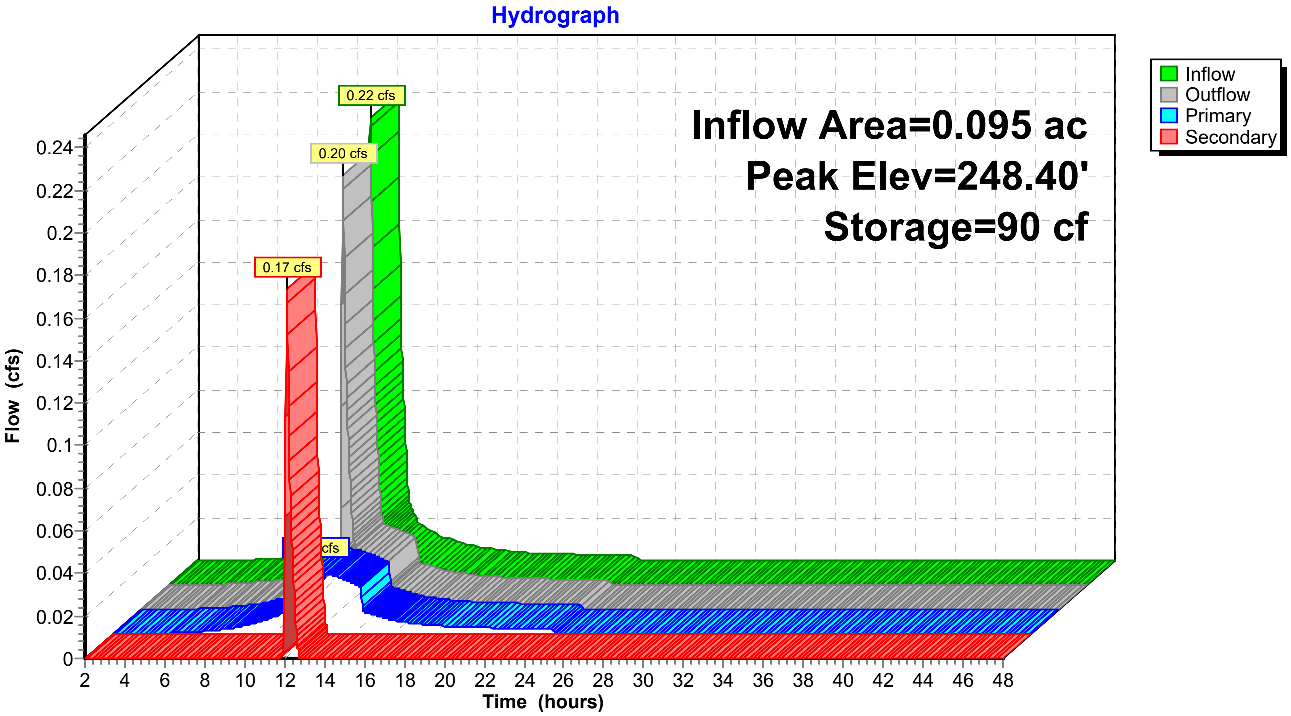
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
248.00	190	60.0	0	0	190
249.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	248.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	248.30'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.03 cfs @ 12.12 hrs HW=248.40' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.17 cfs @ 12.12 hrs HW=248.40' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.17 cfs @ 0.88 fps)

Pond 10P: BIORETENTION POOL



Summary for Pond 11P: DRY SWALE FILTER

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 1.59" for 1-Year Event event
Inflow = 0.03 cfs @ 12.12 hrs, Volume= 0.013 af
Outflow = 0.02 cfs @ 11.42 hrs, Volume= 0.013 af, Atten= 40%, Lag= 0.0 min
Primary = 0.02 cfs @ 11.42 hrs, Volume= 0.013 af
Routed to Reach 14R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.58' @ 14.46 hrs Surf.Area= 391 sf Storage= 90 cf

Plug-Flow detention time= 31.1 min calculated for 0.013 af (100% of inflow)
Center-of-Mass det. time= 31.1 min (849.4 - 818.4)

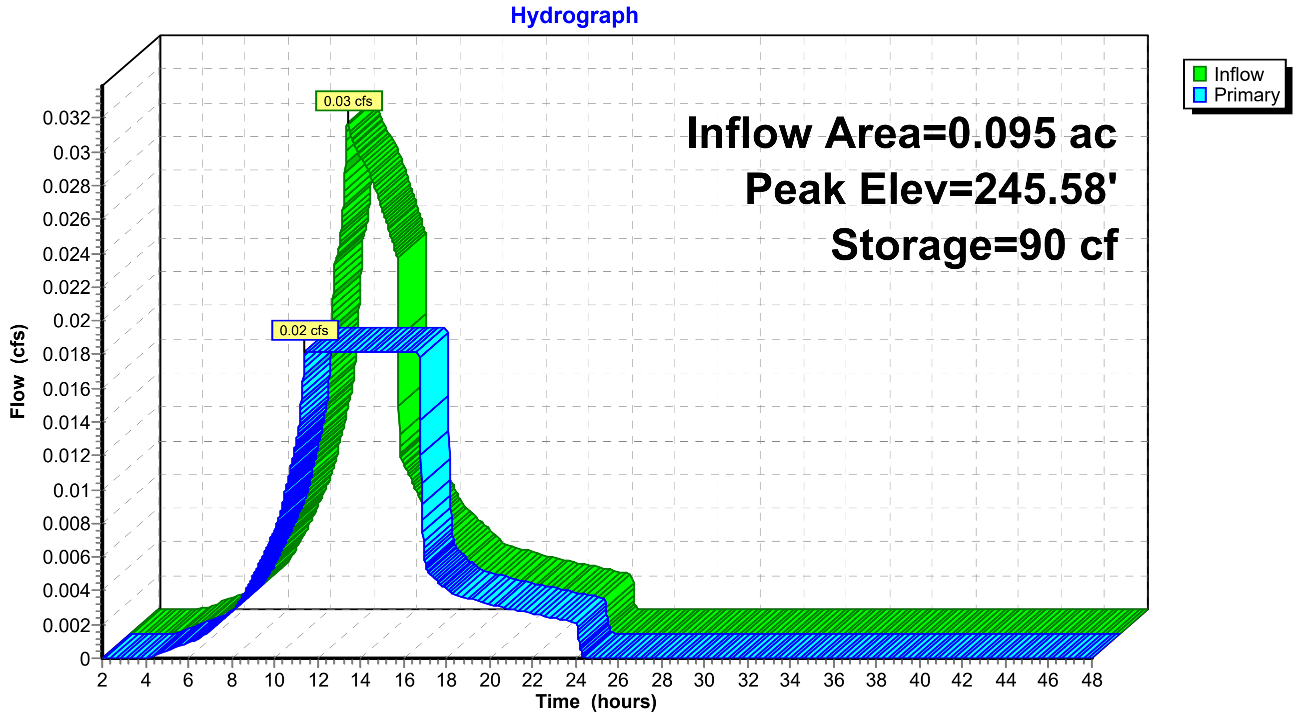
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 11.42 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 11P: DRY SWALE FILTER



Summary for Pond 12P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 2.82" for 1-Year Event event
Inflow = 0.23 cfs @ 12.11 hrs, Volume= 0.008 af
Outflow = 0.09 cfs @ 12.32 hrs, Volume= 0.008 af, Atten= 60%, Lag= 12.3 min
Primary = 0.03 cfs @ 12.32 hrs, Volume= 0.007 af
Routed to Pond 13P : DRY SWALE FILTER
Secondary = 0.06 cfs @ 12.32 hrs, Volume= 0.001 af
Routed to Pond 14P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.55' @ 12.32 hrs Surf.Area= 291 sf Storage= 131 cf

Plug-Flow detention time= 25.2 min calculated for 0.008 af (100% of inflow)
Center-of-Mass det. time= 25.2 min (805.9 - 780.7)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

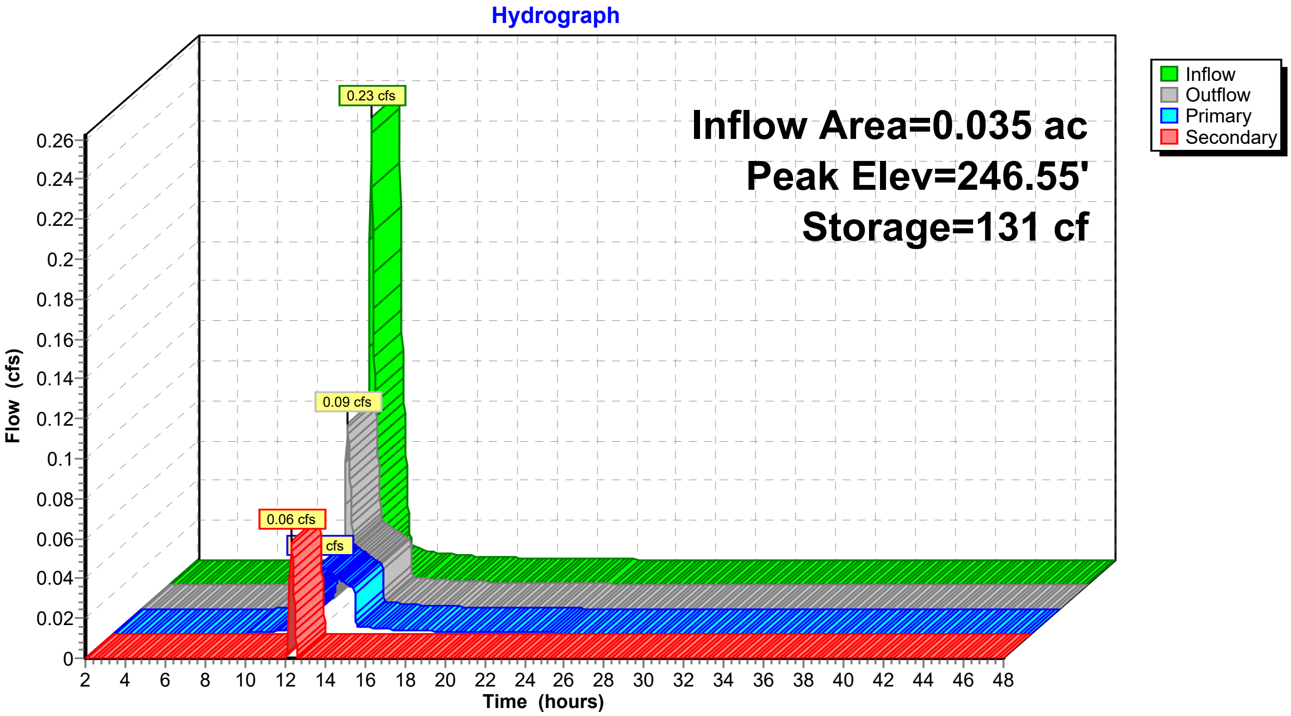
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.03 cfs @ 12.32 hrs HW=246.55' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.06 cfs @ 12.32 hrs HW=246.55' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.06 cfs @ 0.61 fps)

Pond 12P: BIORETENTION POOL



Summary for Pond 13P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 2.45" for 1-Year Event event
Inflow = 0.03 cfs @ 12.32 hrs, Volume= 0.007 af
Outflow = 0.02 cfs @ 11.94 hrs, Volume= 0.007 af, Atten= 46%, Lag= 0.0 min
Primary = 0.02 cfs @ 11.94 hrs, Volume= 0.007 af
Routed to Reach 15R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.54' @ 14.12 hrs Surf.Area= 391 sf Storage= 85 cf

Plug-Flow detention time= 35.0 min calculated for 0.007 af (100% of inflow)
Center-of-Mass det. time= 35.0 min (850.3 - 815.3)

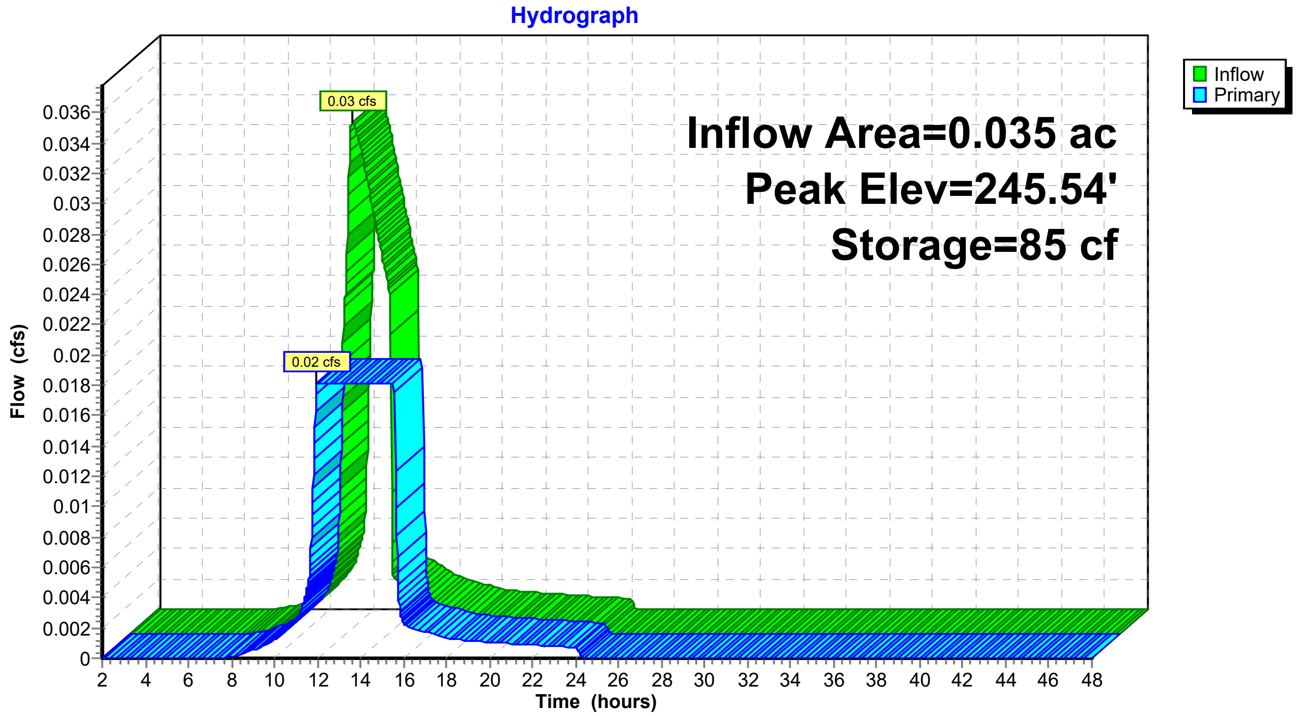
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 11.94 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 13P: DRY SWALE FILTER



Summary for Pond 14P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 1.91" for 1-Year Event event
Inflow = 0.09 cfs @ 12.31 hrs, Volume= 0.006 af
Outflow = 0.03 cfs @ 12.53 hrs, Volume= 0.006 af, Atten= 67%, Lag= 13.5 min
Primary = 0.03 cfs @ 12.53 hrs, Volume= 0.006 af
Routed to Pond 15P : DRY SWALE FILTER
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-5 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.30' @ 12.53 hrs Surf.Area= 243 sf Storage= 65 cf

Plug-Flow detention time= 13.5 min calculated for 0.006 af (100% of inflow)
Center-of-Mass det. time= 13.5 min (818.4 - 804.9)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

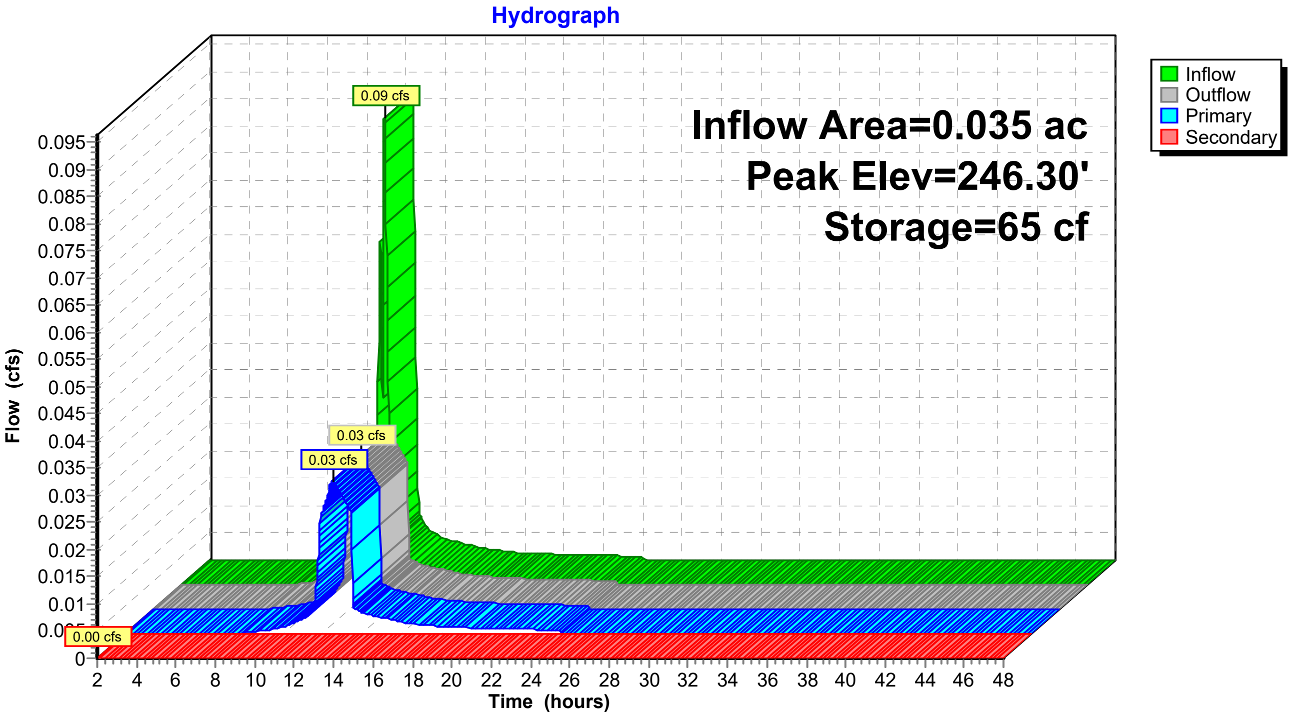
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.03 cfs @ 12.53 hrs HW=246.30' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=246.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 14P: BIORETENTION POOL



Summary for Pond 15P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 1.91" for 1-Year Event event
Inflow = 0.03 cfs @ 12.53 hrs, Volume= 0.006 af
Outflow = 0.02 cfs @ 11.94 hrs, Volume= 0.006 af, Atten= 36%, Lag= 0.0 min
Primary = 0.02 cfs @ 11.94 hrs, Volume= 0.006 af
Routed to Reach 4R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.29' @ 13.51 hrs Surf.Area= 391 sf Storage= 45 cf

Plug-Flow detention time= 16.6 min calculated for 0.006 af (100% of inflow)
Center-of-Mass det. time= 16.6 min (835.0 - 818.4)

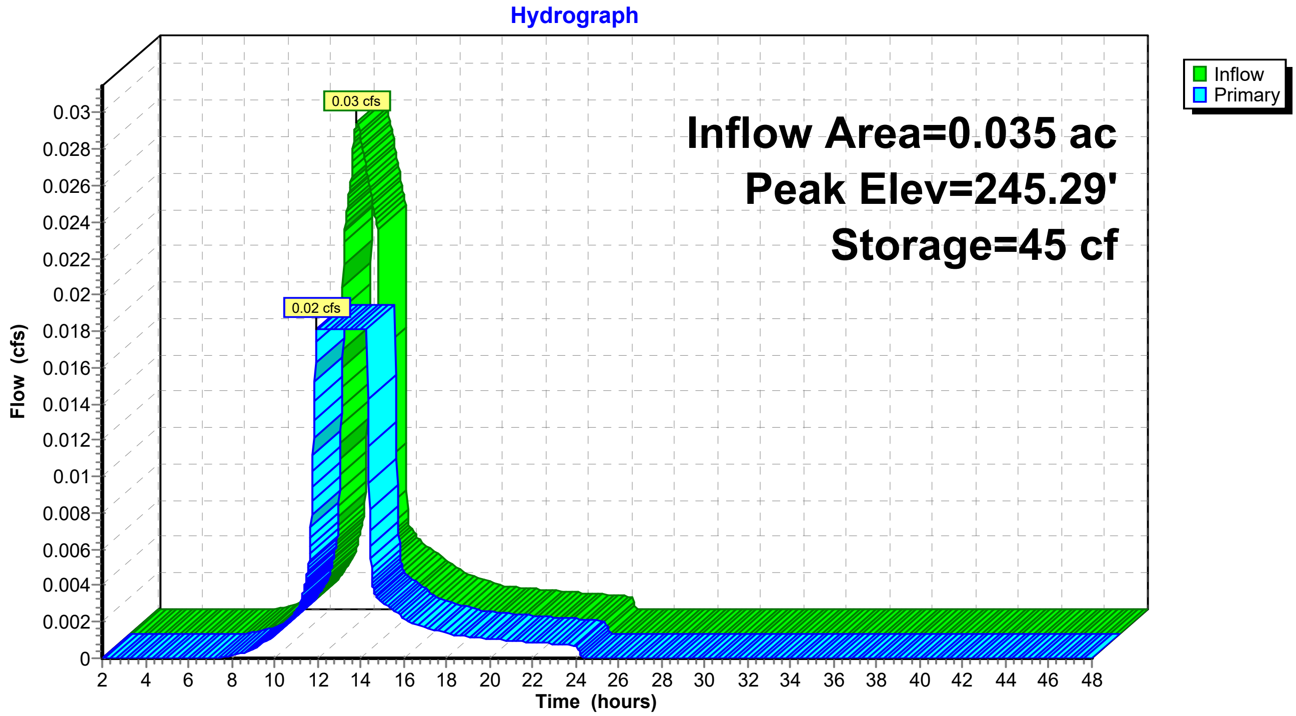
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 11.94 hrs HW=245.03' (Free Discharge)
1=Culvert (Passes 0.02 cfs of 0.50 cfs potential flow)
2=Exfiltration (Exfiltration Controls 0.02 cfs)

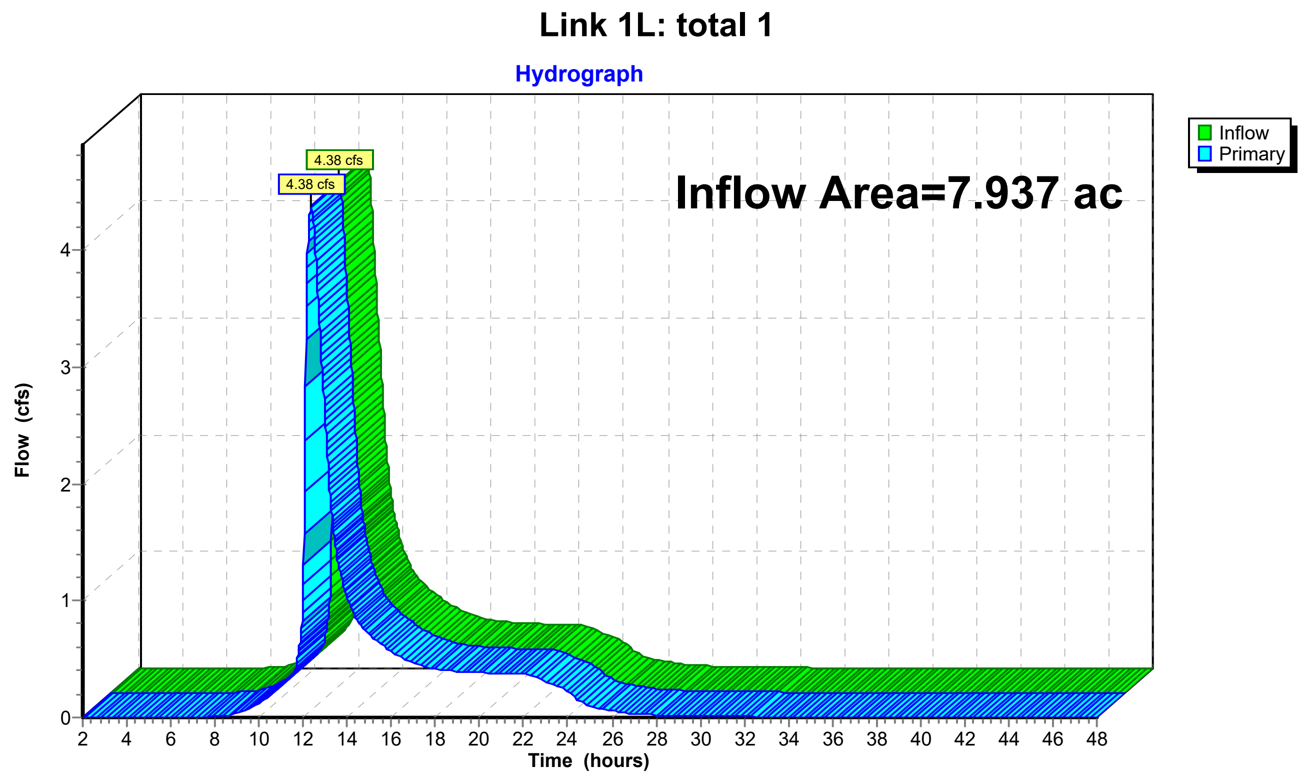
Pond 15P: DRY SWALE FILTER



Summary for Link 1L: total 1

Inflow Area =	7.937 ac,	50.38% Impervious,	Inflow Depth > 1.34"	for 1-Year Event event
Inflow =	4.38 cfs @	12.35 hrs, Volume=	0.889 af	
Primary =	4.38 cfs @	12.35 hrs, Volume=	0.889 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

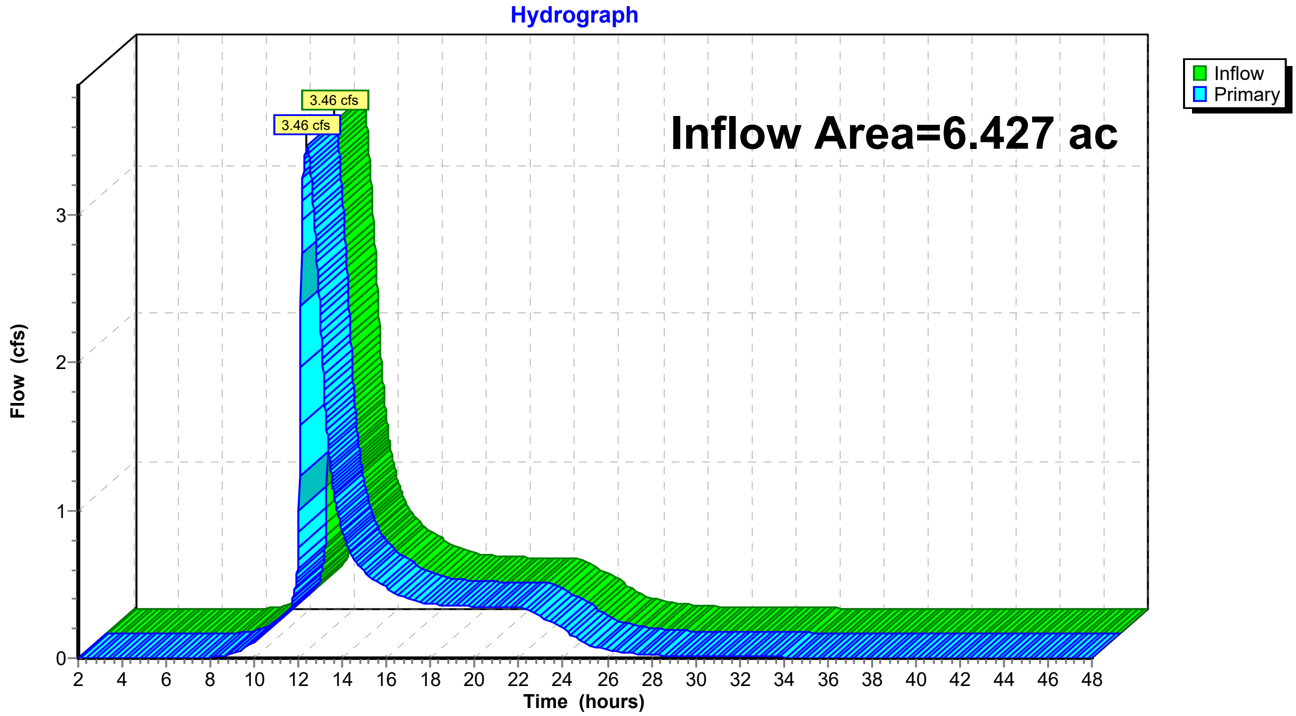


Summary for Link AP-1: Q

Inflow Area = 6.427 ac, 60.43% Impervious, Inflow Depth > 1.42" for 1-Year Event event
Inflow = 3.46 cfs @ 12.37 hrs, Volume= 0.762 af
Primary = 3.46 cfs @ 12.37 hrs, Volume= 0.762 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-1: Q



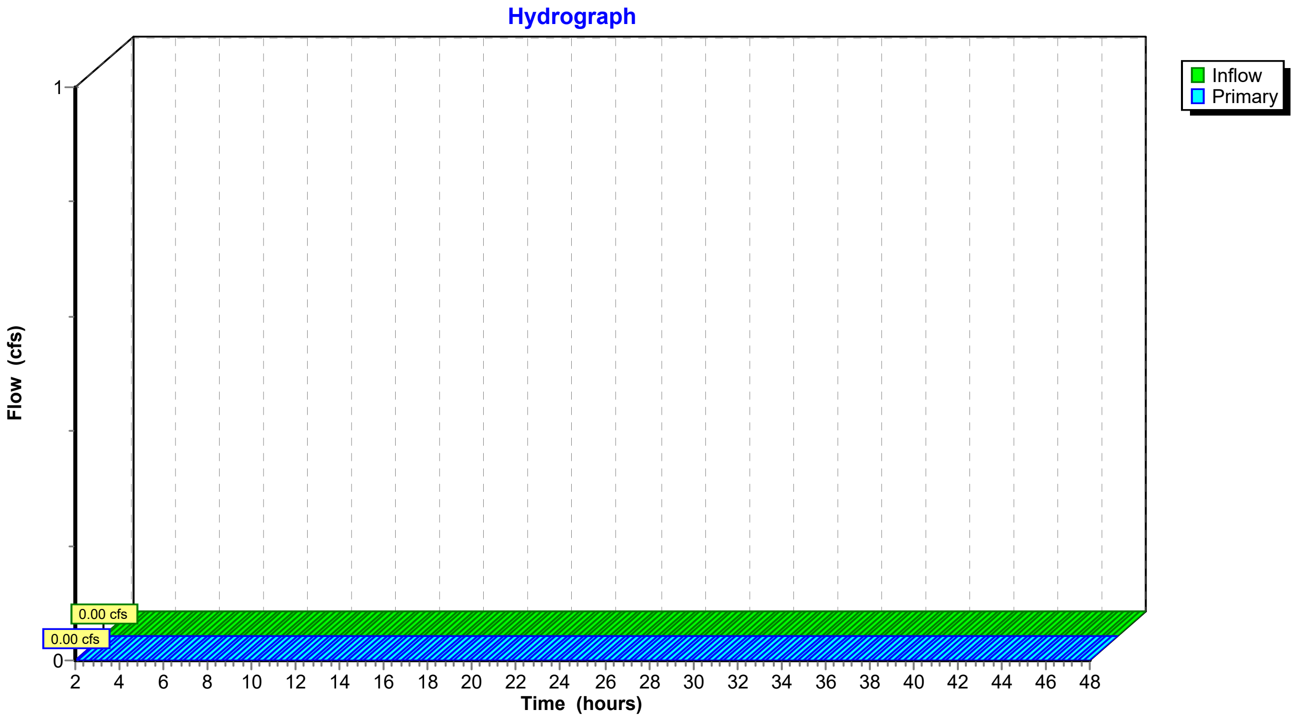
Summary for Link AP-2: Q

Inflow	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af
Primary	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-2: Q

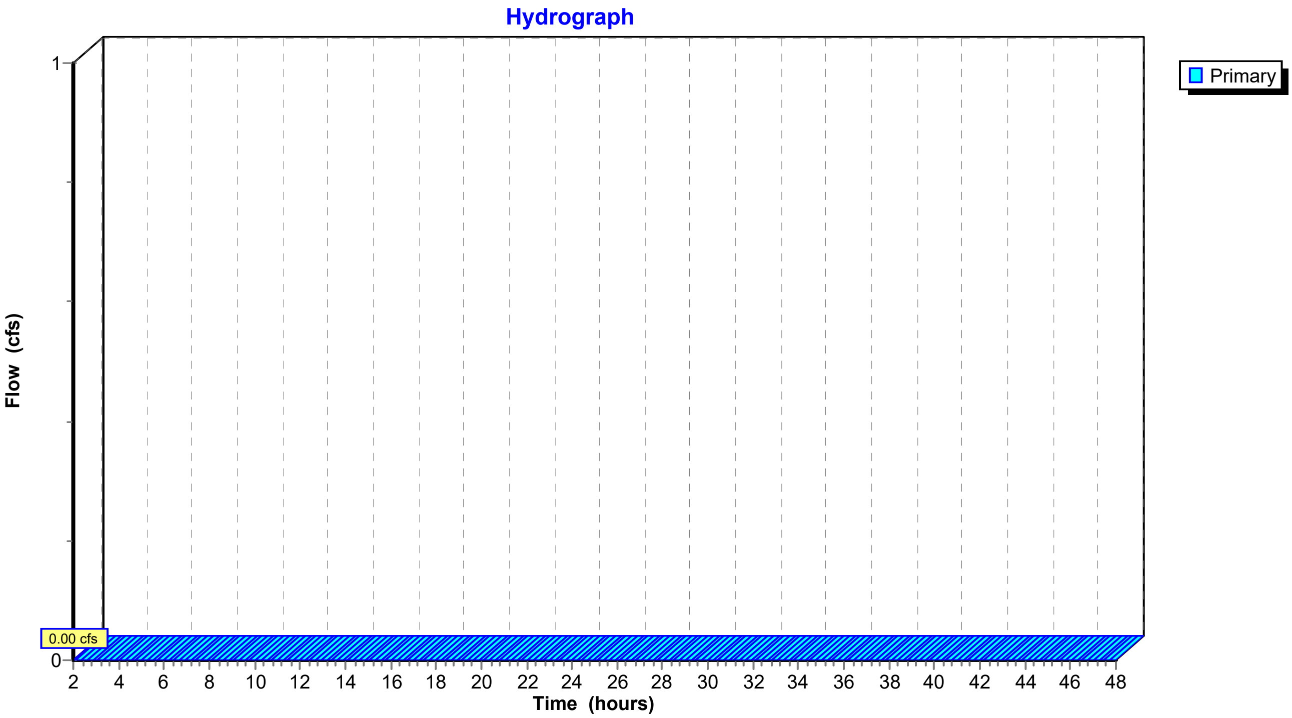


Summary for Link AP-3: Q

Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-3: Q

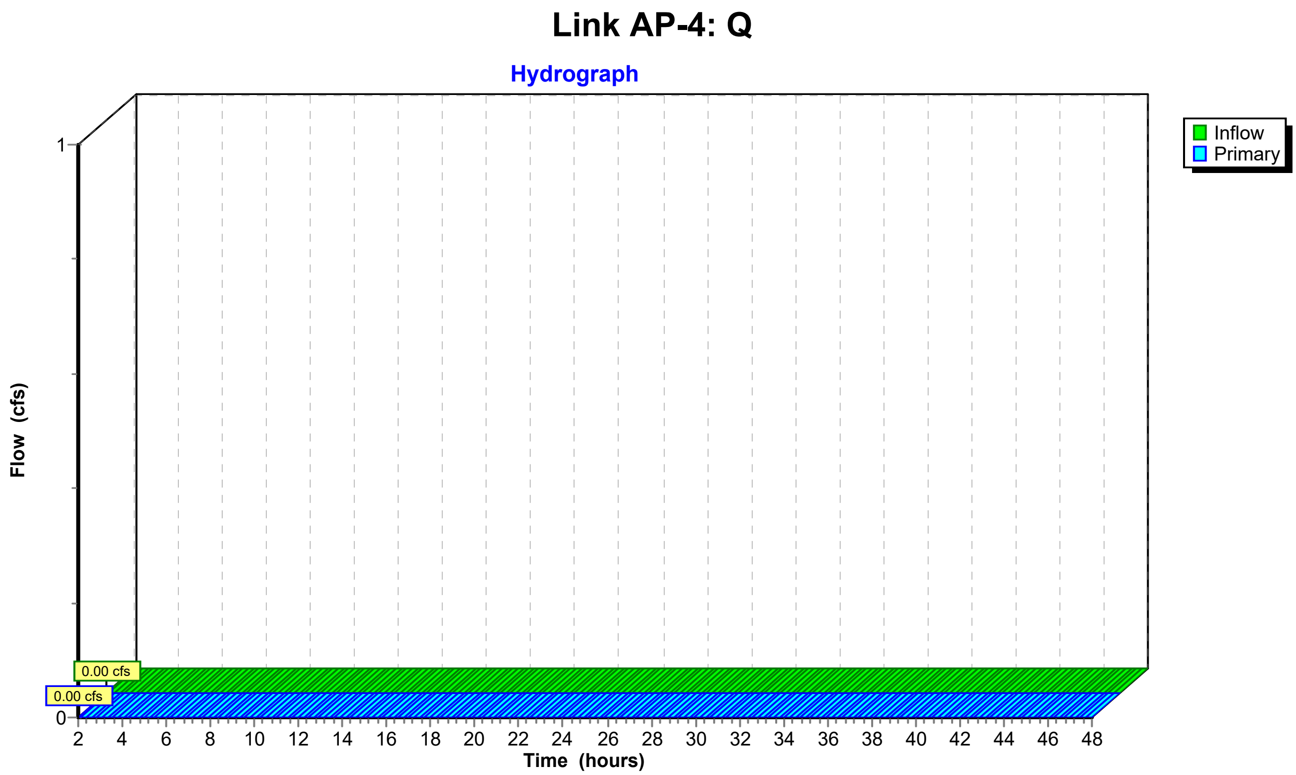


Summary for Link AP-4: Q

Inflow	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af	
Primary	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af,	Atten= 0%, Lag= 0.0 min

Routed to Link 1L : total 1

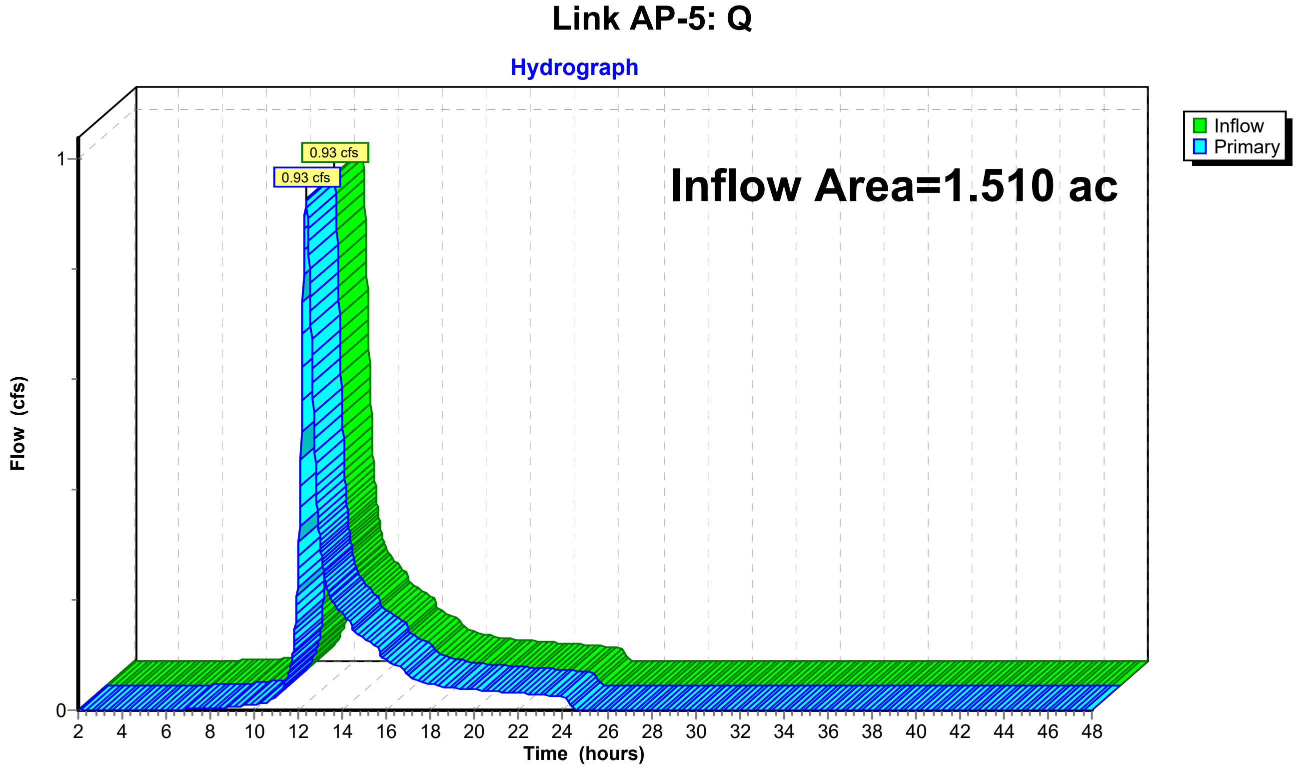
Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs



Summary for Link AP-5: Q

Inflow Area = 1.510 ac, 7.62% Impervious, Inflow Depth = 1.01" for 1-Year Event event
Inflow = 0.93 cfs @ 12.33 hrs, Volume= 0.127 af
Primary = 0.93 cfs @ 12.33 hrs, Volume= 0.127 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs



Time span=2.00-48.00 hrs, dt=0.02 hrs, 2301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1: Subarea 1 Runoff Area=1.040 ac 79.62% Impervious Runoff Depth=4.00"
Flow Length=100' Slope=0.0080 '/' Tc=14.2 min CN=94 Runoff=3.54 cfs 0.347 af

Subcatchment1A: Subarea 1A Runoff Area=0.205 ac 0.00% Impervious Runoff Depth=2.62"
Tc=6.0 min CN=80 Runoff=0.63 cfs 0.045 af

Subcatchment2: Subarea 2 Runoff Area=0.789 ac 61.98% Impervious Runoff Depth=3.68"
Tc=6.0 min CN=91 Runoff=3.27 cfs 0.242 af

Subcatchment2S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=3.48"
Tc=6.0 min CN=89 Runoff=0.14 cfs 0.010 af

Subcatchment3: Subarea 3 Runoff Area=1.019 ac 78.21% Impervious Runoff Depth=4.00"
Flow Length=592' Tc=10.8 min CN=94 Runoff=3.82 cfs 0.340 af

Subcatchment3S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=3.48"
Tc=6.0 min CN=89 Runoff=0.14 cfs 0.010 af

Subcatchment4: Subarea 4 Runoff Area=1.245 ac 60.80% Impervious Runoff Depth=3.68"
Flow Length=100' Tc=6.0 min CN=91 Runoff=5.16 cfs 0.382 af

Subcatchment4A: Subarea 4A Runoff Area=0.488 ac 0.00% Impervious Runoff Depth=2.62"
Tc=6.0 min CN=80 Runoff=1.50 cfs 0.107 af

Subcatchment4B: Subarea 4B Runoff Area=0.688 ac 0.00% Impervious Runoff Depth=2.62"
Flow Length=178' Tc=6.2 min CN=80 Runoff=2.10 cfs 0.150 af

Subcatchment5: Subarea 5 Runoff Area=2.987 ac 78.00% Impervious Runoff Depth=4.00"
Flow Length=35' Slope=0.0080 '/' Tc=6.2 min CN=94 Runoff=12.98 cfs 0.996 af

Subcatchment5A: Subarea 5A Runoff Area=1.345 ac 0.00% Impervious Runoff Depth=2.54"
Flow Length=279' Tc=22.5 min CN=79 Runoff=2.57 cfs 0.284 af

Subcatchment6: Subarea 6 Runoff Area=0.095 ac 82.11% Impervious Runoff Depth=4.11"
Tc=6.0 min CN=95 Runoff=0.42 cfs 0.033 af

Subcatchment7: Subarea 3 Runoff Area=0.471 ac 35.46% Impervious Runoff Depth=3.18"
Flow Length=574' Tc=7.3 min CN=86 Runoff=1.66 cfs 0.125 af

Reach 4R: UNDERDRAIN Avg. Flow Depth=0.07' Max Vel=3.59 fps Inflow=0.05 cfs 0.043 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.05 cfs 0.043 af

Reach 14R: UNDERDRAIN Avg. Flow Depth=0.04' Max Vel=2.58 fps Inflow=0.02 cfs 0.021 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.02 cfs 0.021 af

Reach 15R: UNDERDRAIN Avg. Flow Depth=0.05' Max Vel=3.18 fps Inflow=0.04 cfs 0.032 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.04 cfs 0.032 af

Pond 1P: Infiltration Basin 3 Peak Elev=259.67' Storage=2,091 cf Inflow=1.66 cfs 0.125 af
Discarded=0.21 cfs 0.125 af Secondary=0.00 cfs 0.000 af Outflow=0.21 cfs 0.125 af

Pond 2P: Infiltration Basin 1 Peak Elev=262.18' Storage=7,393 cf Inflow=3.96 cfs 0.392 af
Discarded=0.46 cfs 0.392 af Secondary=0.00 cfs 0.000 af Outflow=0.46 cfs 0.392 af

Pond 3P: Infiltration Basin 2 Peak Elev=260.79' Storage=3,467 cf Inflow=3.27 cfs 0.242 af
Discarded=0.44 cfs 0.242 af Secondary=0.00 cfs 0.000 af Outflow=0.44 cfs 0.242 af

Pond 4P: Infiltration Basin 4 Peak Elev=261.24' Storage=2,515 cf Inflow=3.82 cfs 0.340 af
Discarded=0.59 cfs 0.260 af Primary=3.03 cfs 0.080 af Secondary=0.00 cfs 0.000 af Outflow=3.62 cfs 0.340 af

Pond 5P: BIORETENTION POOL 1 Peak Elev=249.56' Storage=1,286 cf Inflow=1.89 cfs 0.319 af
Primary=0.12 cfs 0.154 af Secondary=1.00 cfs 0.124 af Tertiary=0.76 cfs 0.041 af Outflow=1.88 cfs 0.319 af

Pond 5PF: BIORETENTION FILTER Peak Elev=247.11' Storage=1,068 cf Inflow=0.12 cfs 0.154 af
Outflow=0.09 cfs 0.154 af

Pond 6P: BIORETENTION POOL 2 Peak Elev=257.69' Storage=3,649 cf Inflow=7.41 cfs 0.881 af
Primary=0.26 cfs 0.371 af Secondary=4.15 cfs 0.412 af Tertiary=2.52 cfs 0.098 af Outflow=6.94 cfs 0.881 af

Pond 6PF: BIORETENTION FILTER Peak Elev=254.51' Storage=1,484 cf Inflow=0.26 cfs 0.371 af
Outflow=0.23 cfs 0.371 af

Pond 7P: Detention Basin Peak Elev=242.12' Storage=16,852 cf Inflow=20.54 cfs 1.565 af
Outflow=9.32 cfs 1.564 af

Pond 8P: DIVERSION STRUCTURE Peak Elev=255.60' Inflow=5.16 cfs 0.382 af
Primary=1.89 cfs 0.319 af Secondary=3.26 cfs 0.063 af Outflow=5.16 cfs 0.382 af

Pond 9P: DIVERSION STRUCTURE Peak Elev=260.58' Inflow=12.98 cfs 0.996 af
Primary=7.41 cfs 0.881 af Secondary=5.57 cfs 0.115 af Outflow=12.98 cfs 0.996 af

Pond 10P: BIORETENTION POOL Peak Elev=248.47' Storage=107 cf Inflow=0.42 cfs 0.033 af
Primary=0.03 cfs 0.021 af Secondary=0.38 cfs 0.012 af Outflow=0.41 cfs 0.033 af

Pond 11P: DRY SWALE FILTER Peak Elev=246.10' Storage=172 cf Inflow=0.03 cfs 0.021 af
Outflow=0.02 cfs 0.021 af

Pond 12P: BIORETENTION POOL Peak Elev=246.69' Storage=173 cf Inflow=0.51 cfs 0.022 af
Primary=0.04 cfs 0.011 af Secondary=0.45 cfs 0.011 af Outflow=0.49 cfs 0.022 af

Pond 13P: DRY SWALE FILTER Peak Elev=245.84' Storage=131 cf Inflow=0.04 cfs 0.011 af
Outflow=0.02 cfs 0.011 af

Pond 14P: BIORETENTION POOL Peak Elev=246.69' Storage=176 cf Inflow=0.58 cfs 0.021 af
Primary=0.04 cfs 0.011 af Secondary=0.48 cfs 0.010 af Outflow=0.52 cfs 0.021 af

Pond 15P: DRY SWALE FILTER Peak Elev=245.75' Storage=117 cf Inflow=0.04 cfs 0.011 af
Outflow=0.02 cfs 0.011 af

Link 1L: total 1	Inflow=13.11 cfs 2.052 af Primary=13.11 cfs 2.052 af
Link AP-1: Q	Inflow=10.24 cfs 1.715 af Primary=10.24 cfs 1.715 af
Link AP-2: Q	Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af
Link AP-3: Q	Primary=0.00 cfs 0.000 af
Link AP-4: Q	Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af
Link AP-5: Q	Inflow=2.88 cfs 0.337 af Primary=2.88 cfs 0.337 af

Total Runoff Area = 10.442 ac Runoff Volume = 3.071 af Average Runoff Depth = 3.53"
47.49% Pervious = 4.959 ac 52.51% Impervious = 5.483 ac

Summary for Subcatchment 1: Subarea 1

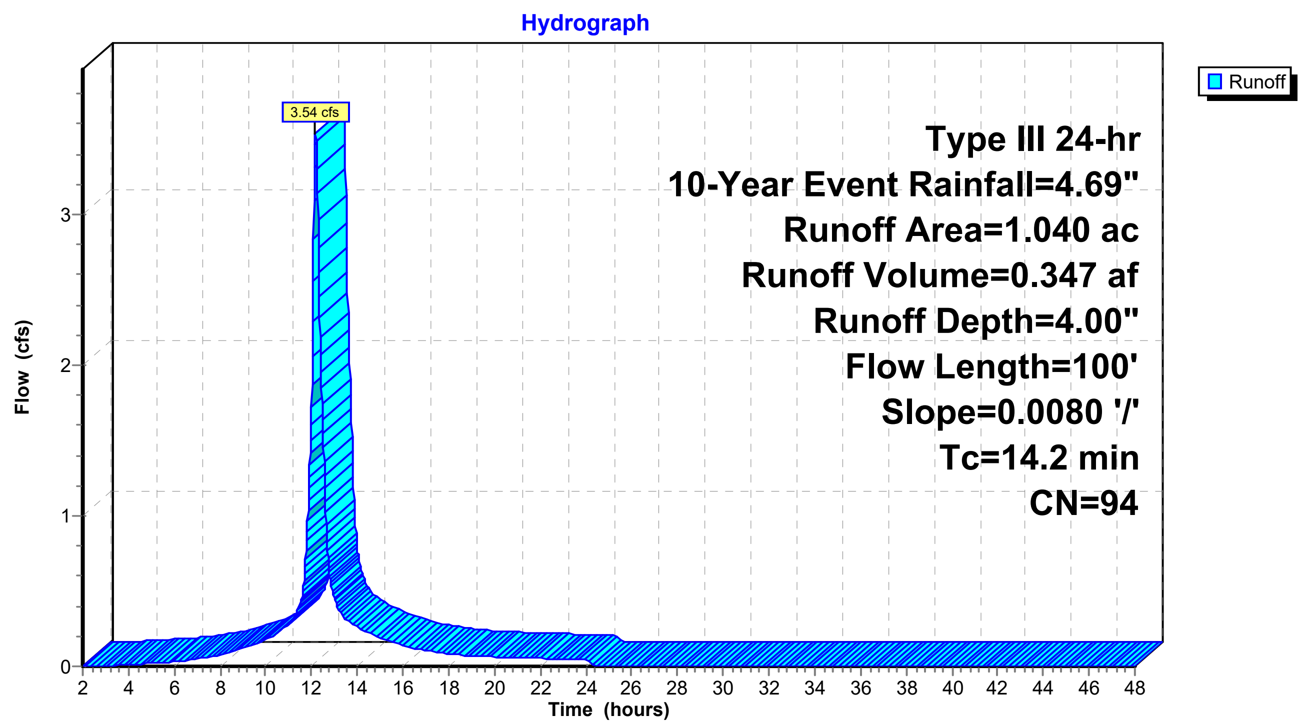
Runoff = 3.54 cfs @ 12.19 hrs, Volume= 0.347 af, Depth= 4.00"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.212	80	>75% Grass cover, Good, HSG D
0.828	98	Paved parking, HSG C
1.040	94	Weighted Average
0.212		20.38% Pervious Area
0.828		79.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	100	0.0080	0.12		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 1: Subarea 1



Summary for Subcatchment 1A: Subarea 1A

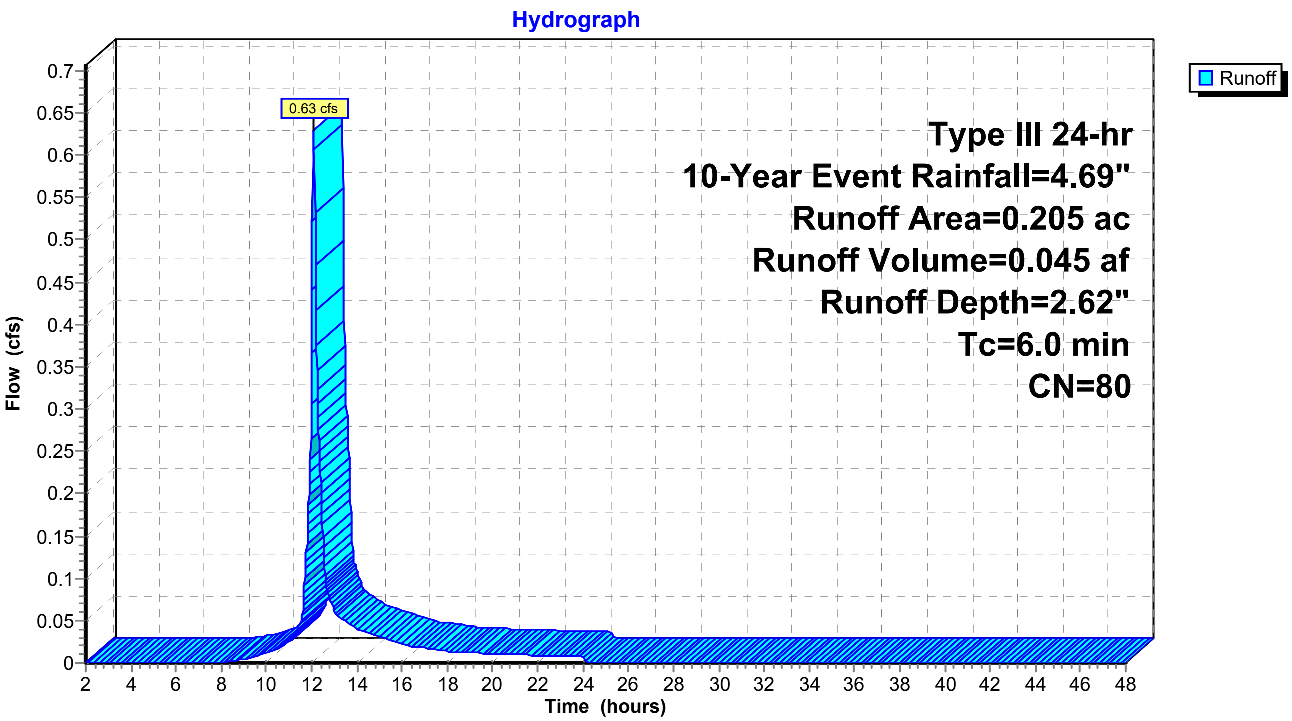
Runoff = 0.63 cfs @ 12.09 hrs, Volume= 0.045 af, Depth= 2.62"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.205	80	>75% Grass cover, Good, HSG D
0.205		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Minimm**

Subcatchment 1A: Subarea 1A



Summary for Subcatchment 2: Subarea 2

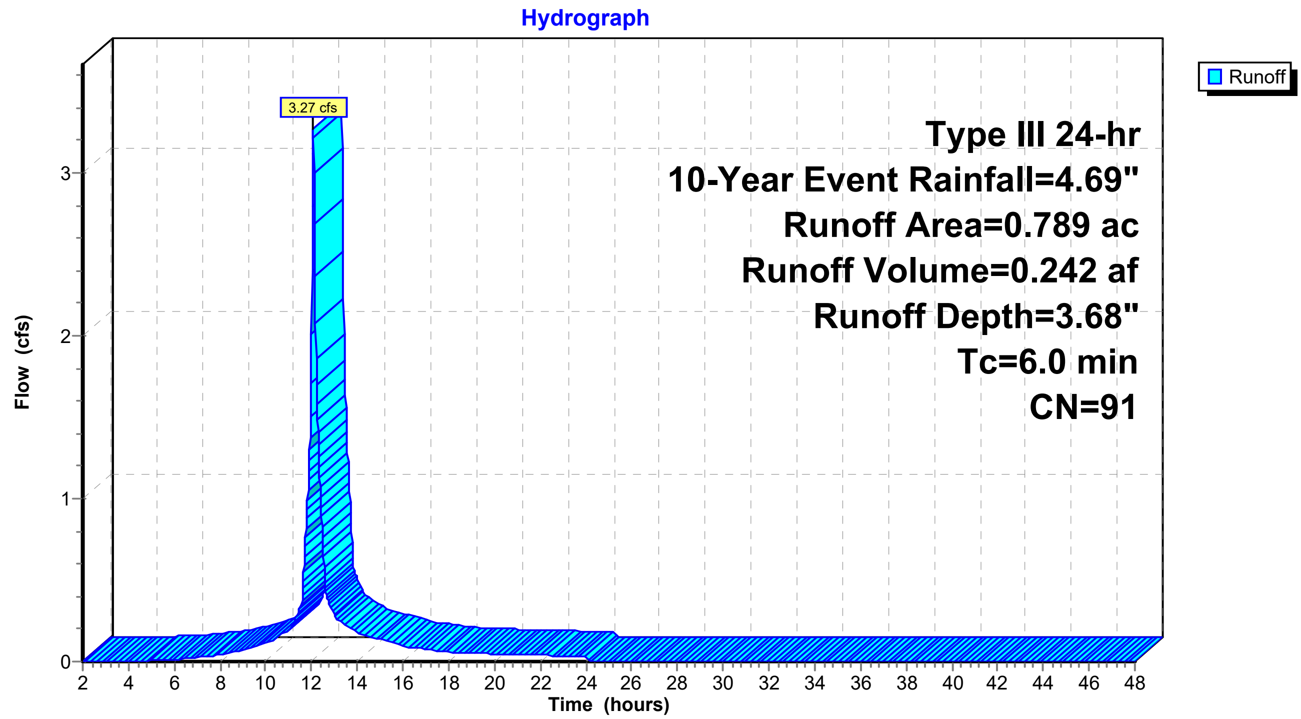
Runoff = 3.27 cfs @ 12.08 hrs, Volume= 0.242 af, Depth= 3.68"
Routed to Pond 3P : Infiltration Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.300	80	>75% Grass cover, Good, HSG D
0.489	98	Paved parking, HSG C
0.789	91	Weighted Average
0.300		38.02% Pervious Area
0.489		61.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MinTC**

Subcatchment 2: Subarea 2



Summary for Subcatchment 2S: Subarea 6

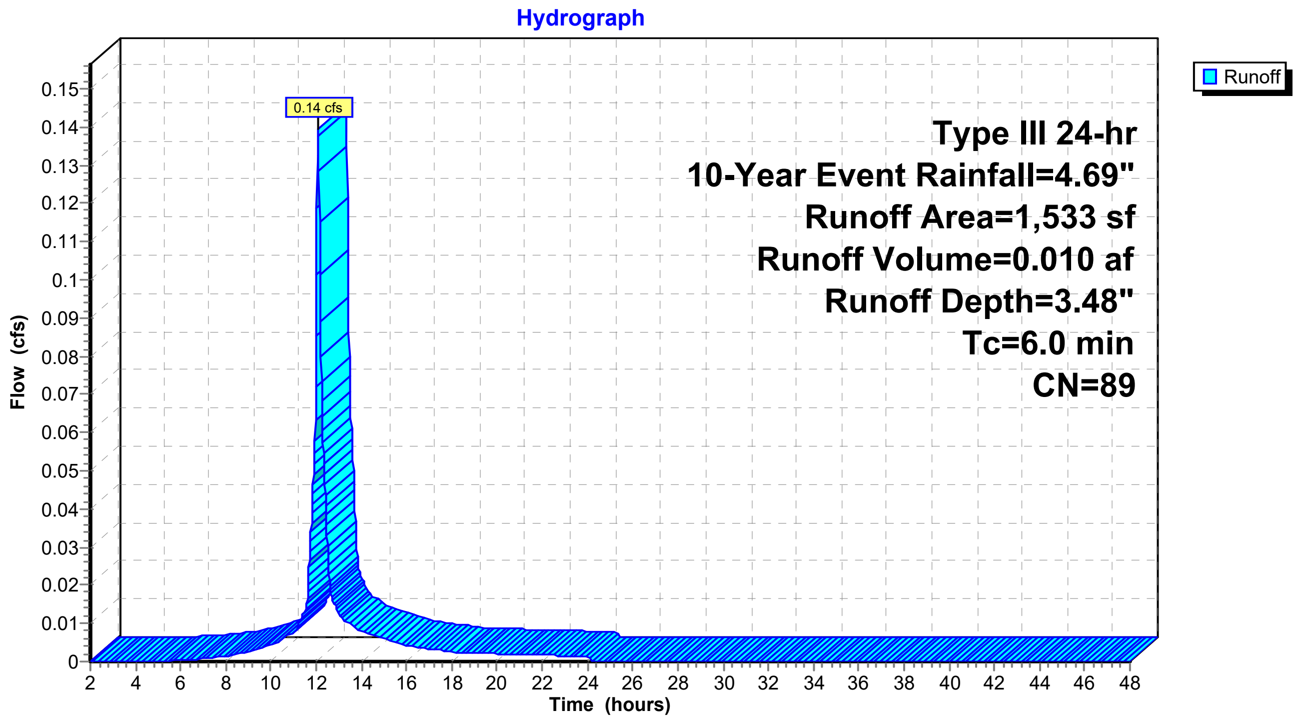
Runoff = 0.14 cfs @ 12.09 hrs, Volume= 0.010 af, Depth= 3.48"
Routed to Pond 12P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 2S: Subarea 6



Summary for Subcatchment 3: Subarea 3

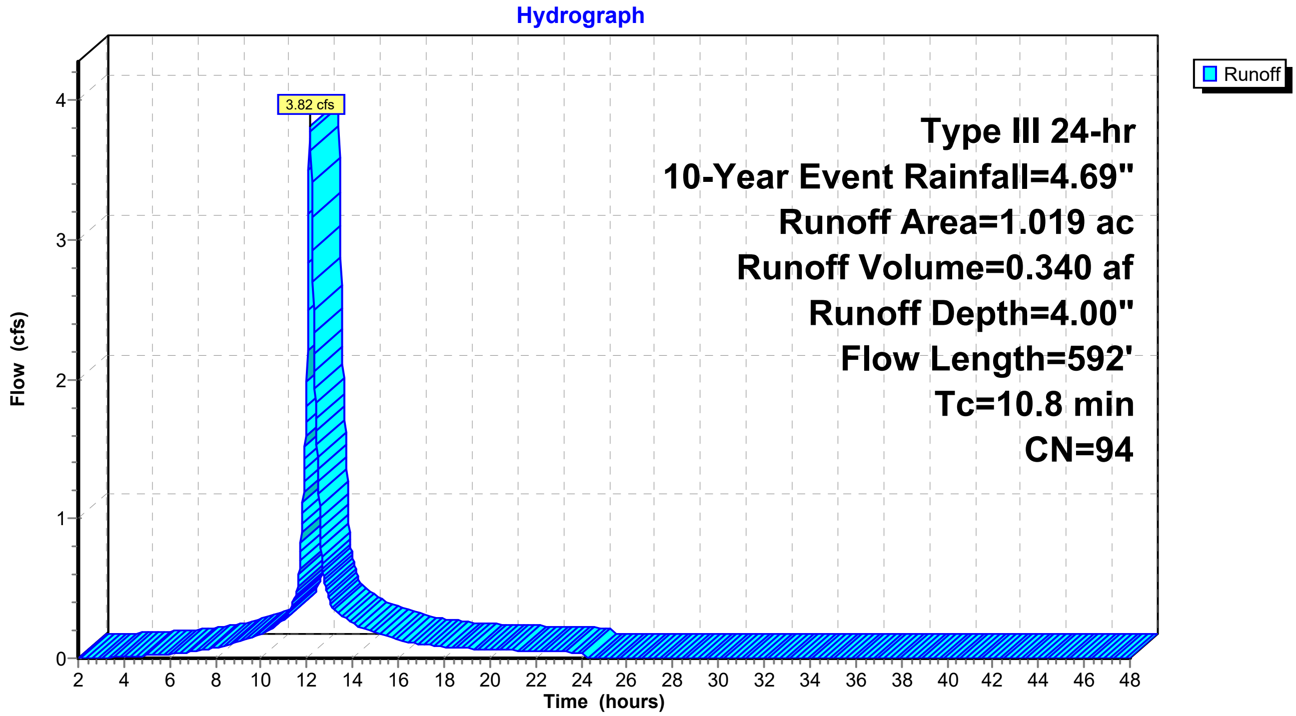
Runoff = 3.82 cfs @ 12.14 hrs, Volume= 0.340 af, Depth= 4.00"
Routed to Pond 4P : Infiltration Basin 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.222	80	>75% Grass cover, Good, HSG D
0.797	98	Paved parking, HSG C
1.019	94	Weighted Average
0.222		21.79% Pervious Area
0.797		78.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	53	0.0100	0.11		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
10.8	592	Total			

Subcatchment 3: Subarea 3



Summary for Subcatchment 3S: Subarea 6

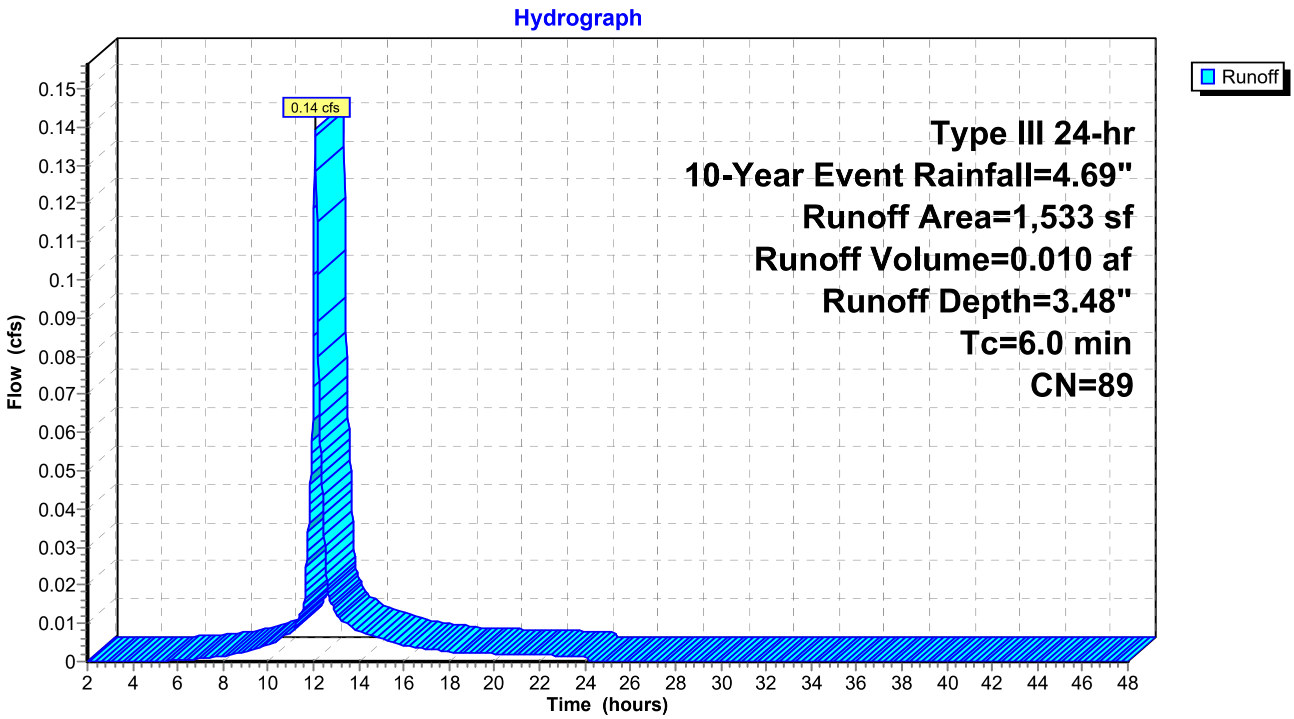
Runoff = 0.14 cfs @ 12.09 hrs, Volume= 0.010 af, Depth= 3.48"
Routed to Pond 14P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 3S: Subarea 6



Summary for Subcatchment 4: Subarea 4

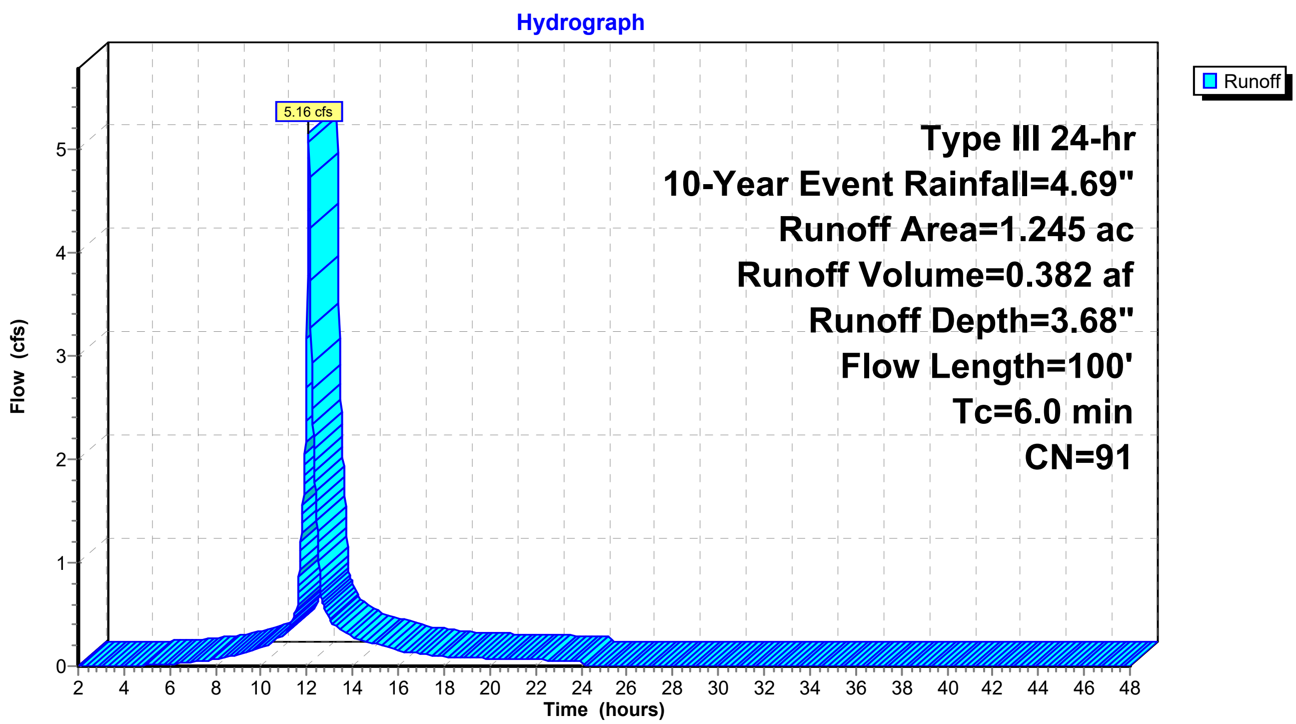
Runoff = 5.16 cfs @ 12.08 hrs, Volume= 0.382 af, Depth= 3.68"
Routed to Pond 8P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.757	98	Paved parking, HSG C
1.245	91	Weighted Average
0.488		39.20% Pervious Area
0.757		60.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	55	0.0900	0.27		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.9	45	0.2500	0.40		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
5.3	100	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4: Subarea 4



Summary for Subcatchment 4A: Subarea 4A

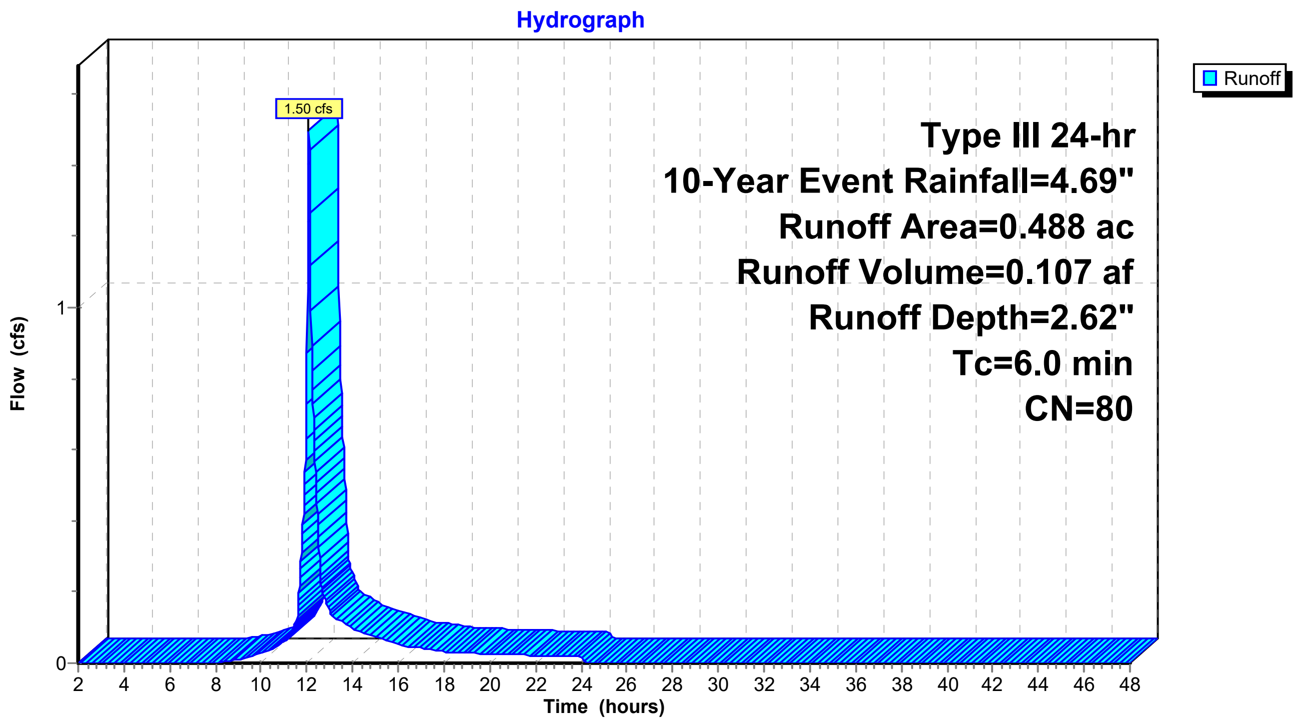
Runoff = 1.50 cfs @ 12.09 hrs, Volume= 0.107 af, Depth= 2.62"
Routed to Pond 7P : Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.488		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 4A: Subarea 4A



Summary for Subcatchment 4B: Subarea 4B

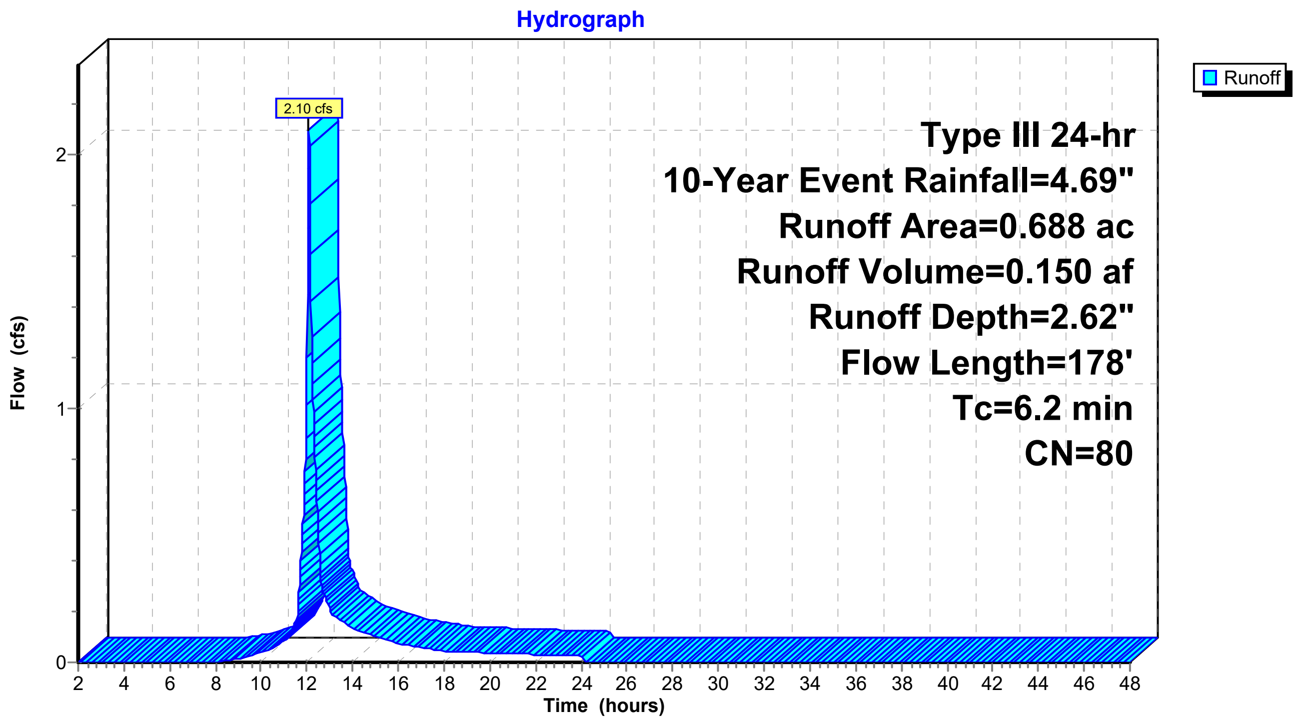
Runoff = 2.10 cfs @ 12.09 hrs, Volume= 0.150 af, Depth= 2.62"
Routed to Link AP-1 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.654	80	>75% Grass cover, Good, HSG D
0.034	77	Woods, Good, HSG D
0.688	80	Weighted Average
0.688		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.8	78	0.0100	1.61		**Shallow Concentrated Flow, Lawn** Unpaved Kv= 16.1 fps
6.2	178	Total			

Subcatchment 4B: Subarea 4B



Summary for Subcatchment 5: Subarea 5

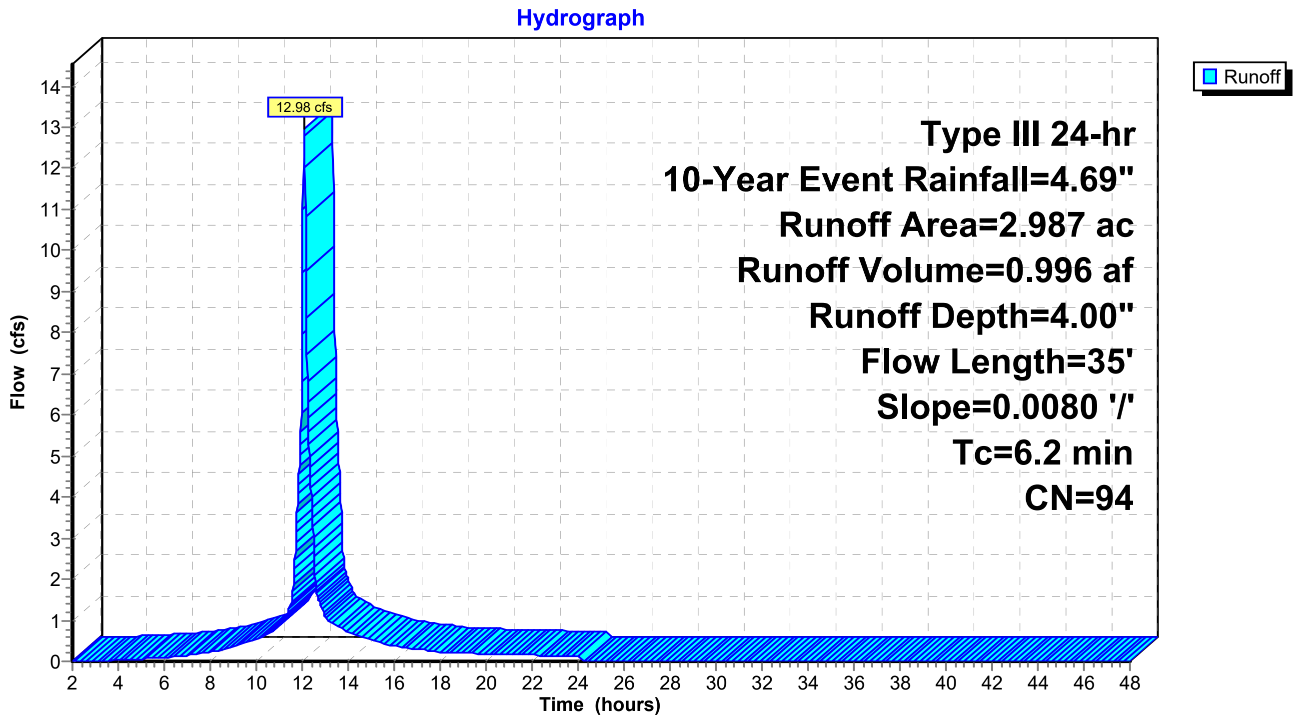
Runoff = 12.98 cfs @ 12.09 hrs, Volume= 0.996 af, Depth= 4.00"
Routed to Pond 9P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.657	80	>75% Grass cover, Good, HSG D
2.330	98	Paved parking, HSG C
2.987	94	Weighted Average
0.657		22.00% Pervious Area
2.330		78.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 5: Subarea 5



Summary for Subcatchment 5A: Subarea 5A

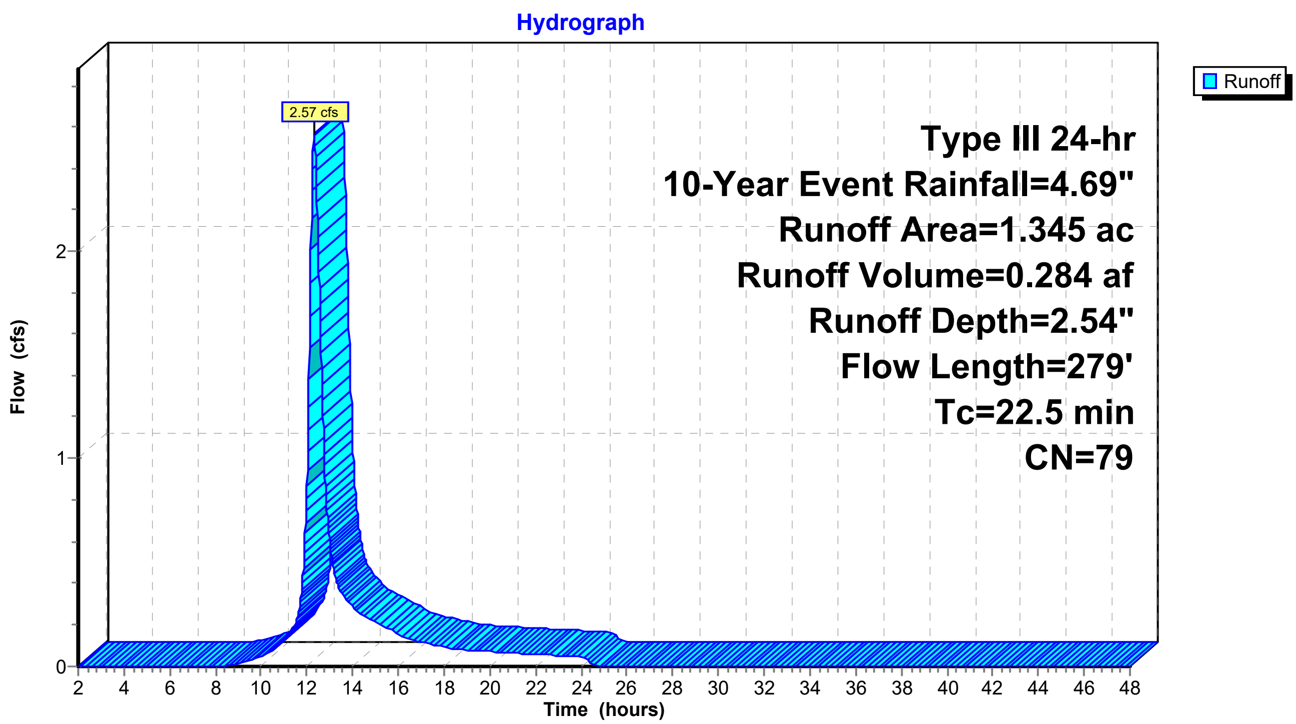
Runoff = 2.57 cfs @ 12.31 hrs, Volume= 0.284 af, Depth= 2.54"
Routed to Link AP-5 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
1.023	80	>75% Grass cover, Good, HSG D
0.322	77	Woods, Good, HSG D
1.345	79	Weighted Average
1.345		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	25	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
11.3	28	0.0080	0.04		**Sheet Flow, woods** Woods: Light underbrush n= 0.400 P2= 3.15"
4.6	46	0.2000	0.17		**Sheet Flow, Brush** Woods: Light underbrush n= 0.400 P2= 3.15"
1.9	180	0.1000	1.58		**Shallow Concentrated Flow, SC Flow** Woodland Kv= 5.0 fps
22.5	279	Total			

Subcatchment 5A: Subarea 5A



Summary for Subcatchment 6: Subarea 6

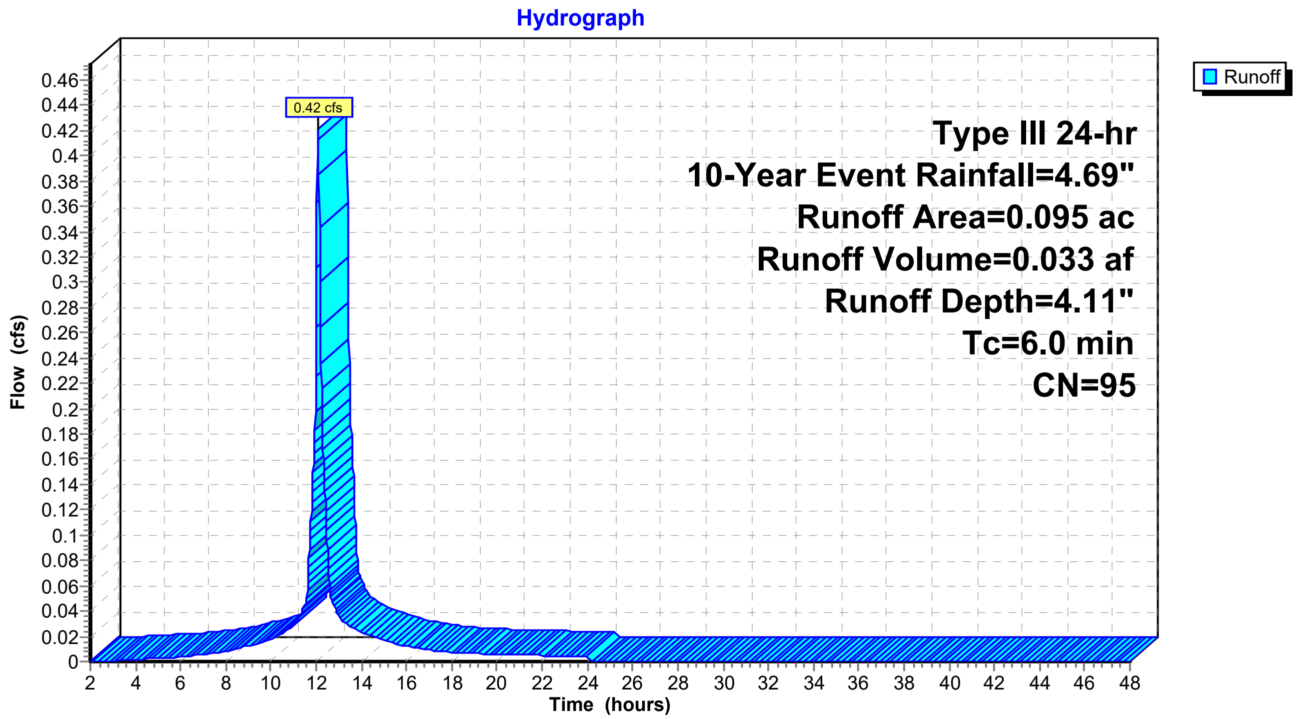
Runoff = 0.42 cfs @ 12.08 hrs, Volume= 0.033 af, Depth= 4.11"
Routed to Pond 10P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.017	80	>75% Grass cover, Good, HSG D
0.078	98	Paved parking, HSG C
0.095	95	Weighted Average
0.017		17.89% Pervious Area
0.078		82.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 6: Subarea 6



Summary for Subcatchment 7: Subarea 3

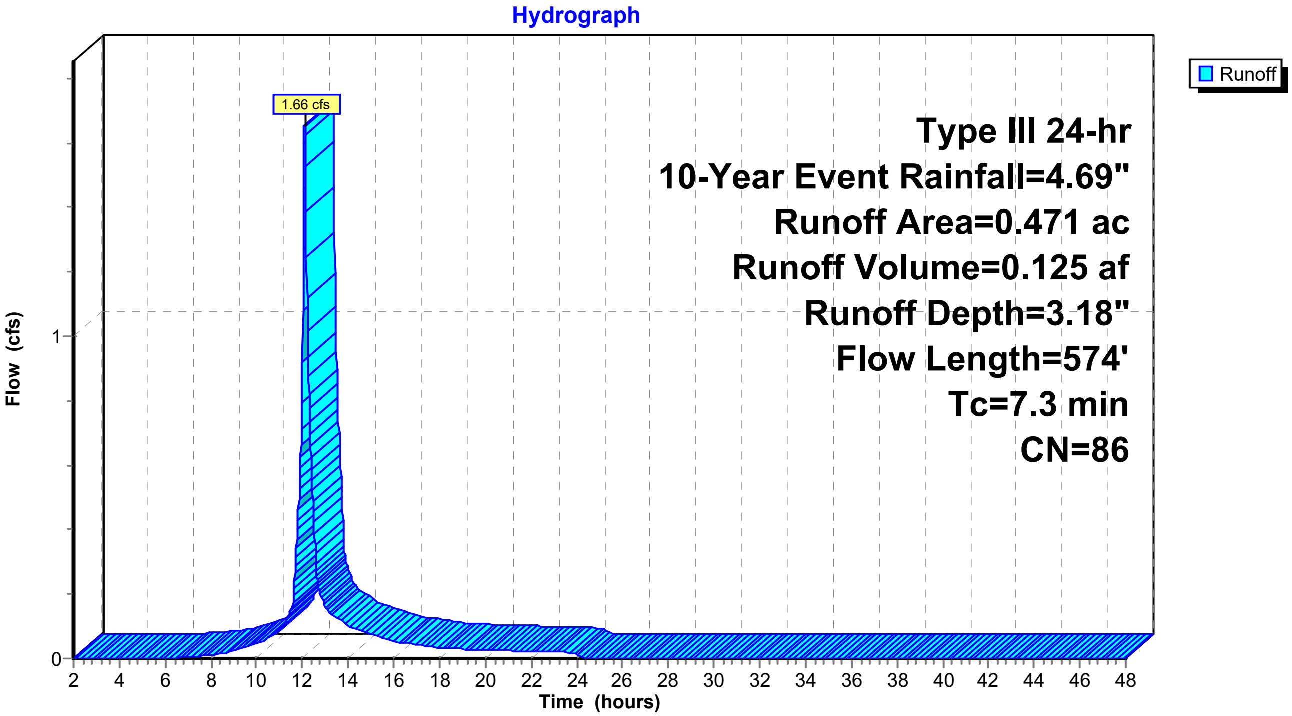
Runoff = 1.66 cfs @ 12.10 hrs, Volume= 0.125 af, Depth= 3.18"
Routed to Pond 1P : Infiltration Basin 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Event Rainfall=4.69"

Area (ac)	CN	Description
0.304	80	>75% Grass cover, Good, HSG D
0.167	98	Paved parking, HSG C
0.471	86	Weighted Average
0.304		64.54% Pervious Area
0.167		35.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	35	0.0200	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
7.3	574	Total			

Subcatchment 7: Subarea 3



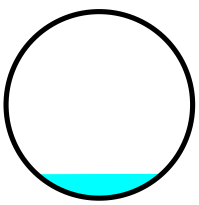
Summary for Reach 4R: UNDERDRAIN

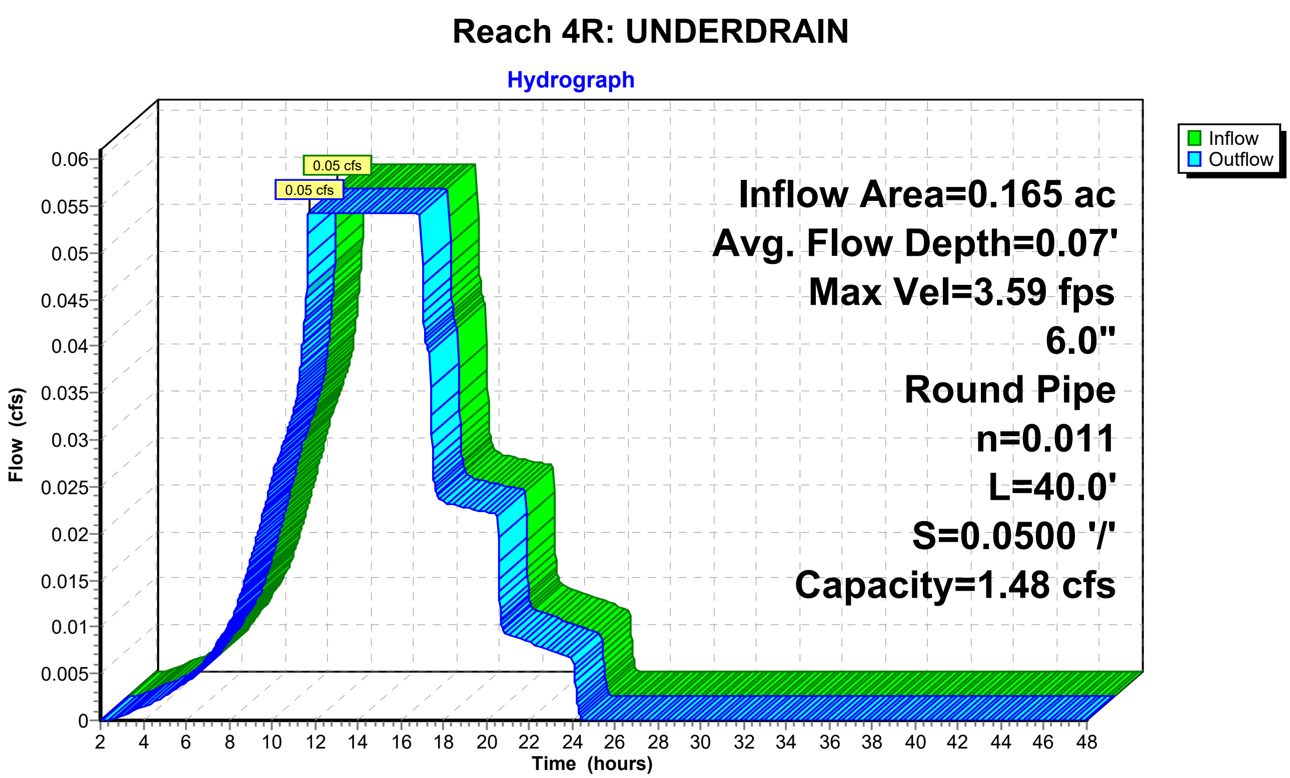
Inflow Area = 0.165 ac, 69.59% Impervious, Inflow Depth = 3.11" for 10-Year Event event
Inflow = 0.05 cfs @ 11.72 hrs, Volume= 0.043 af
Outflow = 0.05 cfs @ 11.72 hrs, Volume= 0.043 af, Atten= 0%, Lag= 0.0 min
Routed to Link AP-5 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.59 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.51 fps, Avg. Travel Time= 0.3 min

Peak Storage= 1 cf @ 11.72 hrs
Average Depth at Peak Storage= 0.07' , Surface Width= 0.34'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'





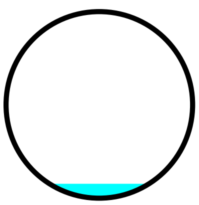
Summary for Reach 14R: UNDERDRAIN

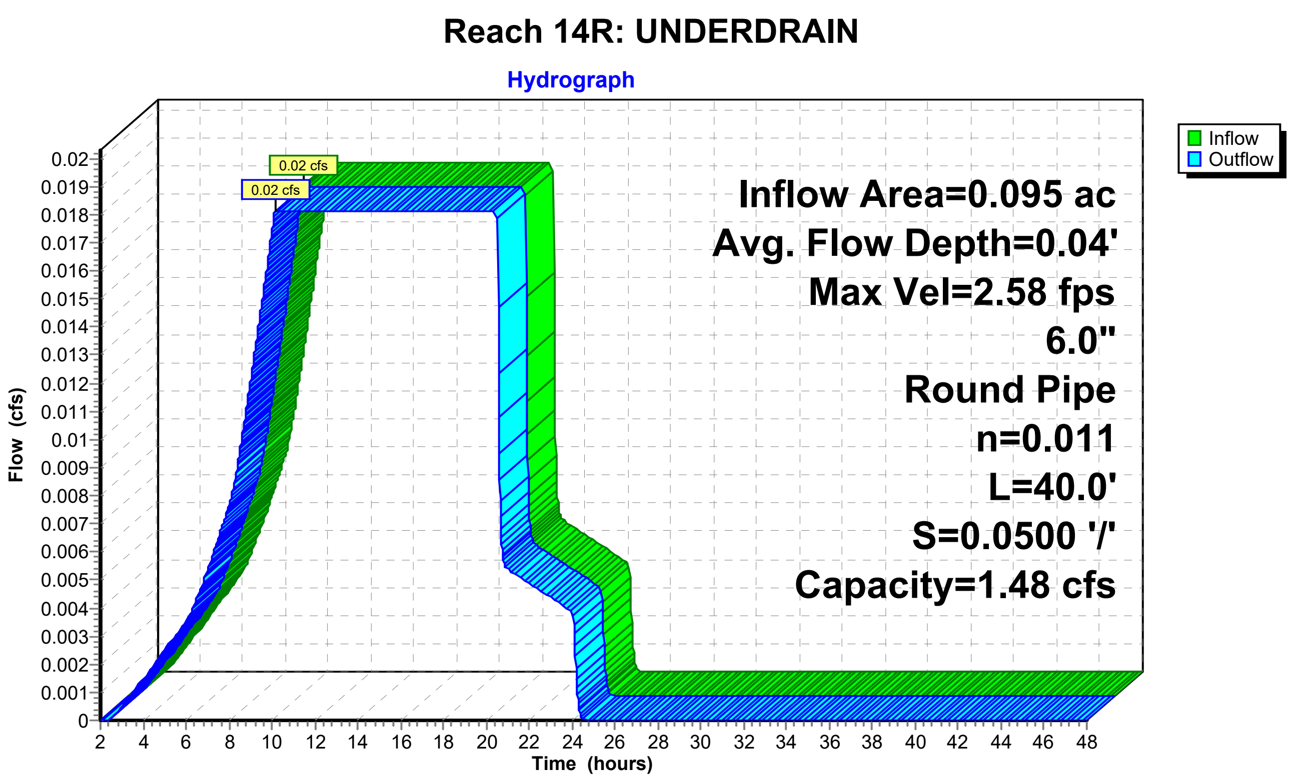
Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 2.61" for 10-Year Event event
Inflow = 0.02 cfs @ 10.14 hrs, Volume= 0.021 af
Outflow = 0.02 cfs @ 10.14 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 15R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.58 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.10 fps, Avg. Travel Time= 0.3 min

Peak Storage= 0 cf @ 10.14 hrs
Average Depth at Peak Storage= 0.04' , Surface Width= 0.27'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 244.50', Outlet Invert= 242.50'





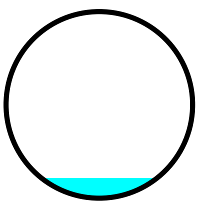
Summary for Reach 15R: UNDERDRAIN

Inflow Area = 0.130 ac, 74.16% Impervious, Inflow Depth = 2.95" for 10-Year Event event
Inflow = 0.04 cfs @ 11.70 hrs, Volume= 0.032 af
Outflow = 0.04 cfs @ 11.72 hrs, Volume= 0.032 af, Atten= 0%, Lag= 1.2 min
Routed to Reach 4R : UNDERDRAIN

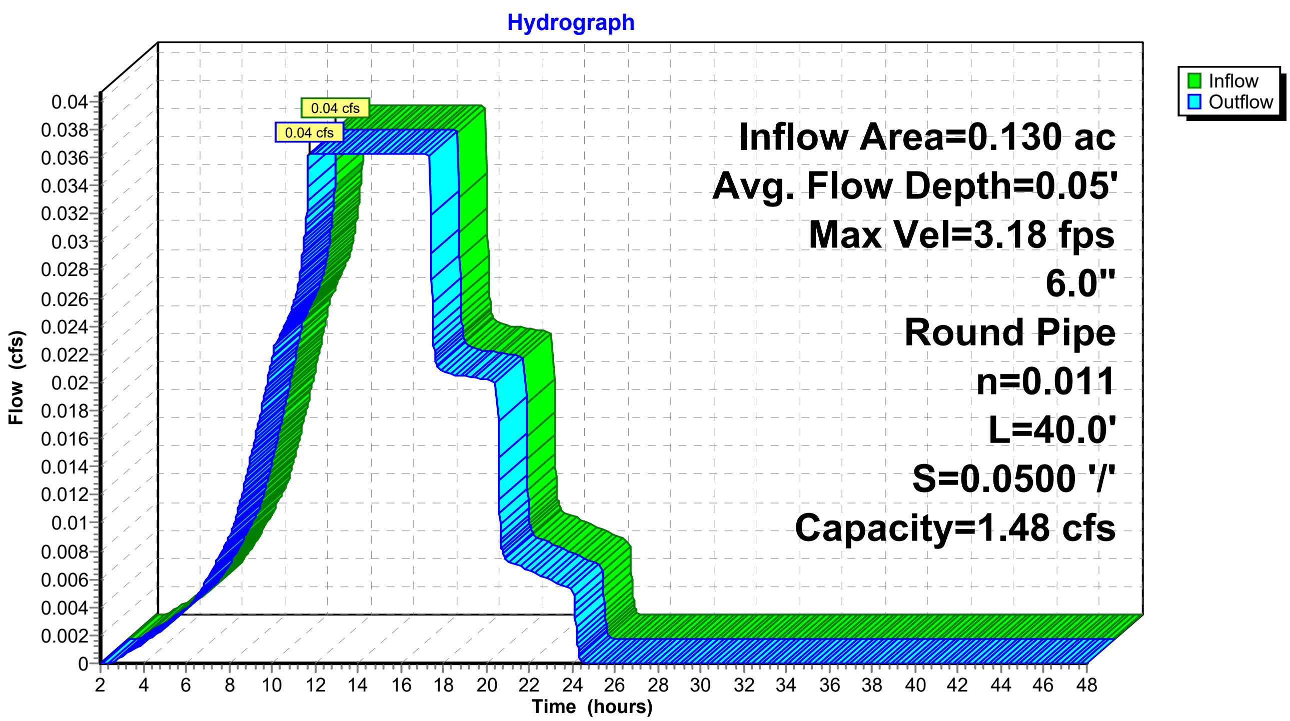
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.34 fps, Avg. Travel Time= 0.3 min

Peak Storage= 0 cf @ 11.72 hrs
Average Depth at Peak Storage= 0.05' , Surface Width= 0.31'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'



Reach 15R: UNDERDRAIN



Summary for Pond 1P: Infiltration Basin 3

Inflow Area = 0.471 ac, 35.46% Impervious, Inflow Depth = 3.18" for 10-Year Event event
Inflow = 1.66 cfs @ 12.10 hrs, Volume= 0.125 af
Outflow = 0.21 cfs @ 12.75 hrs, Volume= 0.125 af, Atten= 87%, Lag= 39.1 min
Discarded = 0.21 cfs @ 12.75 hrs, Volume= 0.125 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 259.67' @ 12.75 hrs Surf.Area= 1,804 sf Storage= 2,091 cf

Plug-Flow detention time= 95.7 min calculated for 0.125 af (100% of inflow)
Center-of-Mass det. time= 95.7 min (903.8 - 808.1)

Volume	Invert	Avail.Storage	Storage Description
#1	258.00'	8,592 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

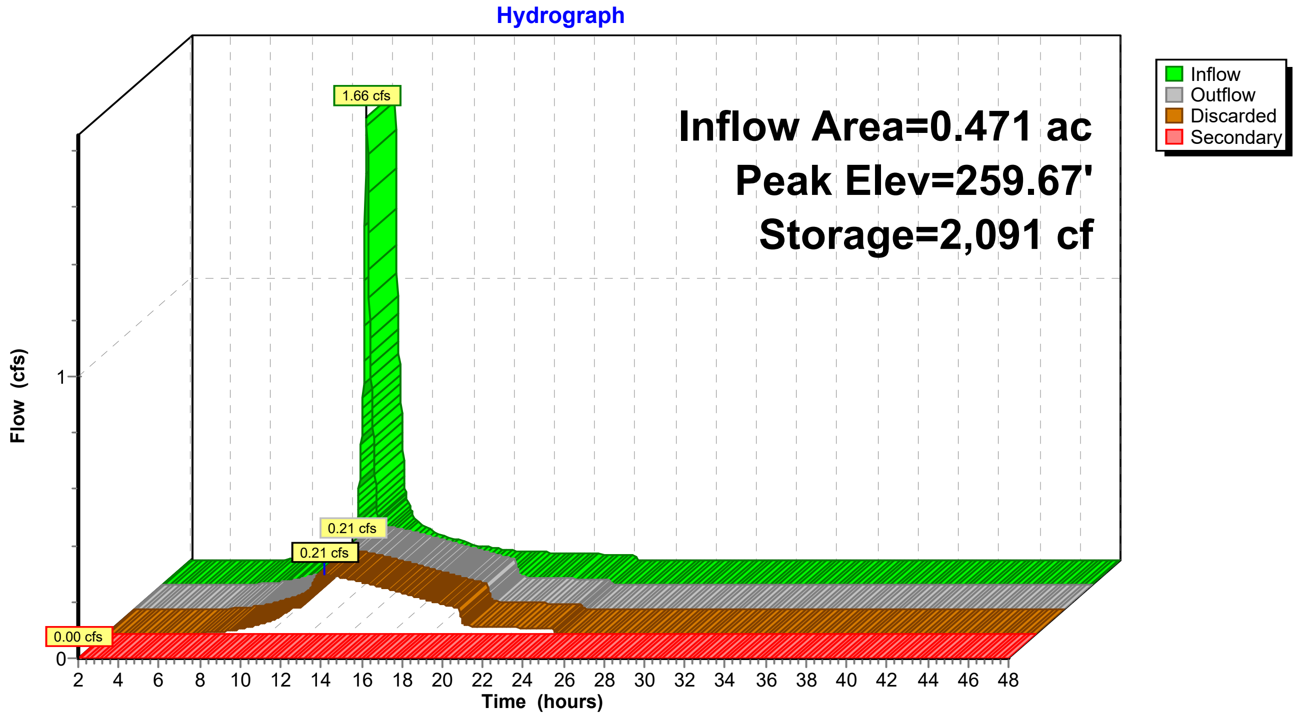
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
258.00	768	159.0	0	0	768
259.00	1,336	214.0	1,039	1,039	2,411
260.00	2,058	260.0	1,684	2,723	4,162
261.00	2,918	302.0	2,476	5,199	6,062
262.00	3,892	340.0	3,393	8,592	8,029

Device	Routing	Invert	Outlet Devices
#1	Discarded	258.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	261.00'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.21 cfs @ 12.75 hrs HW=259.67' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=258.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Infiltration Basin 3



Summary for Pond 2P: Infiltration Basin 1

Inflow Area = 1.245 ac, 66.51% Impervious, Inflow Depth = 3.78" for 10-Year Event event
Inflow = 3.96 cfs @ 12.17 hrs, Volume= 0.392 af
Outflow = 0.46 cfs @ 13.11 hrs, Volume= 0.392 af, Atten= 88%, Lag= 55.9 min
Discarded = 0.46 cfs @ 13.11 hrs, Volume= 0.392 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-4 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 262.18' @ 13.11 hrs Surf.Area= 4,959 sf Storage= 7,393 cf

Plug-Flow detention time= 161.7 min calculated for 0.392 af (100% of inflow)
Center-of-Mass det. time= 161.6 min (949.3 - 787.7)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	28,403 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

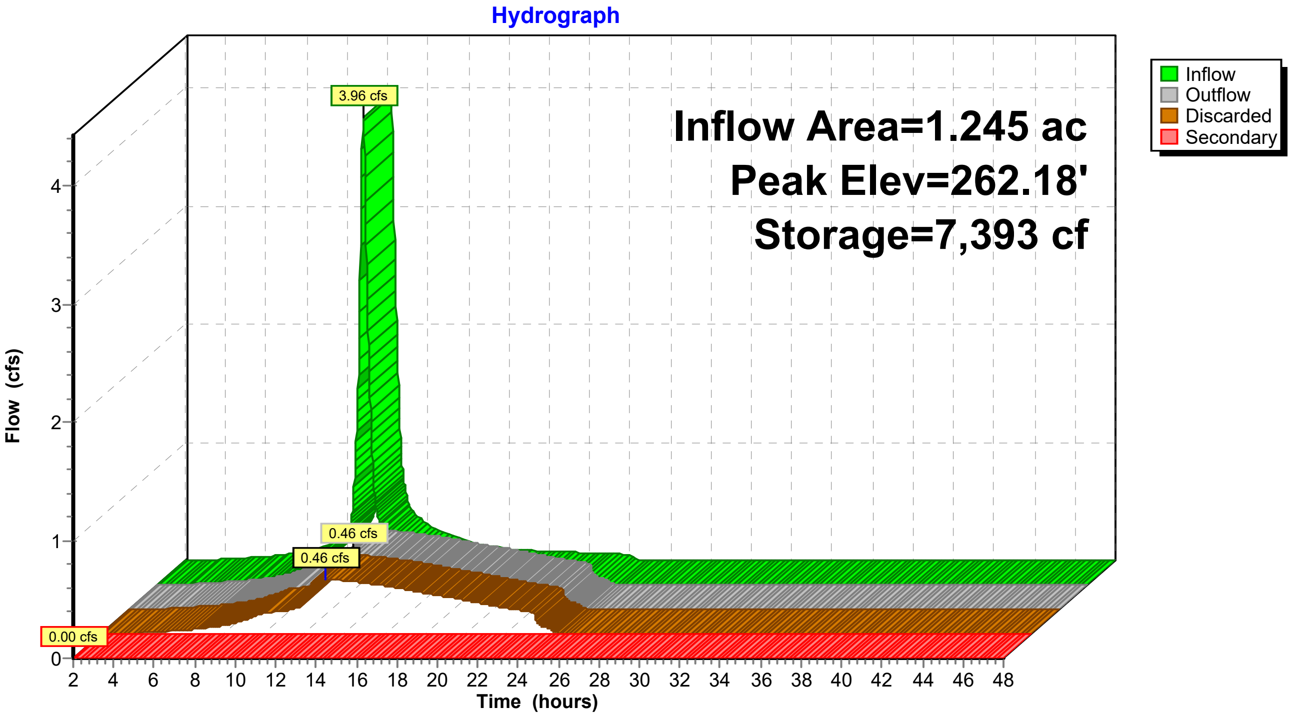
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	1,899	346.0	0	0	1,899
261.00	3,262	444.0	2,550	2,550	8,073
262.00	4,687	481.0	3,953	6,503	10,835
263.00	6,254	534.0	5,452	11,955	15,146
264.00	7,942	571.0	7,081	19,036	18,446
265.50	4,689	396.0	9,367	28,403	31,932

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	263.75'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.46 cfs @ 13.11 hrs HW=262.18' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.46 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Infiltration Basin 1



Summary for Pond 3P: Infiltration Basin 2

Inflow Area = 0.789 ac, 61.98% Impervious, Inflow Depth = 3.68" for 10-Year Event event
Inflow = 3.27 cfs @ 12.08 hrs, Volume= 0.242 af
Outflow = 0.44 cfs @ 12.62 hrs, Volume= 0.242 af, Atten= 87%, Lag= 31.9 min
Discarded = 0.44 cfs @ 12.62 hrs, Volume= 0.242 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-2 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 260.79' @ 12.62 hrs Surf.Area= 4,732 sf Storage= 3,467 cf

Plug-Flow detention time= 57.1 min calculated for 0.242 af (100% of inflow)
Center-of-Mass det. time= 57.1 min (846.0 - 789.0)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	16,256 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

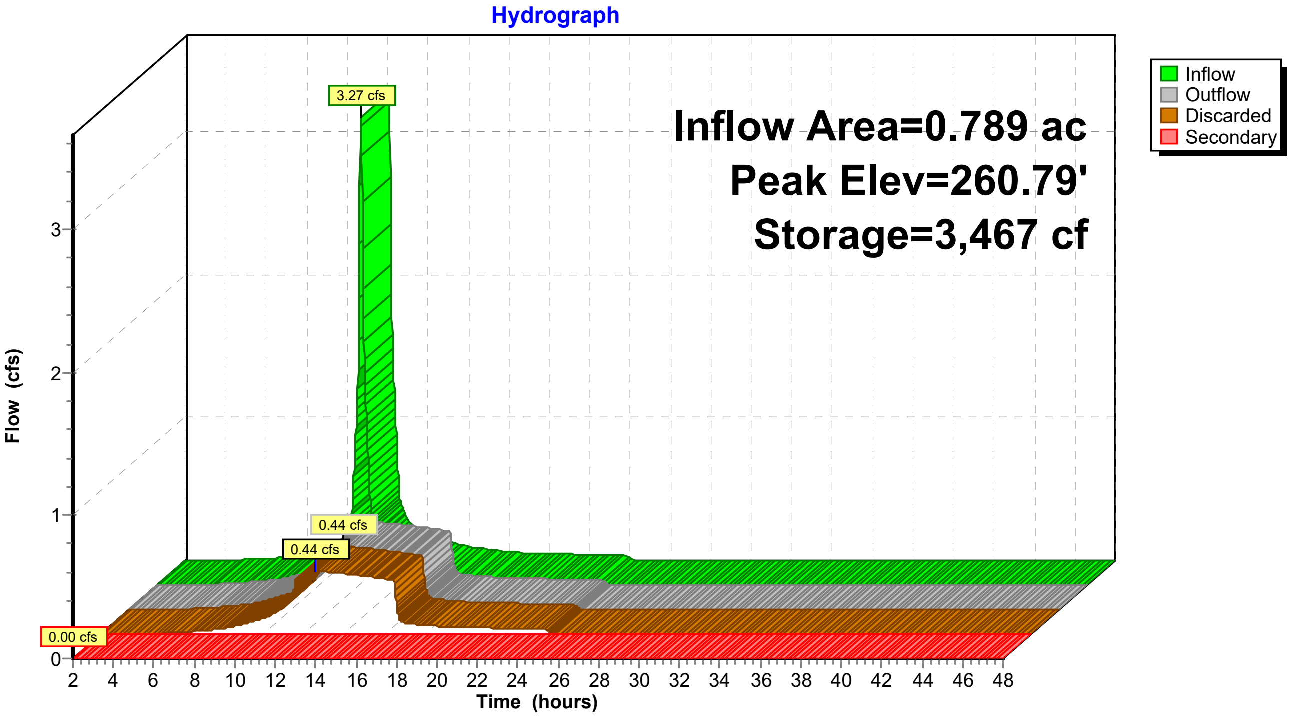
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	4,044	279.0	0	0	4,044
261.00	4,923	304.0	4,476	4,476	5,240
262.00	5,880	330.0	5,394	9,871	6,589
263.00	6,905	353.0	6,386	16,256	7,885

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	262.00'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.44 cfs @ 12.62 hrs HW=260.79' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.44 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 3P: Infiltration Basin 2



Summary for Pond 4P: Infiltration Basin 4

Inflow Area = 1.019 ac, 78.21% Impervious, Inflow Depth = 4.00" for 10-Year Event event
Inflow = 3.82 cfs @ 12.14 hrs, Volume= 0.340 af
Outflow = 3.62 cfs @ 12.18 hrs, Volume= 0.340 af, Atten= 5%, Lag= 2.3 min
Discarded = 0.59 cfs @ 12.18 hrs, Volume= 0.260 af
Primary = 3.03 cfs @ 12.18 hrs, Volume= 0.080 af
Routed to Pond 7P : Detention Basin
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 261.24' @ 12.18 hrs Surf.Area= 2,135 sf Storage= 2,515 cf

Plug-Flow detention time= 29.4 min calculated for 0.340 af (100% of inflow)
Center-of-Mass det. time= 29.4 min (809.2 - 779.8)

Volume	Invert	Avail.Storage	Storage Description
#1	259.00'	4,563 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
259.00	377	128.0	0	0	377
260.00	988	176.0	658	658	1,548
261.00	1,829	236.0	1,387	2,046	3,526
262.00	3,276	431.0	2,518	4,563	13,882

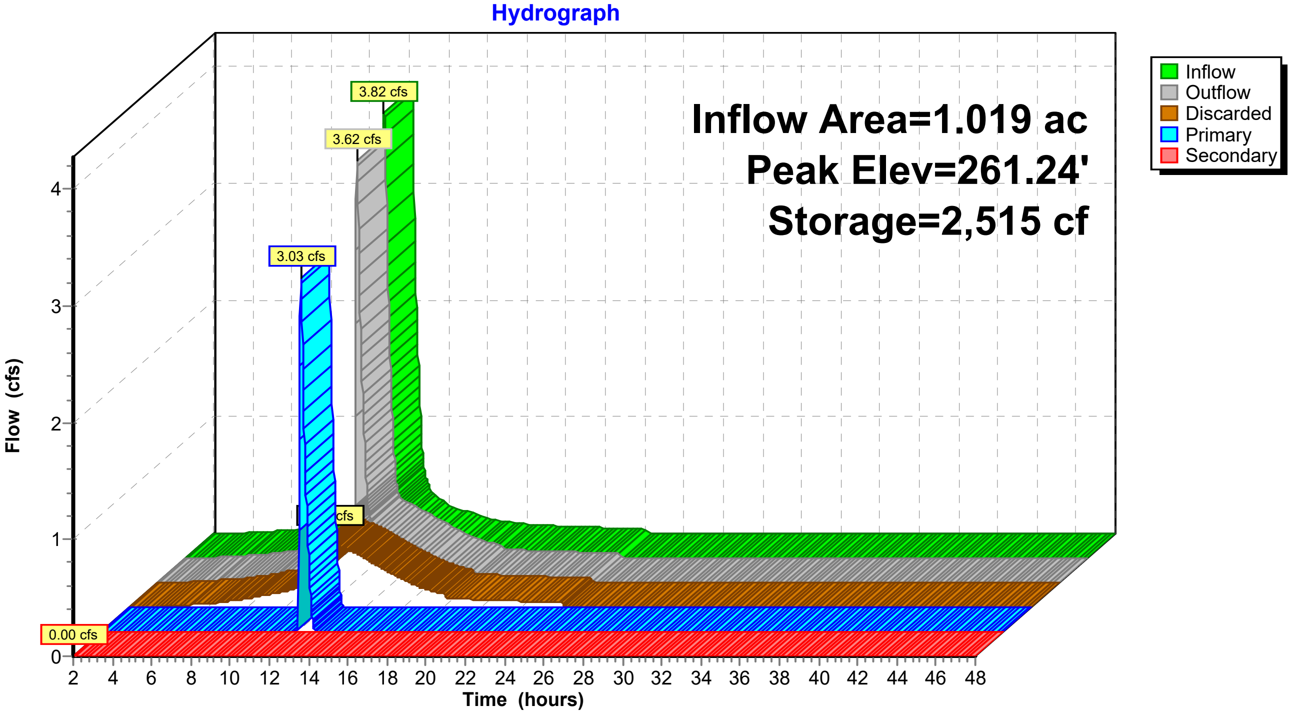
Device	Routing	Invert	Outlet Devices
#1	Discarded	259.00'	**12.000 in/hr Exfiltration over Surface area**
#2	Primary	259.00'	**18.0" Round Culvert** L= 47.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 259.00' / 255.20' S= 0.0809 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	261.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	261.40'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.59 cfs @ 12.18 hrs HW=261.24' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.59 cfs)

Primary OutFlow Max=3.02 cfs @ 12.18 hrs HW=261.24' (Free Discharge)
└─**2=Culvert** (Passes 3.02 cfs of 10.38 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 3.02 cfs @ 1.59 fps)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=259.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Infiltration Basin 4



Summary for Pond 5P: BIORETENTION POOL 1

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 3.08" for 10-Year Event event
Inflow = 1.89 cfs @ 12.08 hrs, Volume= 0.319 af
Outflow = 1.88 cfs @ 12.11 hrs, Volume= 0.319 af, Atten= 1%, Lag= 1.3 min
Primary = 0.12 cfs @ 12.11 hrs, Volume= 0.154 af
Routed to Pond 5PF : BIORETENTION FILTER
Secondary = 1.00 cfs @ 12.11 hrs, Volume= 0.124 af
Routed to Pond 7P : Detention Basin
Tertiary = 0.76 cfs @ 12.11 hrs, Volume= 0.041 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 249.56' @ 12.11 hrs Surf.Area= 2,487 sf Storage= 1,286 cf

Plug-Flow detention time= 52.1 min calculated for 0.319 af (100% of inflow)
Center-of-Mass det. time= 52.1 min (853.4 - 801.3)

Volume	Invert	Avail.Storage	Storage Description
#1	249.00'	2,444 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
249.00	2,084	225.0	0	0	2,084
250.00	2,823	249.0	2,444	2,444	3,020

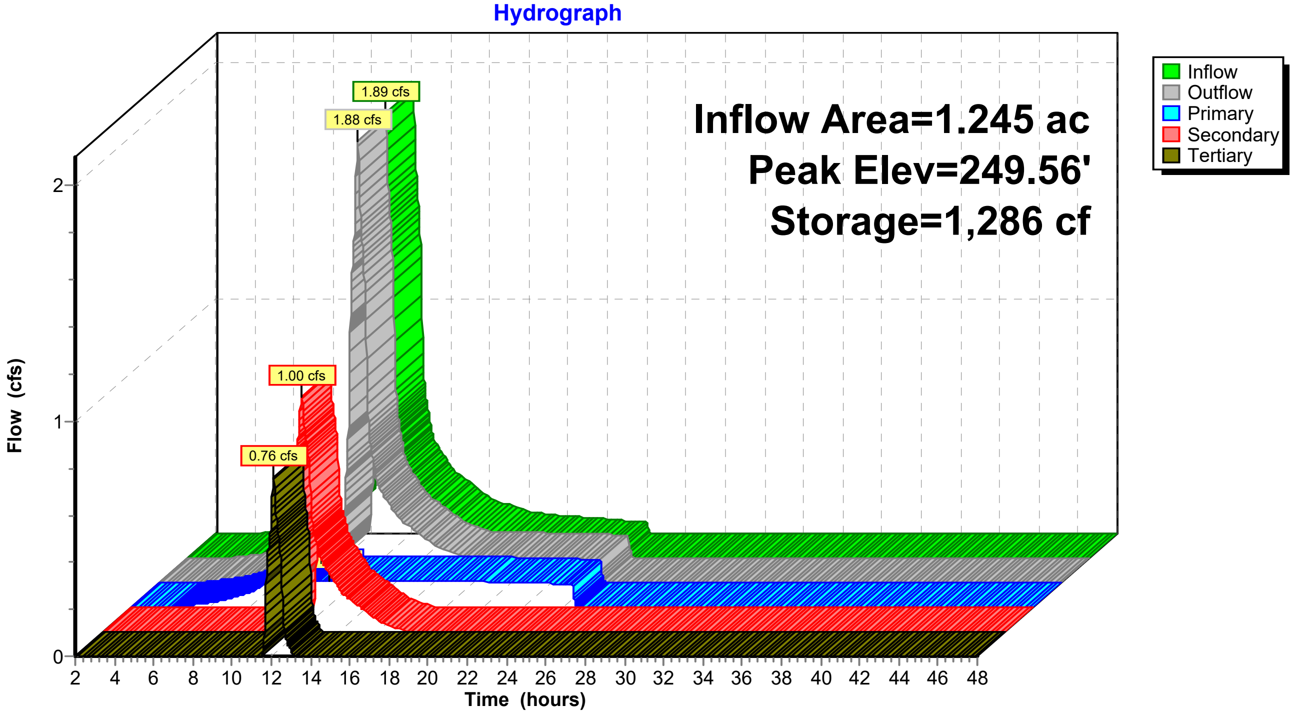
Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	249.45'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	249.50'	**20.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.12 cfs @ 12.11 hrs HW=249.56' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Secondary OutFlow Max=1.00 cfs @ 12.11 hrs HW=249.56' (Free Discharge)
└─**2=Culvert** (Passes 1.00 cfs of 6.07 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 1.00 cfs @ 1.10 fps)

Tertiary OutFlow Max=0.76 cfs @ 12.11 hrs HW=249.56' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.76 cfs @ 0.60 fps)

Pond 5P: BIORETENTION POOL 1



Summary for Pond 5PF: BIORETENTION FILTER

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 1.48" for 10-Year Event event
Inflow = 0.12 cfs @ 12.11 hrs, Volume= 0.154 af
Outflow = 0.09 cfs @ 9.12 hrs, Volume= 0.154 af, Atten= 21%, Lag= 0.0 min
Primary = 0.09 cfs @ 9.12 hrs, Volume= 0.154 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 247.11' @ 24.52 hrs Surf.Area= 1,965 sf Storage= 1,068 cf

Plug-Flow detention time= 105.5 min calculated for 0.154 af (100% of inflow)
Center-of-Mass det. time= 105.4 min (1,056.1 - 950.8)

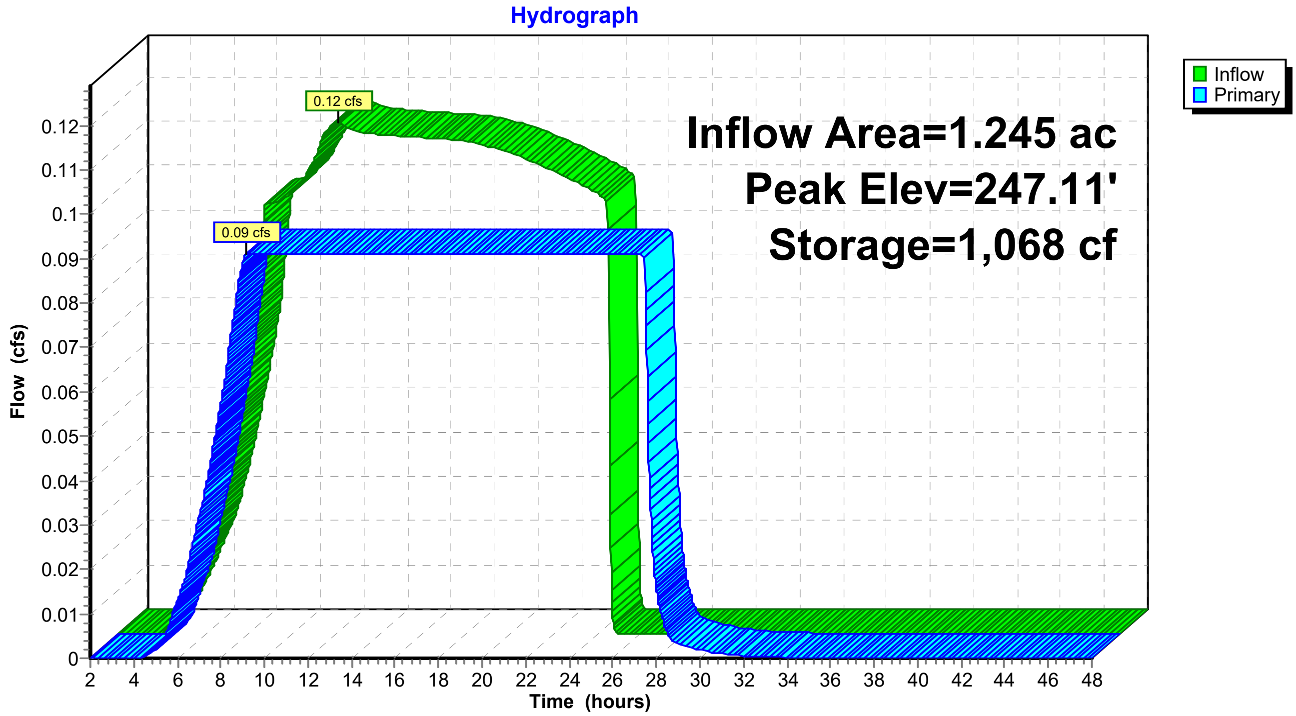
Volume	Invert	Avail.Storage	Storage Description
#1	245.75'	2,555 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 6,386 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.75	1,965	214.0	0	0	1,965
249.00	1,965	214.0	6,386	6,386	2,661

Device	Routing	Invert	Outlet Devices
#1	Primary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	245.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.09 cfs @ 9.12 hrs HW=245.91' (Free Discharge)
└─**1=Culvert** (Passes 0.09 cfs of 0.11 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 5PF: BIORETENTION FILTER



Summary for Pond 6P: BIORETENTION POOL 2

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 3.54" for 10-Year Event event
Inflow = 7.41 cfs @ 12.09 hrs, Volume= 0.881 af
Outflow = 6.94 cfs @ 12.12 hrs, Volume= 0.881 af, Atten= 6%, Lag= 2.0 min
Primary = 0.26 cfs @ 12.12 hrs, Volume= 0.371 af
Routed to Pond 6PF : BIORETENTION FILTER
Secondary = 4.15 cfs @ 12.12 hrs, Volume= 0.412 af
Routed to Pond 7P : Detention Basin
Tertiary = 2.52 cfs @ 12.12 hrs, Volume= 0.098 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 257.69' @ 12.12 hrs Surf.Area= 5,652 sf Storage= 3,649 cf

Plug-Flow detention time= 44.7 min calculated for 0.880 af (100% of inflow)
Center-of-Mass det. time= 44.7 min (826.6 - 782.0)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	5,437 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
257.00	4,885	362.0	0	0	4,885
258.00	6,009	386.0	5,437	5,437	6,362

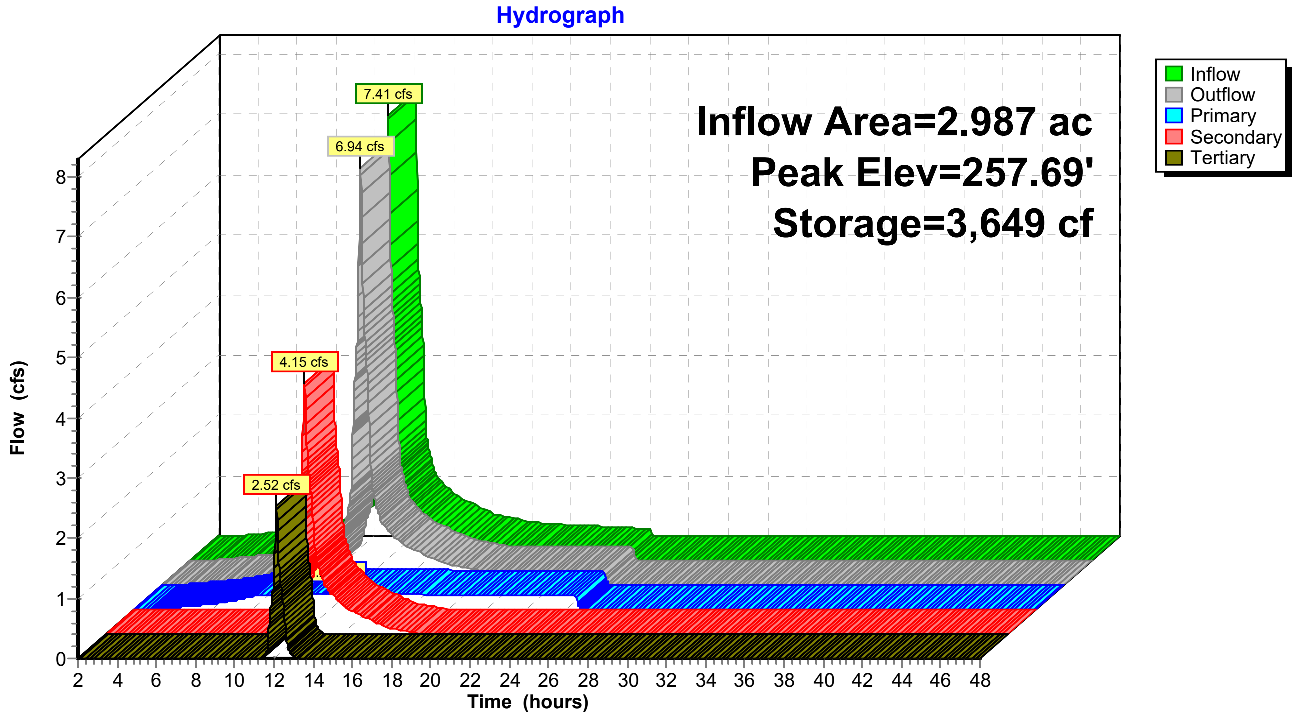
Device	Routing	Invert	Outlet Devices
#1	Primary	257.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	257.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	257.50'	**12.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.26 cfs @ 12.12 hrs HW=257.69' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.26 cfs)

Secondary OutFlow Max=4.15 cfs @ 12.12 hrs HW=257.69' (Free Discharge)
└─**2=Culvert** (Passes 4.15 cfs of 7.02 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 4.15 cfs @ 1.77 fps)

Tertiary OutFlow Max=2.52 cfs @ 12.12 hrs HW=257.69' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 2.52 cfs @ 1.04 fps)

Pond 6P: BIORETENTION POOL 2



Summary for Pond 6PF: BIORETENTION FILTER

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 1.49" for 10-Year Event event
Inflow = 0.26 cfs @ 12.12 hrs, Volume= 0.371 af
Outflow = 0.23 cfs @ 10.24 hrs, Volume= 0.371 af, Atten= 14%, Lag= 0.0 min
Primary = 0.23 cfs @ 10.24 hrs, Volume= 0.371 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 254.51' @ 24.60 hrs Surf.Area= 4,885 sf Storage= 1,484 cf

Plug-Flow detention time= 73.1 min calculated for 0.371 af (100% of inflow)
Center-of-Mass det. time= 73.0 min (992.8 - 919.8)

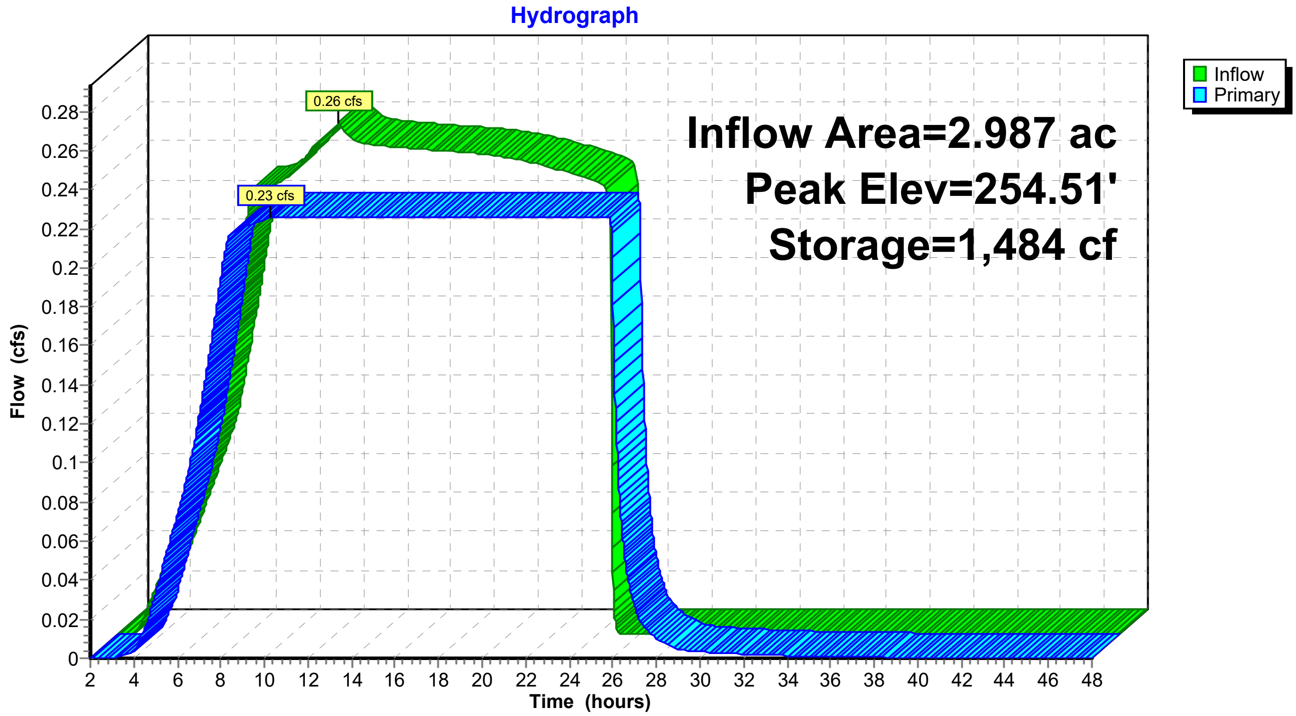
Volume	Invert	Avail.Storage	Storage Description
#1	253.75'	6,351 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 15,876 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.75	4,885	363.0	0	0	4,885
257.00	4,885	363.0	15,876	15,876	6,065

Device	Routing	Invert	Outlet Devices
#1	Primary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	253.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.23 cfs @ 10.24 hrs HW=254.01' (Free Discharge)
└─**1=Culvert** (Passes 0.23 cfs of 0.28 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 6PF: BIORETENTION FILTER



Summary for Pond 7P: Detention Basin

Inflow Area = 5.739 ac, 67.68% Impervious, Inflow Depth = 3.27" for 10-Year Event event
Inflow = 20.54 cfs @ 12.11 hrs, Volume= 1.565 af
Outflow = 9.32 cfs @ 12.34 hrs, Volume= 1.564 af, Atten= 55%, Lag= 13.6 min
Primary = 9.32 cfs @ 12.34 hrs, Volume= 1.564 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 242.12' @ 12.34 hrs Surf.Area= 7,265 sf Storage= 16,852 cf

Plug-Flow detention time= 48.9 min calculated for 1.563 af (100% of inflow)
Center-of-Mass det. time= 48.8 min (892.5 - 843.7)

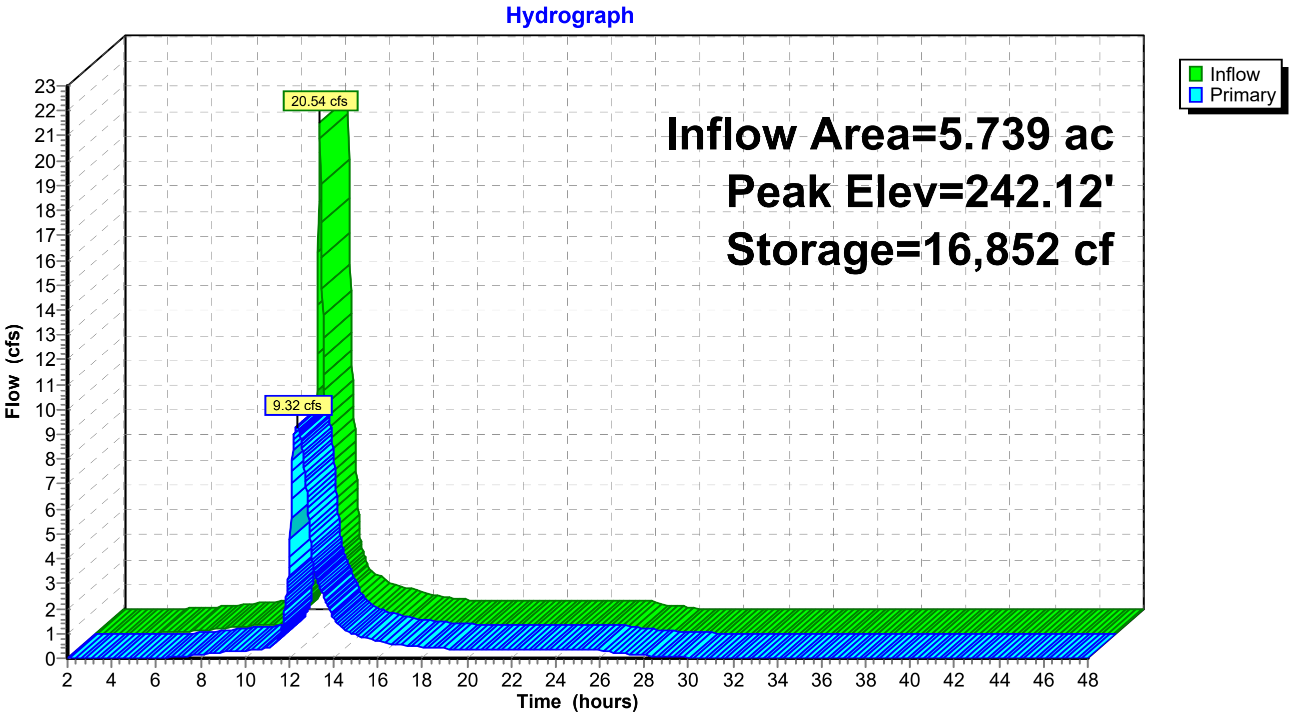
Volume	Invert	Avail.Storage	Storage Description
#1	239.00'	43,611 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
239.00	3,719	242.0	0	0	3,719
240.00	4,746	270.0	4,222	4,222	4,888
241.00	5,883	297.0	5,304	9,526	6,139
242.00	7,115	321.0	6,489	16,016	7,359
243.00	8,454	347.0	7,775	23,791	8,781
244.00	9,894	373.0	9,165	32,955	10,314
245.00	11,437	398.0	10,656	43,611	11,895

Device	Routing	Invert	Outlet Devices
#1	Primary	239.00'	**18.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 239.00' / 238.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	239.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	239.55'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	240.60'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	244.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=9.32 cfs @ 12.34 hrs HW=242.12' (Free Discharge)
└─**1=Culvert** (Passes 9.32 cfs of 13.09 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.60 cfs @ 8.15 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 3.66 cfs @ 7.32 fps)
  ├─**4=Orifice/Grate** (Orifice Controls 4.06 cfs @ 5.41 fps)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Pond 7P: Detention Basin



Summary for Pond 8P: DIVERSION STRUCTURE

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 3.68" for 10-Year Event event
Inflow = 5.16 cfs @ 12.08 hrs, Volume= 0.382 af
Outflow = 5.16 cfs @ 12.08 hrs, Volume= 0.382 af, Atten= 0%, Lag= 0.0 min
Primary = 1.89 cfs @ 12.08 hrs, Volume= 0.319 af
Routed to Pond 5P : BIORETENTION POOL 1
Secondary = 3.26 cfs @ 12.08 hrs, Volume= 0.063 af
Routed to Pond 7P : Detention Basin

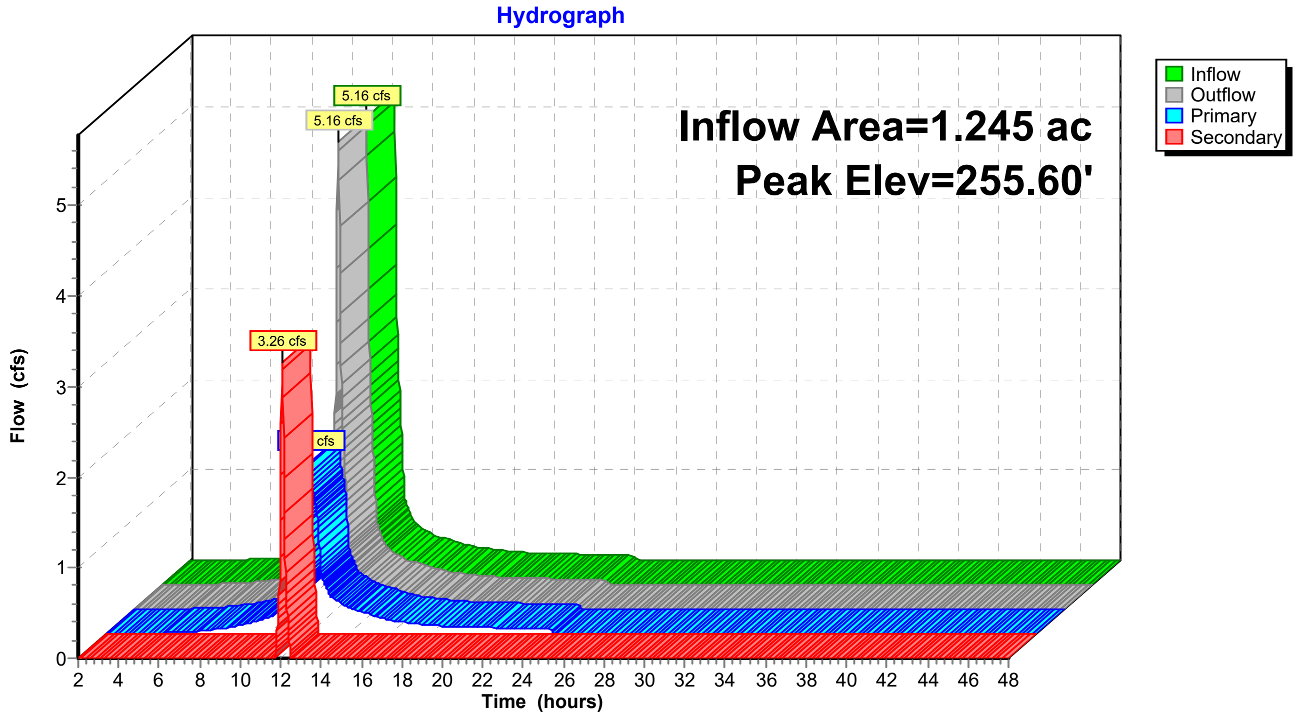
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 255.60' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	254.00'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.00' / 251.50' S= 0.0625 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.35 sf
#2	Secondary	254.75'	**18.0" Round Culvert** L= 90.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.75' / 249.00' S= 0.0639 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=1.89 cfs @ 12.08 hrs HW=255.60' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.89 cfs @ 5.42 fps)

Secondary OutFlow Max=3.24 cfs @ 12.08 hrs HW=255.60' (Free Discharge)
└─**2=Culvert** (Inlet Controls 3.24 cfs @ 3.14 fps)

Pond 8P: DIVERSION STRUCTURE



Summary for Pond 9P: DIVERSION STRUCTURE

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 4.00" for 10-Year Event event
Inflow = 12.98 cfs @ 12.09 hrs, Volume= 0.996 af
Outflow = 12.98 cfs @ 12.09 hrs, Volume= 0.996 af, Atten= 0%, Lag= 0.0 min
Primary = 7.41 cfs @ 12.09 hrs, Volume= 0.881 af
Routed to Pond 6P : BIORETENTION POOL 2
Secondary = 5.57 cfs @ 12.09 hrs, Volume= 0.115 af
Routed to Pond 7P : Detention Basin

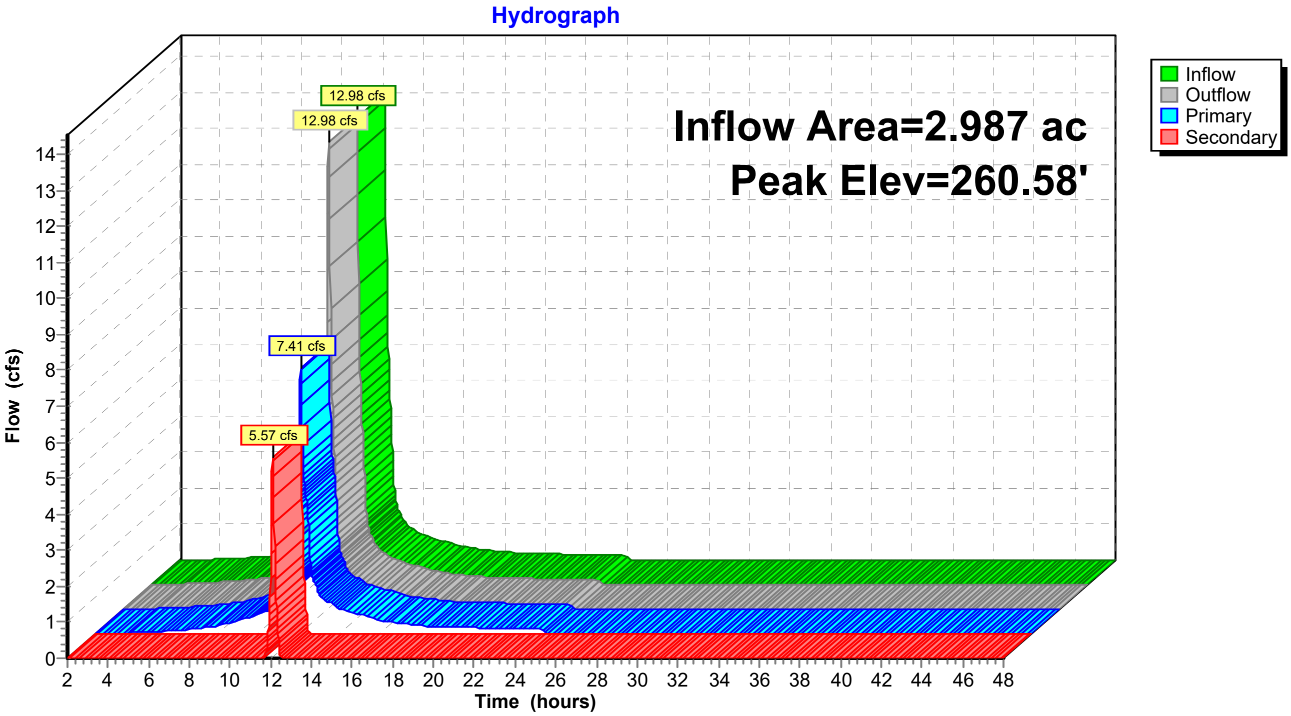
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 260.58' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	256.25'	**12.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 256.25' / 255.75' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	257.30'	**12.0" Round Culvert** L= 175.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 257.30' / 246.00' S= 0.0646 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=7.36 cfs @ 12.09 hrs HW=260.54' (Free Discharge)
└─**1=Culvert** (Inlet Controls 7.36 cfs @ 9.38 fps)

Secondary OutFlow Max=5.53 cfs @ 12.09 hrs HW=260.54' (Free Discharge)
└─**2=Culvert** (Inlet Controls 5.53 cfs @ 7.04 fps)

Pond 9P: DIVERSION STRUCTURE



Summary for Pond 10P: BIORETENTION POOL

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 4.11" for 10-Year Event event
Inflow = 0.42 cfs @ 12.08 hrs, Volume= 0.033 af
Outflow = 0.41 cfs @ 12.11 hrs, Volume= 0.033 af, Atten= 3%, Lag= 1.3 min
Primary = 0.03 cfs @ 12.11 hrs, Volume= 0.021 af
Routed to Pond 11P : DRY SWALE FILTER
Secondary = 0.38 cfs @ 12.11 hrs, Volume= 0.012 af
Routed to Pond 12P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 248.47' @ 12.11 hrs Surf.Area= 275 sf Storage= 107 cf

Plug-Flow detention time= 11.2 min calculated for 0.033 af (100% of inflow)
Center-of-Mass det. time= 11.2 min (781.1 - 769.9)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

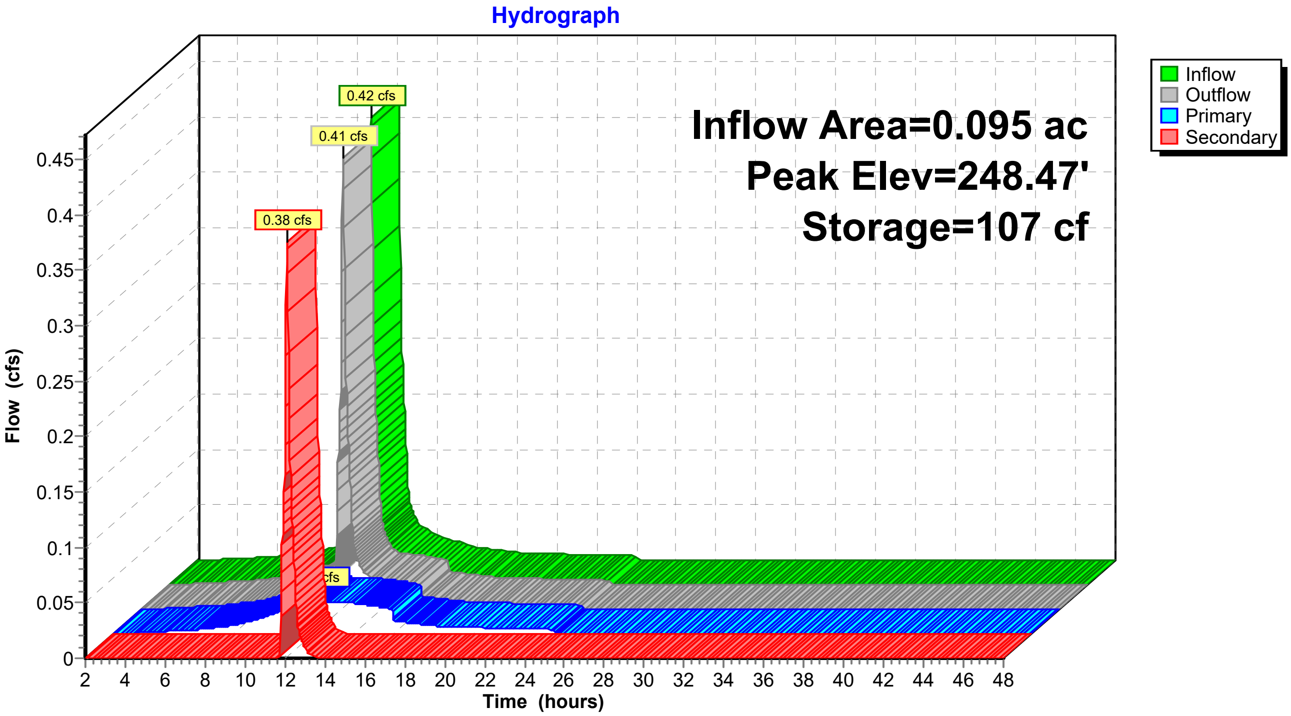
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
248.00	190	60.0	0	0	190
249.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	248.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	248.30'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.03 cfs @ 12.11 hrs HW=248.46' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.37 cfs @ 12.11 hrs HW=248.46' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.37 cfs @ 1.14 fps)

Pond 10P: BIORETENTION POOL



Summary for Pond 11P: DRY SWALE FILTER

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 2.61" for 10-Year Event event
Inflow = 0.03 cfs @ 12.11 hrs, Volume= 0.021 af
Outflow = 0.02 cfs @ 10.14 hrs, Volume= 0.021 af, Atten= 43%, Lag= 0.0 min
Primary = 0.02 cfs @ 10.14 hrs, Volume= 0.021 af
Routed to Reach 14R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.10' @ 16.00 hrs Surf.Area= 391 sf Storage= 172 cf

Plug-Flow detention time= 63.7 min calculated for 0.021 af (100% of inflow)
Center-of-Mass det. time= 63.7 min (873.2 - 809.5)

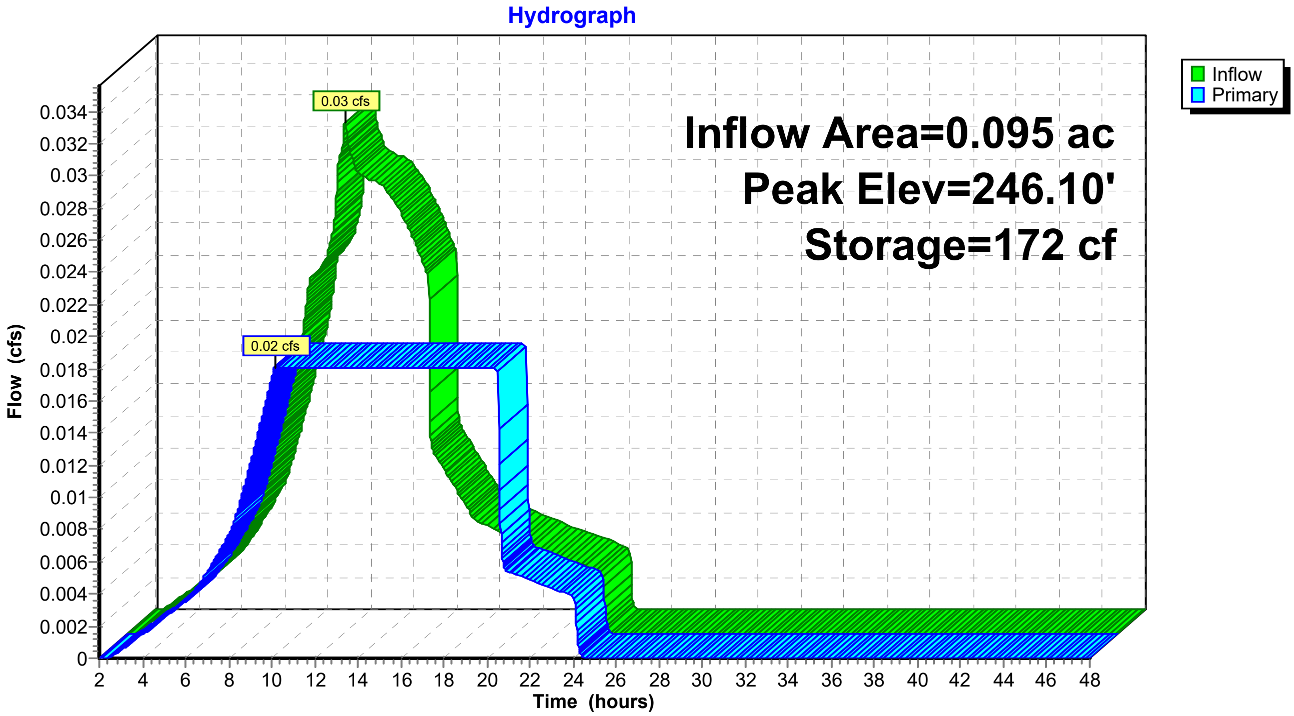
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 10.14 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 11P: DRY SWALE FILTER



Summary for Pond 12P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 7.54" for 10-Year Event event
Inflow = 0.51 cfs @ 12.10 hrs, Volume= 0.022 af
Outflow = 0.49 cfs @ 12.13 hrs, Volume= 0.022 af, Atten= 4%, Lag= 1.6 min
Primary = 0.04 cfs @ 12.13 hrs, Volume= 0.011 af
Routed to Pond 13P : DRY SWALE FILTER
Secondary = 0.45 cfs @ 12.13 hrs, Volume= 0.011 af
Routed to Pond 14P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.69' @ 12.13 hrs Surf.Area= 320 sf Storage= 173 cf

Plug-Flow detention time= 16.1 min calculated for 0.022 af (100% of inflow)
Center-of-Mass det. time= 16.1 min (777.9 - 761.8)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

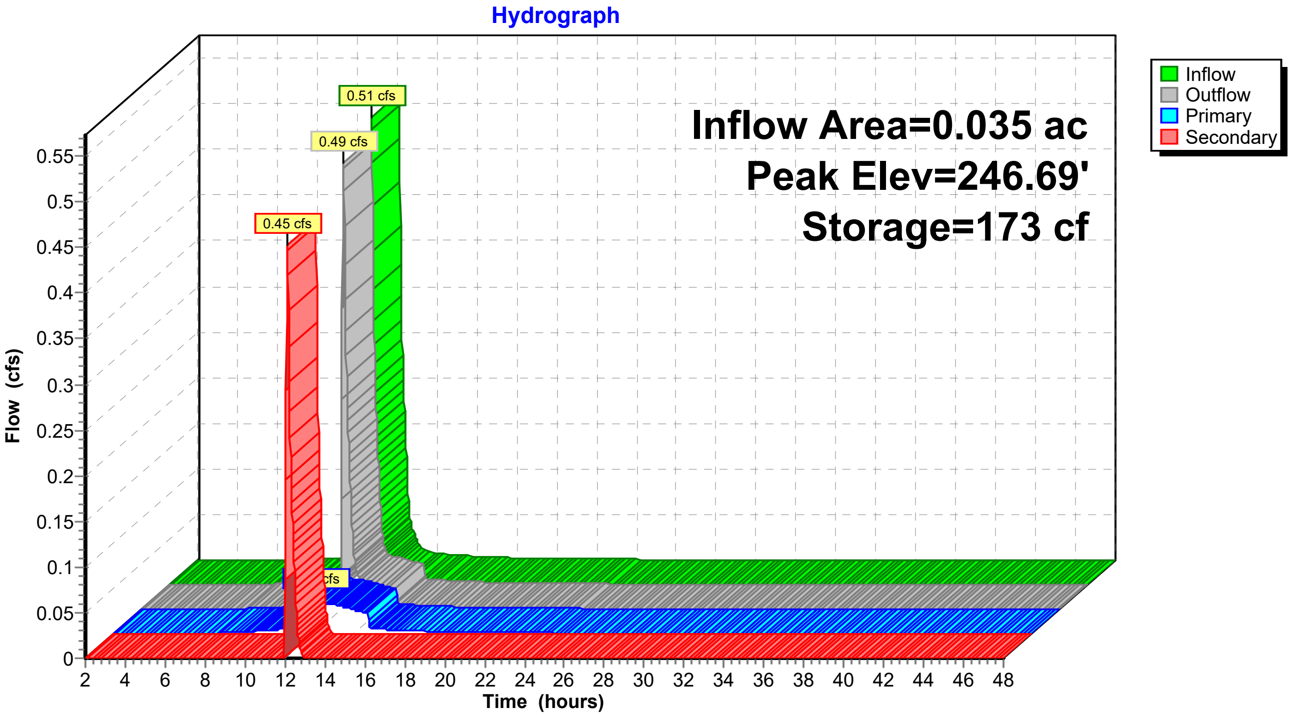
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.04 cfs @ 12.13 hrs HW=246.69' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.45 cfs @ 12.13 hrs HW=246.69' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.45 cfs @ 1.21 fps)

Pond 12P: BIORETENTION POOL



Summary for Pond 13P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 3.88" for 10-Year Event event
Inflow = 0.04 cfs @ 12.13 hrs, Volume= 0.011 af
Outflow = 0.02 cfs @ 11.70 hrs, Volume= 0.011 af, Atten= 51%, Lag= 0.0 min
Primary = 0.02 cfs @ 11.70 hrs, Volume= 0.011 af
Routed to Reach 15R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.84' @ 14.79 hrs Surf.Area= 391 sf Storage= 131 cf

Plug-Flow detention time= 52.2 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 52.2 min (870.9 - 818.7)

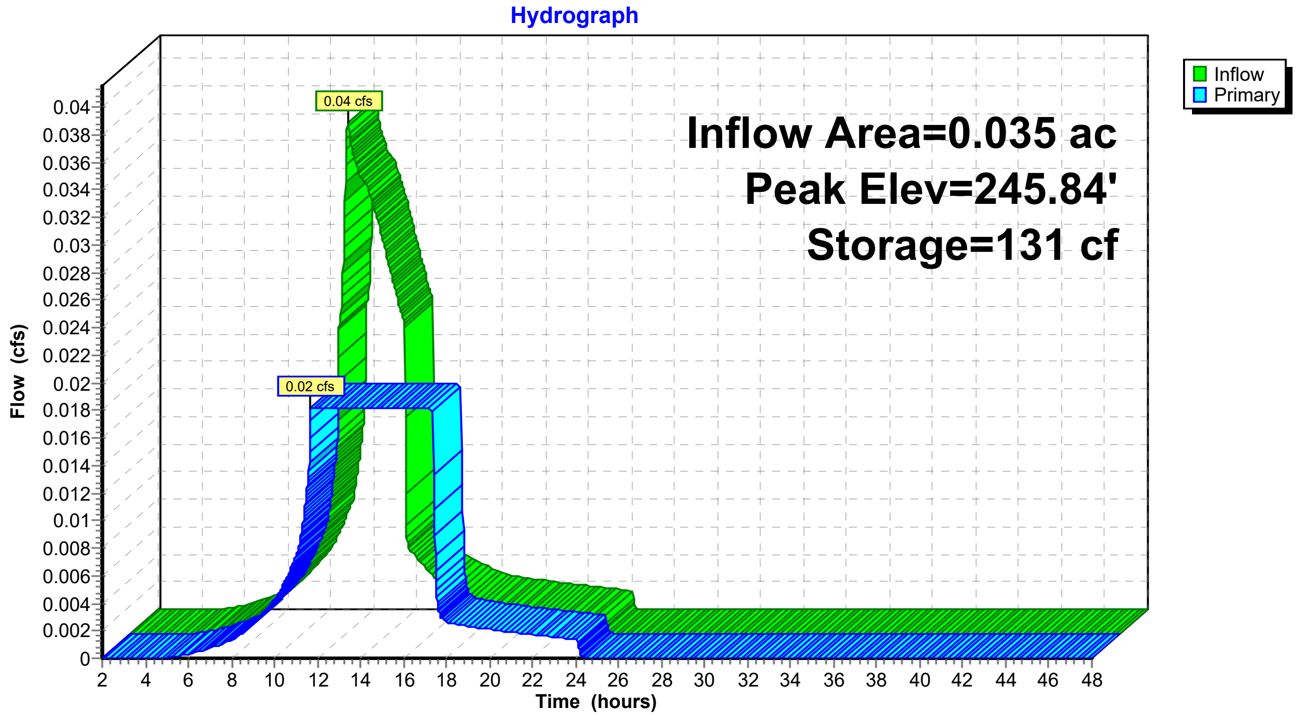
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 11.70 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 13P: DRY SWALE FILTER



Summary for Pond 14P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 7.13" for 10-Year Event event
Inflow = 0.58 cfs @ 12.12 hrs, Volume= 0.021 af
Outflow = 0.52 cfs @ 12.16 hrs, Volume= 0.021 af, Atten= 10%, Lag= 2.7 min
Primary = 0.04 cfs @ 12.16 hrs, Volume= 0.011 af
Routed to Pond 15P : DRY SWALE FILTER
Secondary = 0.48 cfs @ 12.16 hrs, Volume= 0.010 af
Routed to Link AP-5 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.69' @ 12.16 hrs Surf.Area= 322 sf Storage= 176 cf

Plug-Flow detention time= 14.6 min calculated for 0.021 af (100% of inflow)
Center-of-Mass det. time= 14.6 min (779.4 - 764.8)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

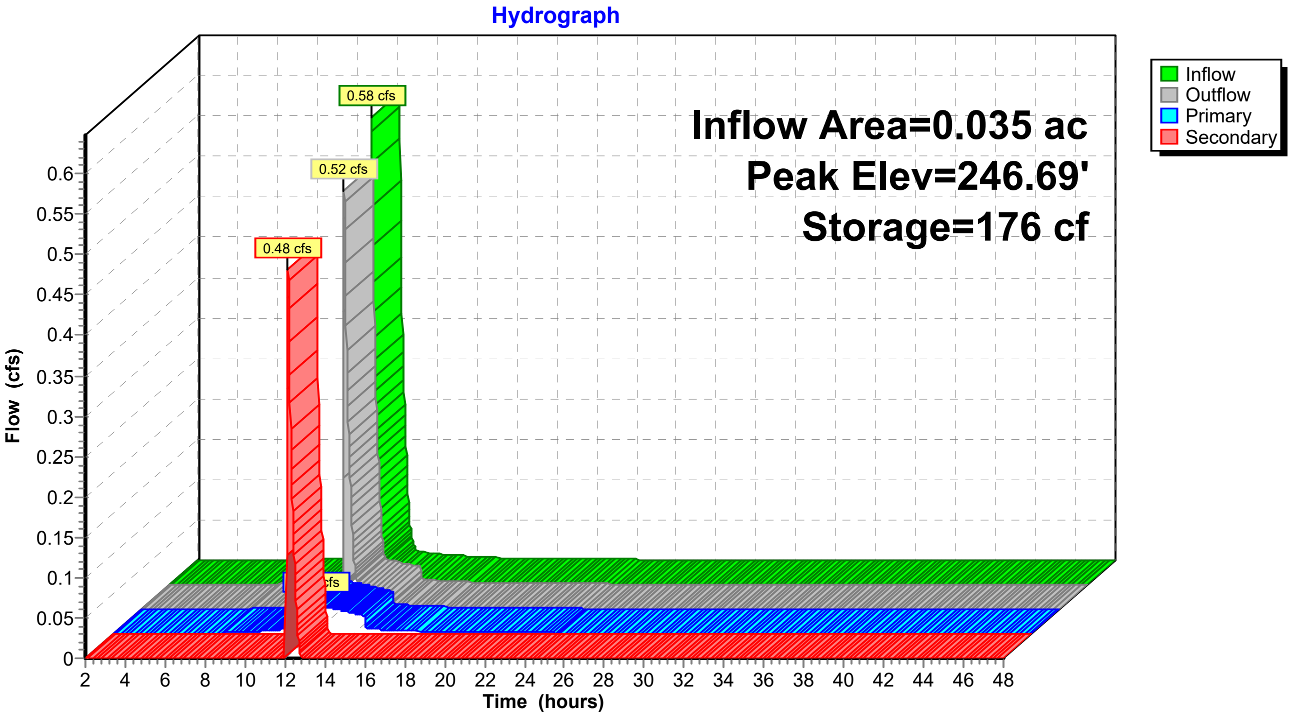
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.04 cfs @ 12.16 hrs HW=246.69' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.48 cfs @ 12.16 hrs HW=246.69' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.48 cfs @ 1.23 fps)

Pond 14P: BIORETENTION POOL



Summary for Pond 15P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 3.71" for 10-Year Event event
Inflow = 0.04 cfs @ 12.16 hrs, Volume= 0.011 af
Outflow = 0.02 cfs @ 11.70 hrs, Volume= 0.011 af, Atten= 51%, Lag= 0.0 min
Primary = 0.02 cfs @ 11.70 hrs, Volume= 0.011 af
Routed to Reach 4R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.75' @ 14.62 hrs Surf.Area= 391 sf Storage= 117 cf

Plug-Flow detention time= 45.1 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 45.1 min (863.4 - 818.3)

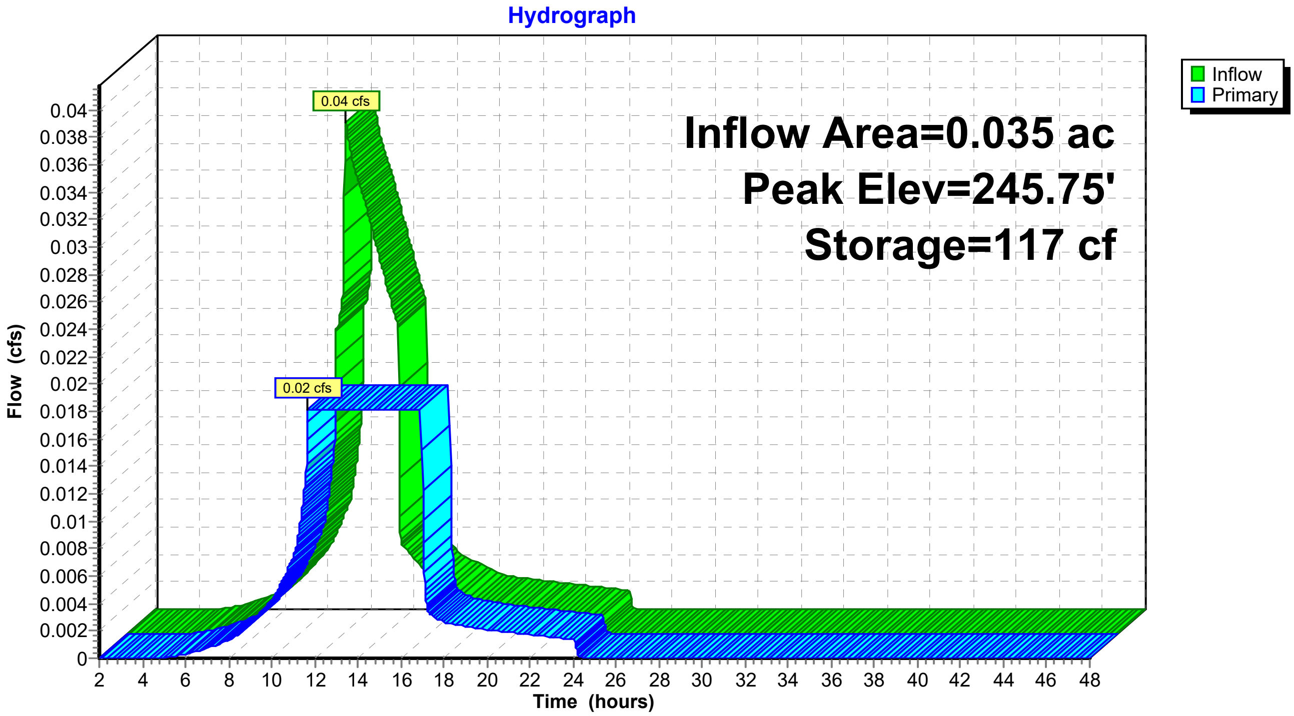
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 11.70 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 15P: DRY SWALE FILTER

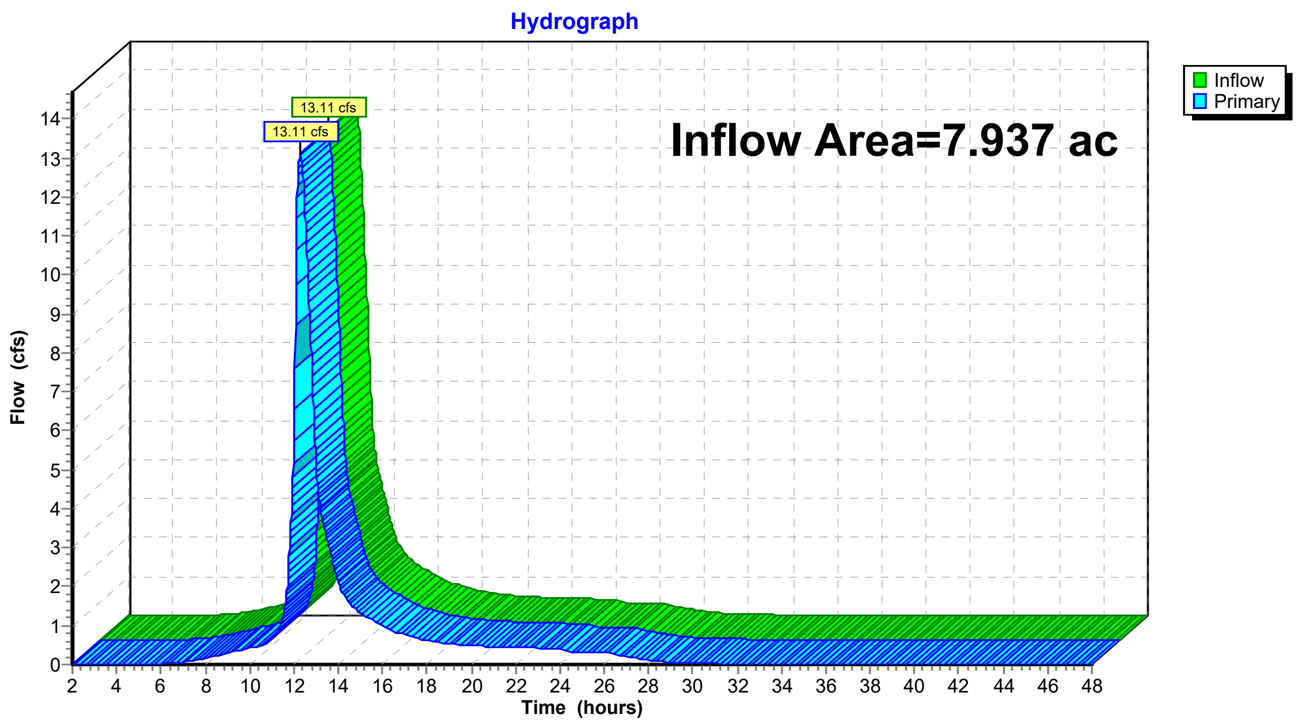


Summary for Link 1L: total 1

Inflow Area =	7.937 ac, 50.38% Impervious, Inflow Depth = 3.10"		for 10-Year Event event
Inflow =	13.11 cfs @ 12.28 hrs, Volume=	2.052 af	
Primary =	13.11 cfs @ 12.28 hrs, Volume=	2.052 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

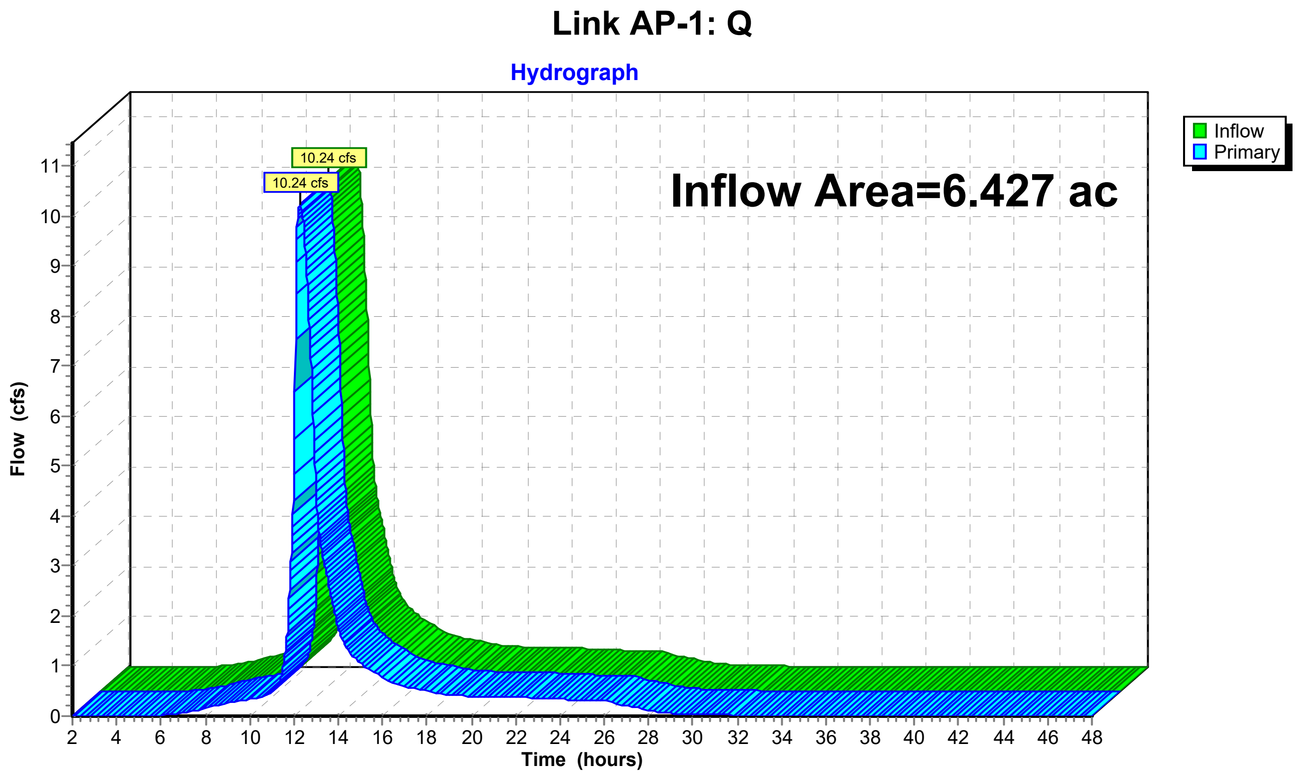
Link 1L: total 1



Summary for Link AP-1: Q

Inflow Area = 6.427 ac, 60.43% Impervious, Inflow Depth = 3.20" for 10-Year Event event
Inflow = 10.24 cfs @ 12.28 hrs, Volume= 1.715 af
Primary = 10.24 cfs @ 12.28 hrs, Volume= 1.715 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs



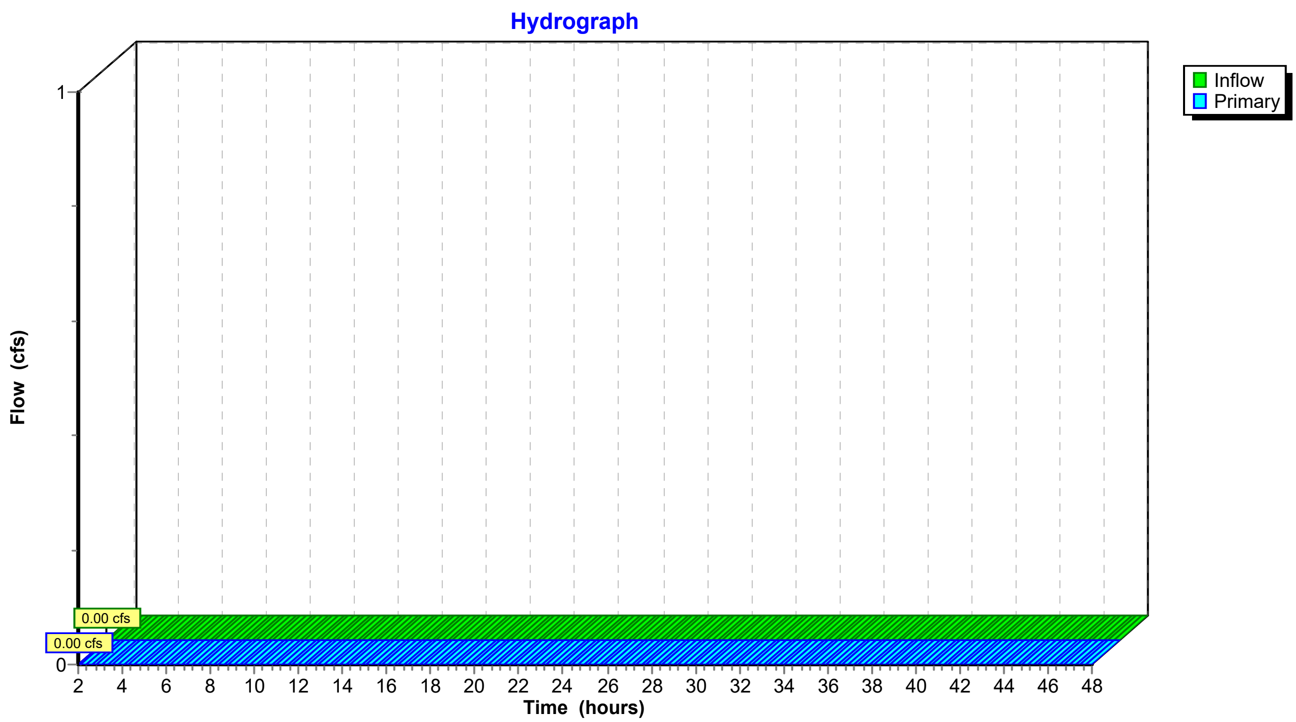
Summary for Link AP-2: Q

Inflow	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af
Primary	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-2: Q

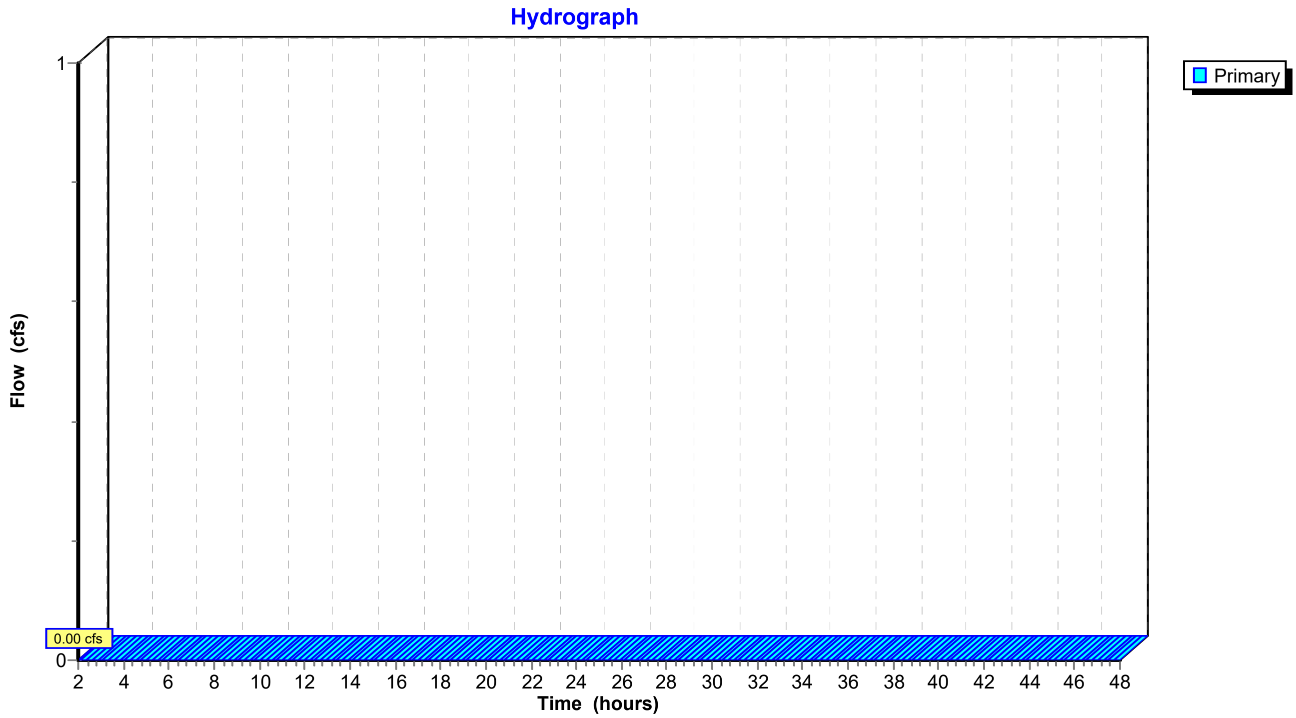


Summary for Link AP-3: Q

Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-3: Q

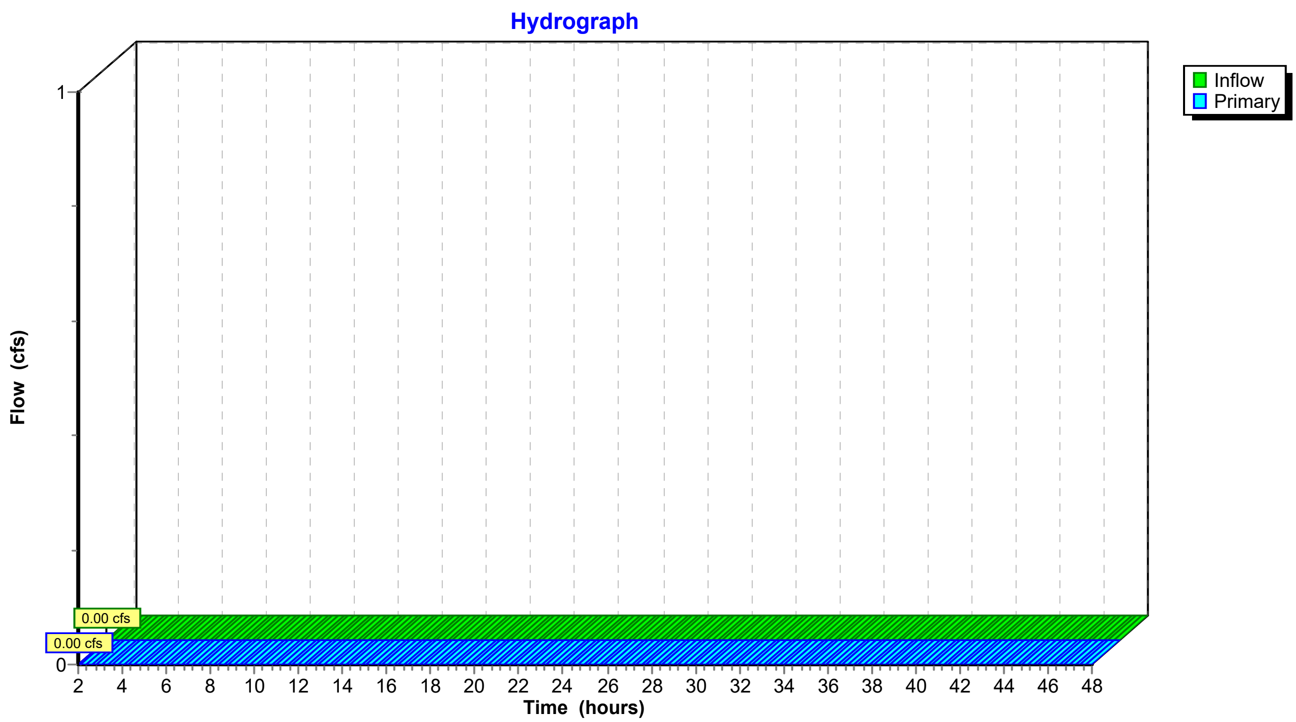


Summary for Link AP-4: Q

Inflow = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

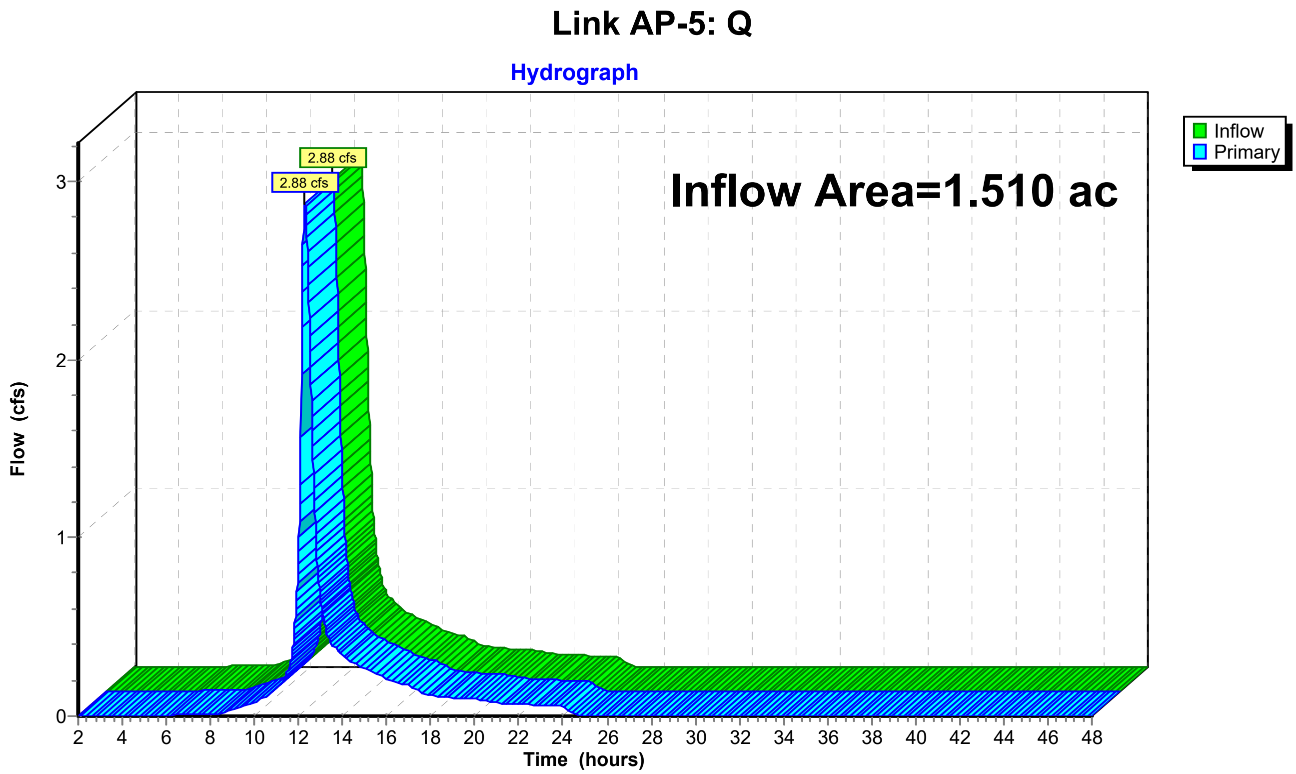
Link AP-4: Q



Summary for Link AP-5: Q

Inflow Area = 1.510 ac, 7.62% Impervious, Inflow Depth = 2.68" for 10-Year Event event
Inflow = 2.88 cfs @ 12.29 hrs, Volume= 0.337 af
Primary = 2.88 cfs @ 12.29 hrs, Volume= 0.337 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs



Time span=2.00-48.00 hrs, dt=0.02 hrs, 2301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1: Subarea 1 Runoff Area=1.040 ac 79.62% Impervious Runoff Depth>7.60"
Flow Length=100' Slope=0.0080 '/' Tc=14.2 min CN=94 Runoff=6.50 cfs 0.659 af

Subcatchment1A: Subarea 1A Runoff Area=0.205 ac 0.00% Impervious Runoff Depth=5.93"
Tc=6.0 min CN=80 Runoff=1.40 cfs 0.101 af

Subcatchment2: Subarea 2 Runoff Area=0.789 ac 61.98% Impervious Runoff Depth=7.24"
Tc=6.0 min CN=91 Runoff=6.19 cfs 0.476 af

Subcatchment2S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=7.00"
Tc=6.0 min CN=89 Runoff=0.27 cfs 0.021 af

Subcatchment3: Subarea 3 Runoff Area=1.019 ac 78.21% Impervious Runoff Depth>7.60"
Flow Length=592' Tc=10.8 min CN=94 Runoff=7.01 cfs 0.645 af

Subcatchment3S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=7.00"
Tc=6.0 min CN=89 Runoff=0.27 cfs 0.021 af

Subcatchment4: Subarea 4 Runoff Area=1.245 ac 60.80% Impervious Runoff Depth=7.24"
Flow Length=100' Tc=6.0 min CN=91 Runoff=9.77 cfs 0.751 af

Subcatchment4A: Subarea 4A Runoff Area=0.488 ac 0.00% Impervious Runoff Depth=5.93"
Tc=6.0 min CN=80 Runoff=3.32 cfs 0.241 af

Subcatchment4B: Subarea 4B Runoff Area=0.688 ac 0.00% Impervious Runoff Depth=5.93"
Flow Length=178' Tc=6.2 min CN=80 Runoff=4.65 cfs 0.340 af

Subcatchment5: Subarea 5 Runoff Area=2.987 ac 78.00% Impervious Runoff Depth>7.60"
Flow Length=35' Slope=0.0080 '/' Tc=6.2 min CN=94 Runoff=23.79 cfs 1.891 af

Subcatchment5A: Subarea 5A Runoff Area=1.345 ac 0.00% Impervious Runoff Depth=5.81"
Flow Length=279' Tc=22.5 min CN=79 Runoff=5.81 cfs 0.651 af

Subcatchment6: Subarea 6 Runoff Area=0.095 ac 82.11% Impervious Runoff Depth>7.72"
Tc=6.0 min CN=95 Runoff=0.77 cfs 0.061 af

Subcatchment7: Subarea 3 Runoff Area=0.471 ac 35.46% Impervious Runoff Depth=6.64"
Flow Length=574' Tc=7.3 min CN=86 Runoff=3.35 cfs 0.261 af

Reach 4R: UNDERDRAIN Avg. Flow Depth=0.07' Max Vel=3.59 fps Inflow=0.05 cfs 0.068 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.05 cfs 0.068 af

Reach 14R: UNDERDRAIN Avg. Flow Depth=0.04' Max Vel=2.58 fps Inflow=0.02 cfs 0.031 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.02 cfs 0.031 af

Reach 15R: UNDERDRAIN Avg. Flow Depth=0.05' Max Vel=3.18 fps Inflow=0.04 cfs 0.050 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.04 cfs 0.050 af

Pond 1P: Infiltration Basin 3 Peak Elev=260.95' Storage=5,063 cf Inflow=3.35 cfs 0.261 af
Discarded=0.33 cfs 0.261 af Secondary=0.00 cfs 0.000 af Outflow=0.33 cfs 0.261 af

Pond 2P: Infiltration Basin 1 Peak Elev=263.65' Storage=16,330 cf Inflow=7.41 cfs 0.760 af
Discarded=0.68 cfs 0.760 af Secondary=0.00 cfs 0.000 af Outflow=0.68 cfs 0.760 af

Pond 3P: Infiltration Basin 2 Peak Elev=261.72' Storage=8,247 cf Inflow=6.19 cfs 0.476 af
Discarded=0.52 cfs 0.476 af Secondary=0.00 cfs 0.000 af Outflow=0.52 cfs 0.476 af

Pond 4P: Infiltration Basin 4 Peak Elev=261.38' Storage=2,838 cf Inflow=7.01 cfs 0.645 af
Discarded=0.65 cfs 0.404 af Primary=6.17 cfs 0.241 af Secondary=0.00 cfs 0.000 af Outflow=6.82 cfs 0.645 af

Pond 5P: BIORETENTION POOL 1 Peak Elev=249.58' Storage=1,319 cf Inflow=2.33 cfs 0.560 af
Primary=0.12 cfs 0.197 af Secondary=1.18 cfs 0.276 af Tertiary=1.01 cfs 0.088 af Outflow=2.30 cfs 0.560 af

Pond 5PF: BIORETENTION FILTER Peak Elev=247.62' Storage=1,469 cf Inflow=0.12 cfs 0.197 af
Outflow=0.09 cfs 0.197 af

Pond 6P: BIORETENTION POOL 2 Peak Elev=257.80' Storage=4,282 cf Inflow=12.92 cfs 1.579 af
Primary=0.27 cfs 0.461 af Secondary=6.72 cfs 0.888 af Tertiary=5.25 cfs 0.230 af Outflow=12.24 cfs 1.579 af

Pond 6PF: BIORETENTION FILTER Peak Elev=254.76' Storage=1,967 cf Inflow=0.27 cfs 0.461 af
Outflow=0.23 cfs 0.461 af

Pond 7P: Detention Basin Peak Elev=244.27' Storage=35,635 cf Inflow=40.57 cfs 3.124 af
Outflow=17.47 cfs 3.124 af

Pond 8P: DIVERSION STRUCTURE Peak Elev=256.26' Inflow=9.77 cfs 0.751 af
Primary=2.33 cfs 0.560 af Secondary=7.43 cfs 0.191 af Outflow=9.77 cfs 0.751 af

Pond 9P: DIVERSION STRUCTURE Peak Elev=268.42' Inflow=23.79 cfs 1.891 af
Primary=12.92 cfs 1.579 af Secondary=10.87 cfs 0.312 af Outflow=23.79 cfs 1.891 af

Pond 10P: BIORETENTION POOL Peak Elev=248.55' Storage=132 cf Inflow=0.77 cfs 0.061 af
Primary=0.03 cfs 0.031 af Secondary=0.71 cfs 0.030 af Outflow=0.75 cfs 0.061 af

Pond 11P: DRY SWALE FILTER Peak Elev=246.98' Storage=310 cf Inflow=0.03 cfs 0.031 af
Outflow=0.02 cfs 0.031 af

Pond 12P: BIORETENTION POOL Peak Elev=246.79' Storage=209 cf Inflow=0.98 cfs 0.051 af
Primary=0.04 cfs 0.019 af Secondary=0.91 cfs 0.032 af Outflow=0.95 cfs 0.051 af

Pond 13P: DRY SWALE FILTER Peak Elev=246.60' Storage=250 cf Inflow=0.04 cfs 0.019 af
Outflow=0.02 cfs 0.019 af

Pond 14P: BIORETENTION POOL Peak Elev=246.83' Storage=222 cf Inflow=1.17 cfs 0.052 af
Primary=0.04 cfs 0.018 af Secondary=1.10 cfs 0.035 af Outflow=1.14 cfs 0.052 af

Pond 15P: DRY SWALE FILTER Peak Elev=246.26' Storage=197 cf Inflow=0.04 cfs 0.018 af
Outflow=0.02 cfs 0.018 af

Link 1L: total 1	Inflow=25.60 cfs 4.216 af
	Primary=25.60 cfs 4.216 af
Link AP-1: Q	Inflow=19.28 cfs 3.463 af
	Primary=19.28 cfs 3.463 af
Link AP-2: Q	Inflow=0.00 cfs 0.000 af
	Primary=0.00 cfs 0.000 af
Link AP-3: Q	
	Primary=0.00 cfs 0.000 af
Link AP-4: Q	Inflow=0.00 cfs 0.000 af
	Primary=0.00 cfs 0.000 af
Link AP-5: Q	Inflow=6.41 cfs 0.753 af
	Primary=6.41 cfs 0.753 af

Total Runoff Area = 10.442 ac Runoff Volume = 6.118 af Average Runoff Depth = 7.03"
47.49% Pervious = 4.959 ac 52.51% Impervious = 5.483 ac

Summary for Subcatchment 1: Subarea 1

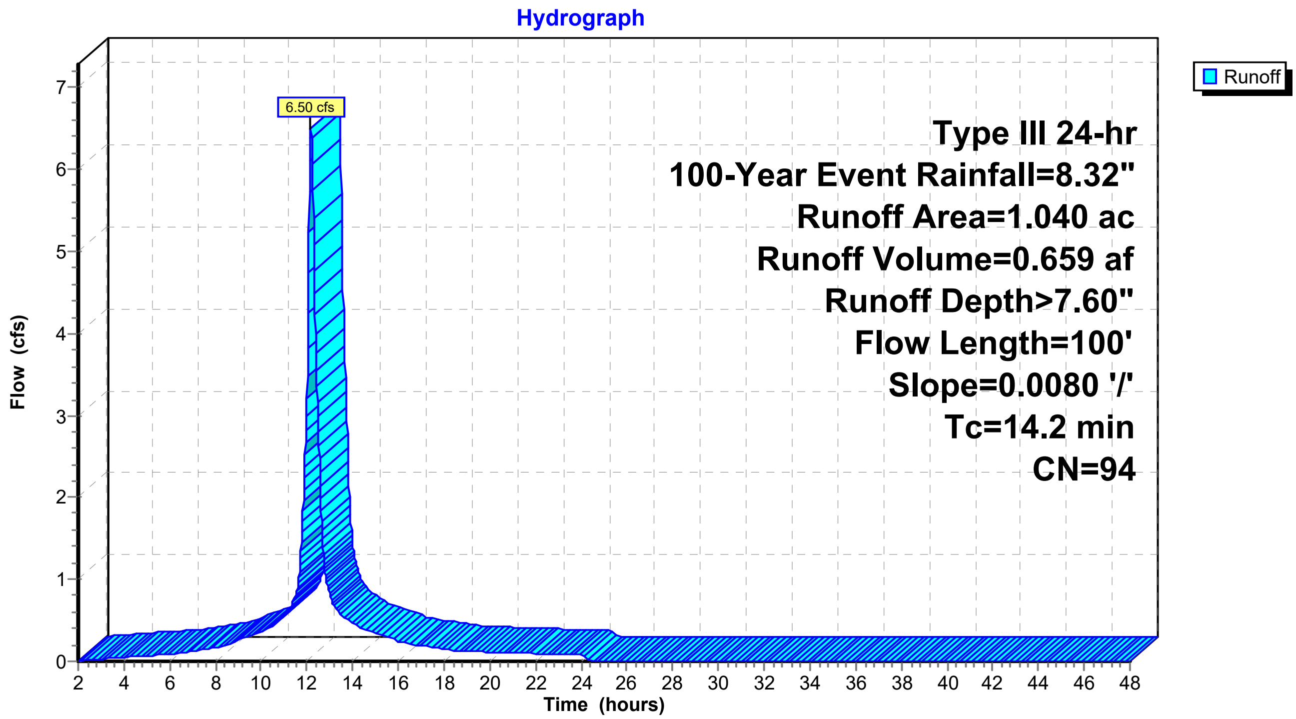
Runoff = 6.50 cfs @ 12.19 hrs, Volume= 0.659 af, Depth> 7.60"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.212	80	>75% Grass cover, Good, HSG D
0.828	98	Paved parking, HSG C
1.040	94	Weighted Average
0.212		20.38% Pervious Area
0.828		79.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	100	0.0080	0.12		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 1: Subarea 1



Summary for Subcatchment 1A: Subarea 1A

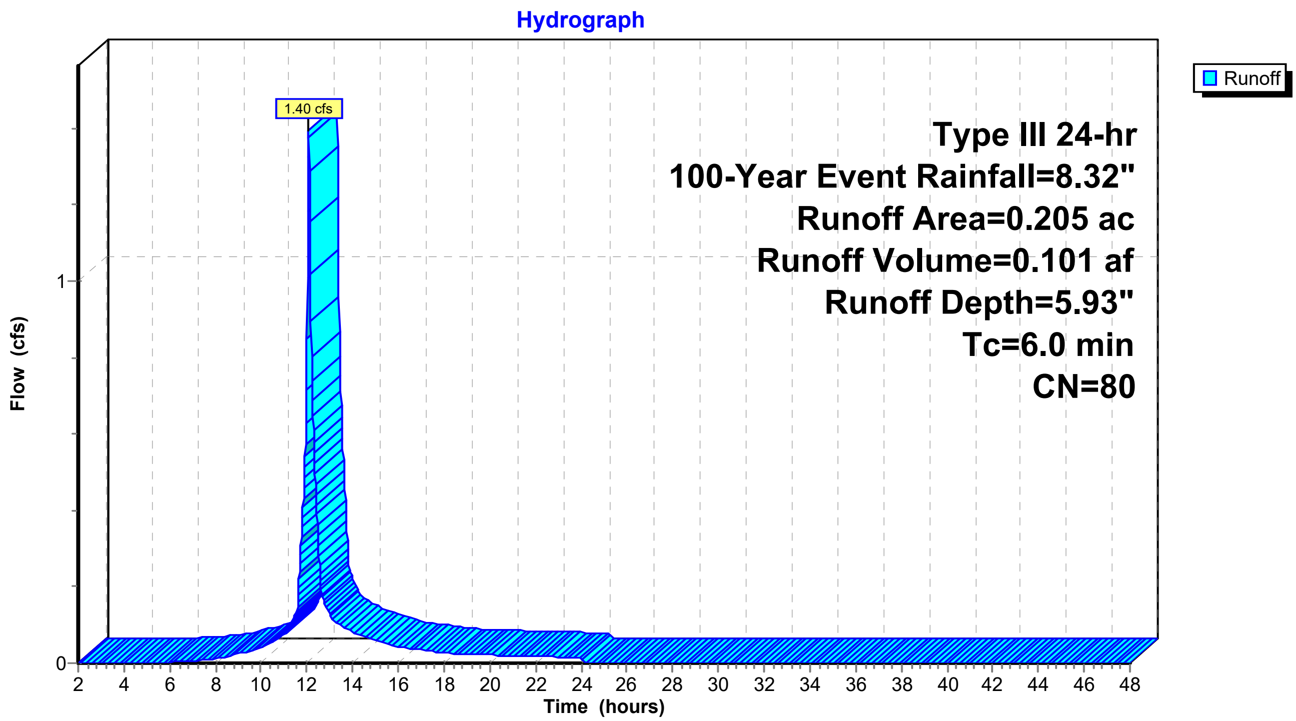
Runoff = 1.40 cfs @ 12.09 hrs, Volume= 0.101 af, Depth= 5.93"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.205	80	>75% Grass cover, Good, HSG D
0.205		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Minimm**

Subcatchment 1A: Subarea 1A



Summary for Subcatchment 2: Subarea 2

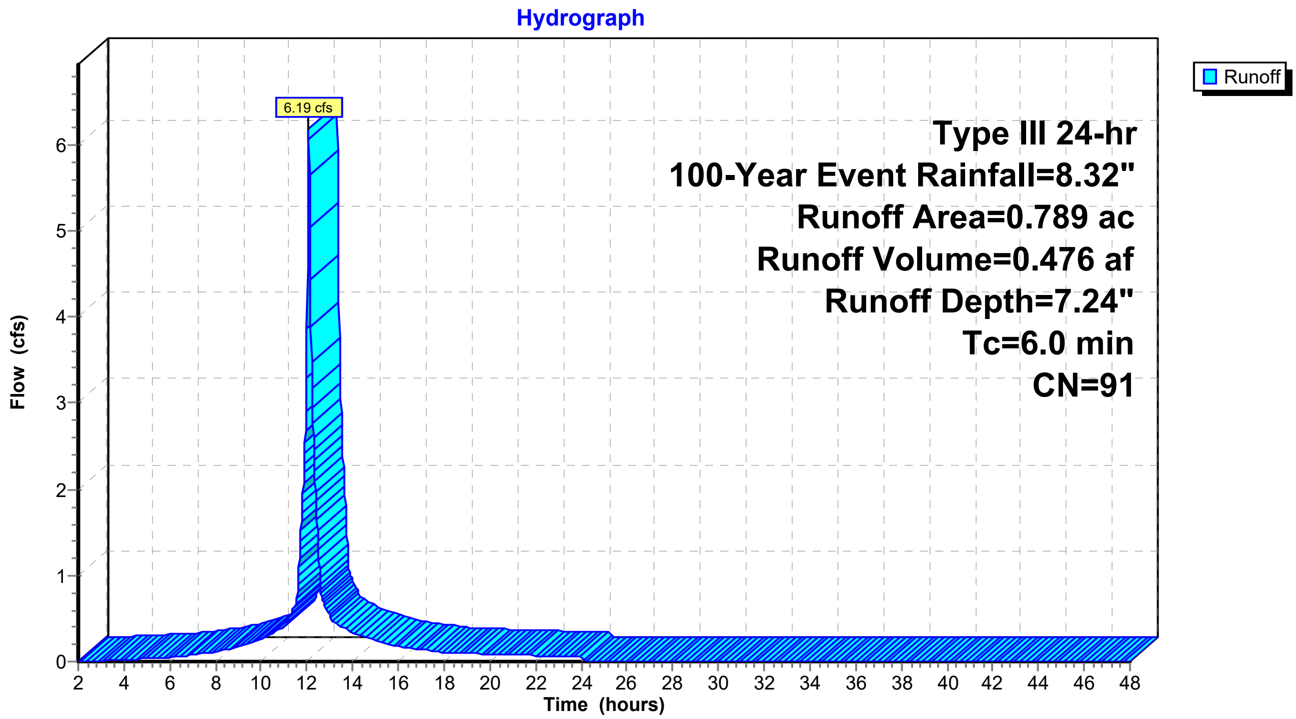
Runoff = 6.19 cfs @ 12.08 hrs, Volume= 0.476 af, Depth= 7.24"
Routed to Pond 3P : Infiltration Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.300	80	>75% Grass cover, Good, HSG D
0.489	98	Paved parking, HSG C
0.789	91	Weighted Average
0.300		38.02% Pervious Area
0.489		61.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MinTC**

Subcatchment 2: Subarea 2



Summary for Subcatchment 2S: Subarea 6

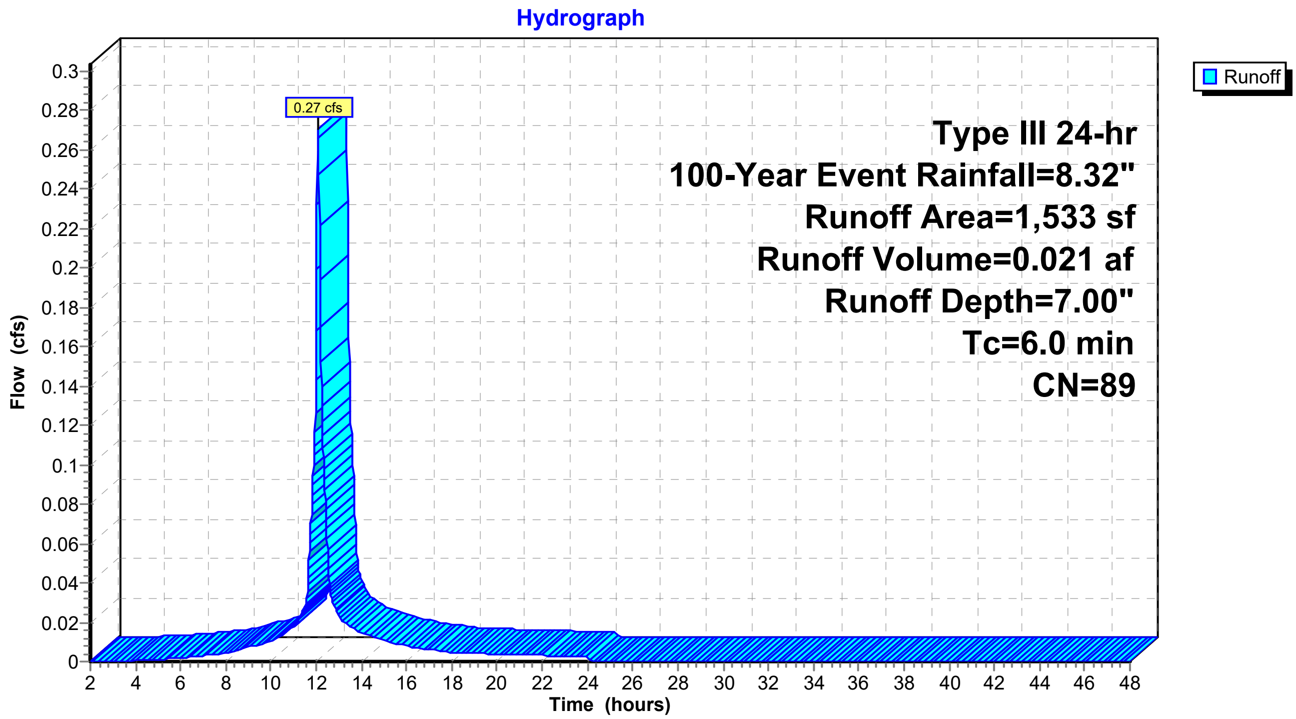
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 0.021 af, Depth= 7.00"
Routed to Pond 12P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 2S: Subarea 6



Summary for Subcatchment 3: Subarea 3

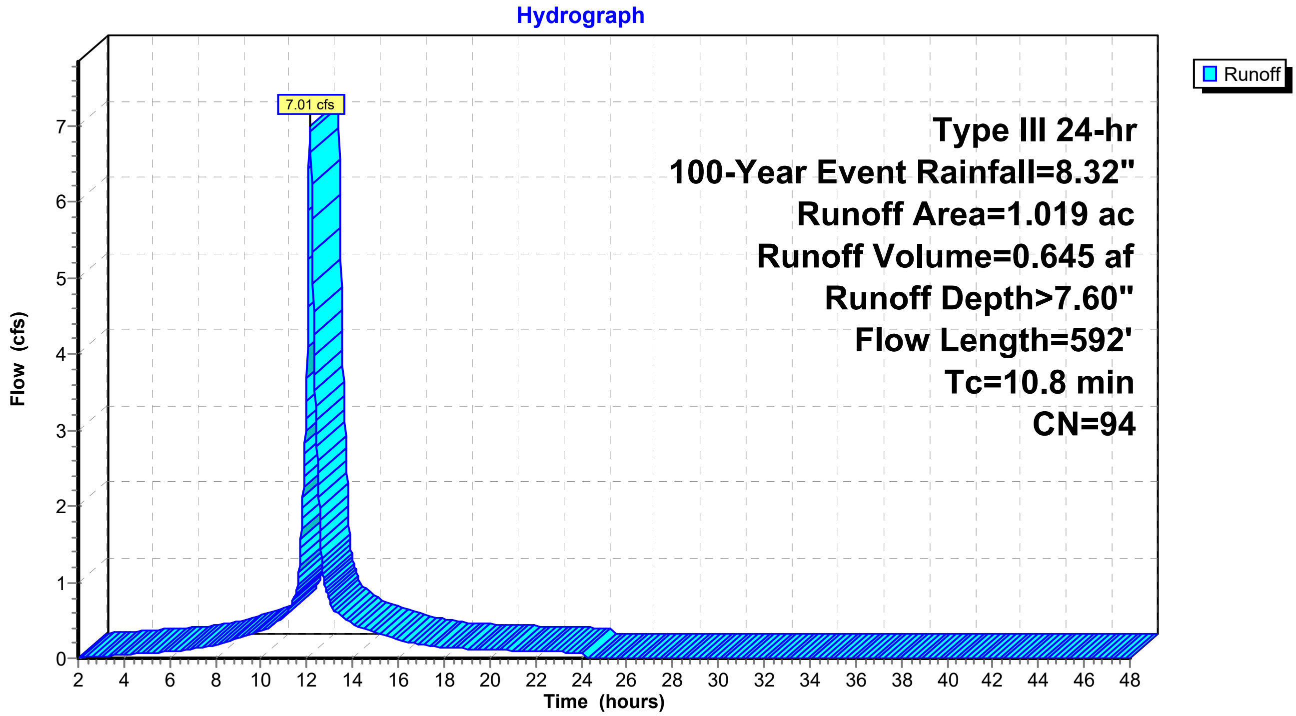
Runoff = 7.01 cfs @ 12.14 hrs, Volume= 0.645 af, Depth> 7.60"
Routed to Pond 4P : Infiltration Basin 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.222	80	>75% Grass cover, Good, HSG D
0.797	98	Paved parking, HSG C
1.019	94	Weighted Average
0.222		21.79% Pervious Area
0.797		78.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	53	0.0100	0.11		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
10.8	592	Total			

Subcatchment 3: Subarea 3



Summary for Subcatchment 3S: Subarea 6

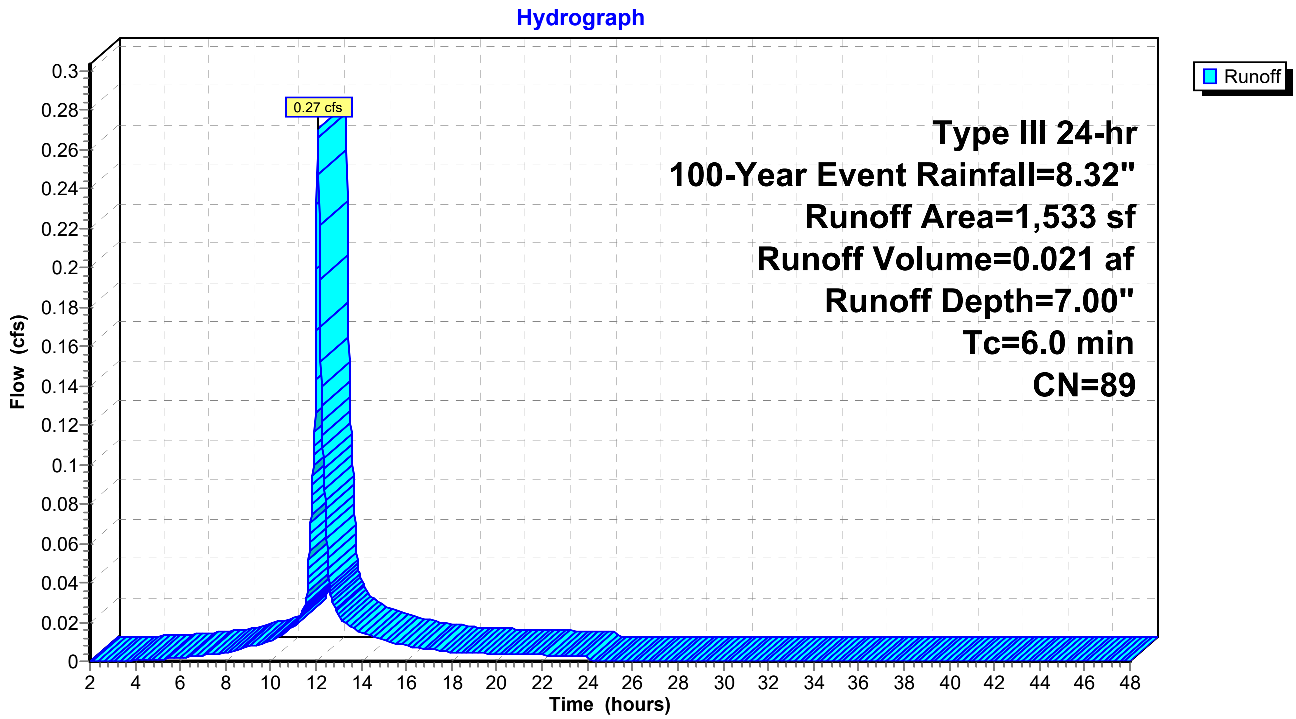
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 0.021 af, Depth= 7.00"
Routed to Pond 14P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 3S: Subarea 6



Summary for Subcatchment 4: Subarea 4

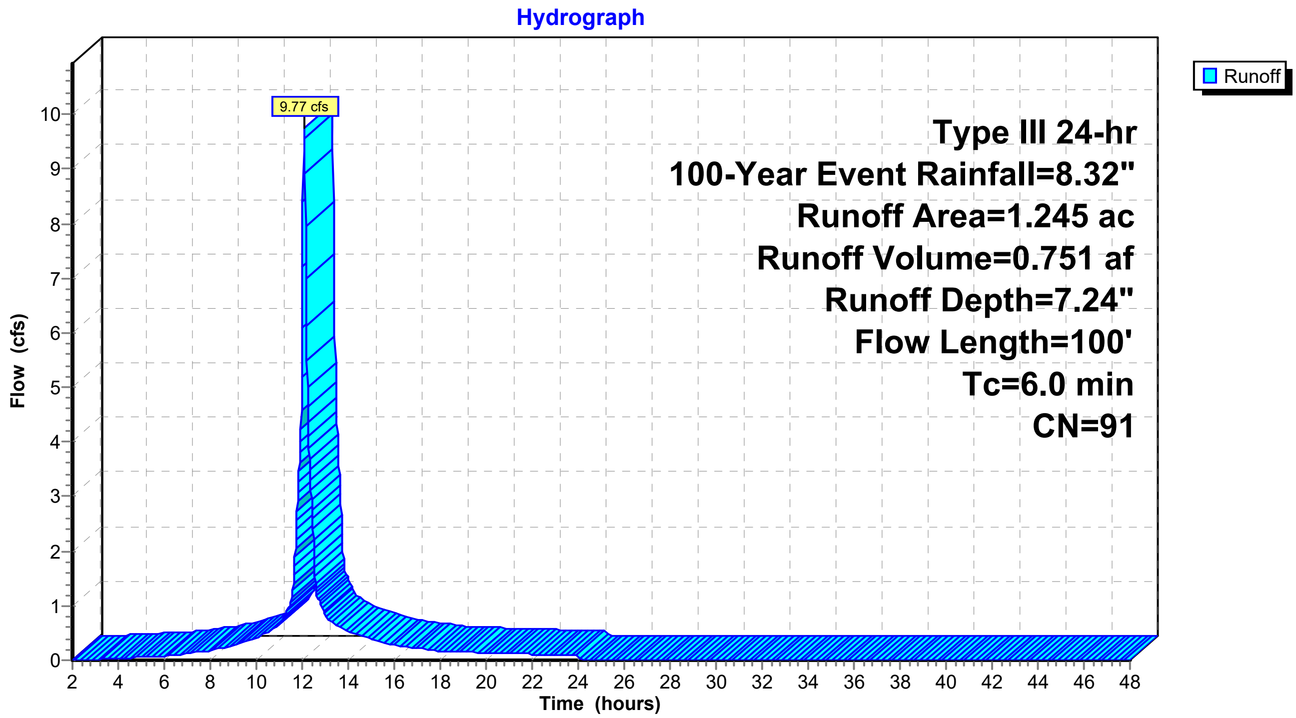
Runoff = 9.77 cfs @ 12.08 hrs, Volume= 0.751 af, Depth= 7.24"
Routed to Pond 8P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.757	98	Paved parking, HSG C
1.245	91	Weighted Average
0.488		39.20% Pervious Area
0.757		60.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	55	0.0900	0.27		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.9	45	0.2500	0.40		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
5.3	100	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4: Subarea 4



Summary for Subcatchment 4A: Subarea 4A

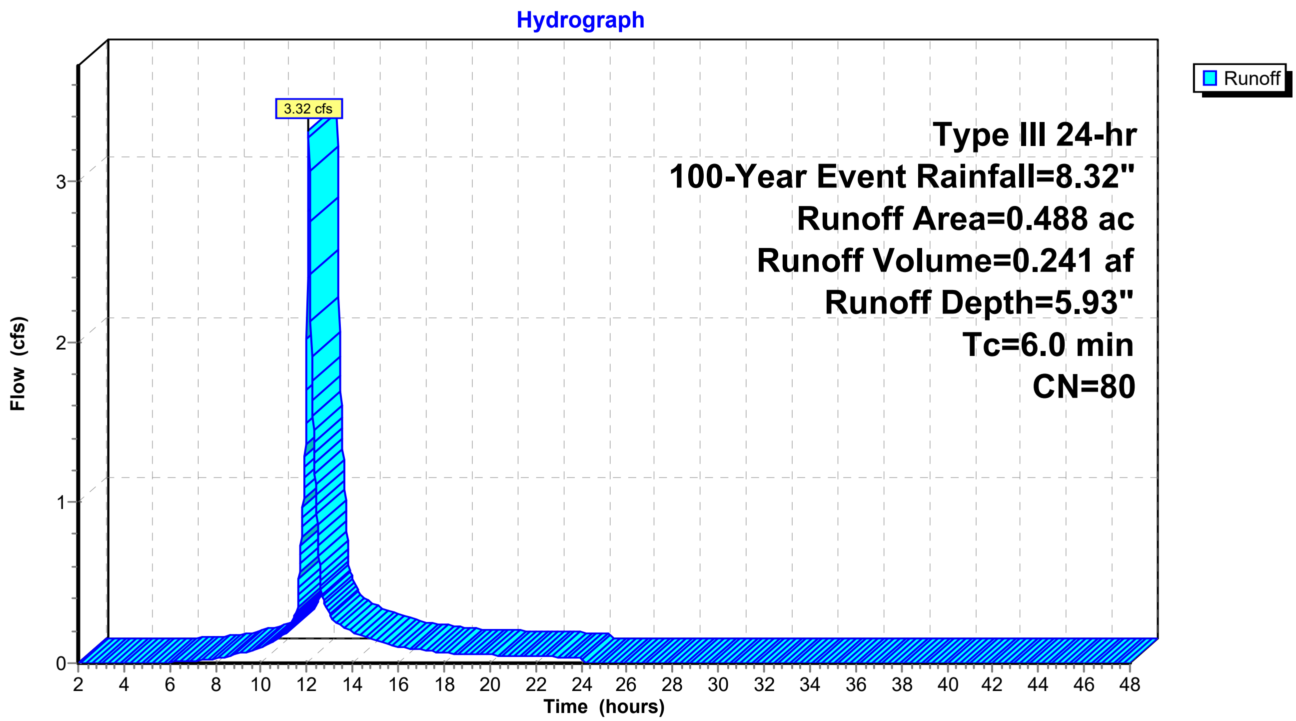
Runoff = 3.32 cfs @ 12.09 hrs, Volume= 0.241 af, Depth= 5.93"
Routed to Pond 7P : Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.488		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 4A: Subarea 4A



Summary for Subcatchment 4B: Subarea 4B

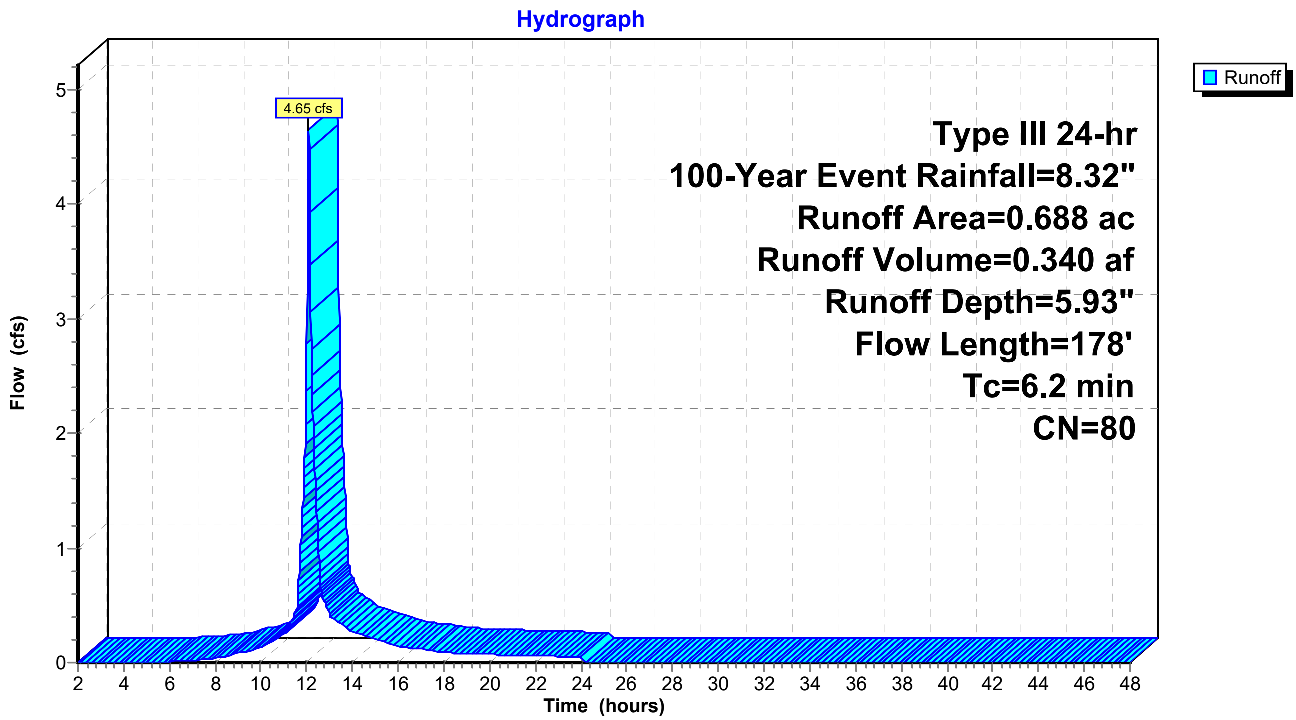
Runoff = 4.65 cfs @ 12.09 hrs, Volume= 0.340 af, Depth= 5.93"
Routed to Link AP-1 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.654	80	>75% Grass cover, Good, HSG D
0.034	77	Woods, Good, HSG D
0.688	80	Weighted Average
0.688		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.8	78	0.0100	1.61		**Shallow Concentrated Flow, Lawn** Unpaved Kv= 16.1 fps
6.2	178	Total			

Subcatchment 4B: Subarea 4B



Summary for Subcatchment 5: Subarea 5

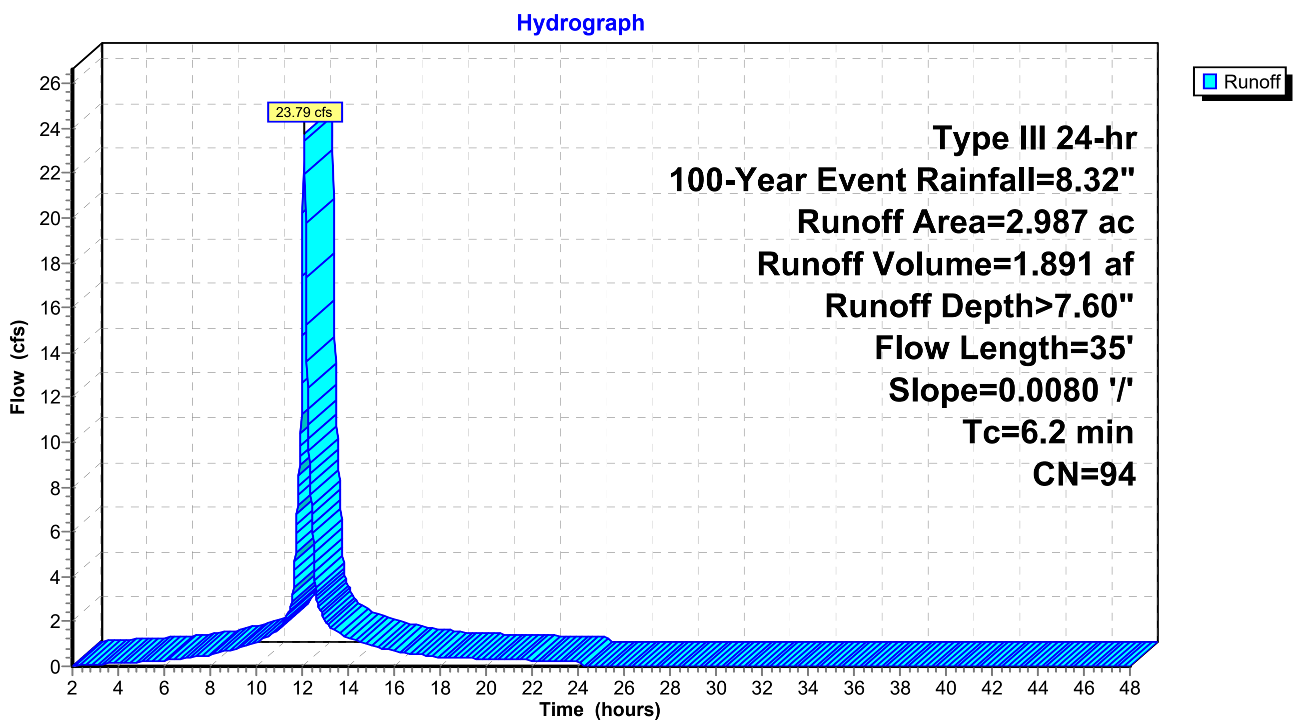
Runoff = 23.79 cfs @ 12.09 hrs, Volume= 1.891 af, Depth> 7.60"
Routed to Pond 9P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.657	80	>75% Grass cover, Good, HSG D
2.330	98	Paved parking, HSG C
2.987	94	Weighted Average
0.657		22.00% Pervious Area
2.330		78.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 5: Subarea 5



Summary for Subcatchment 5A: Subarea 5A

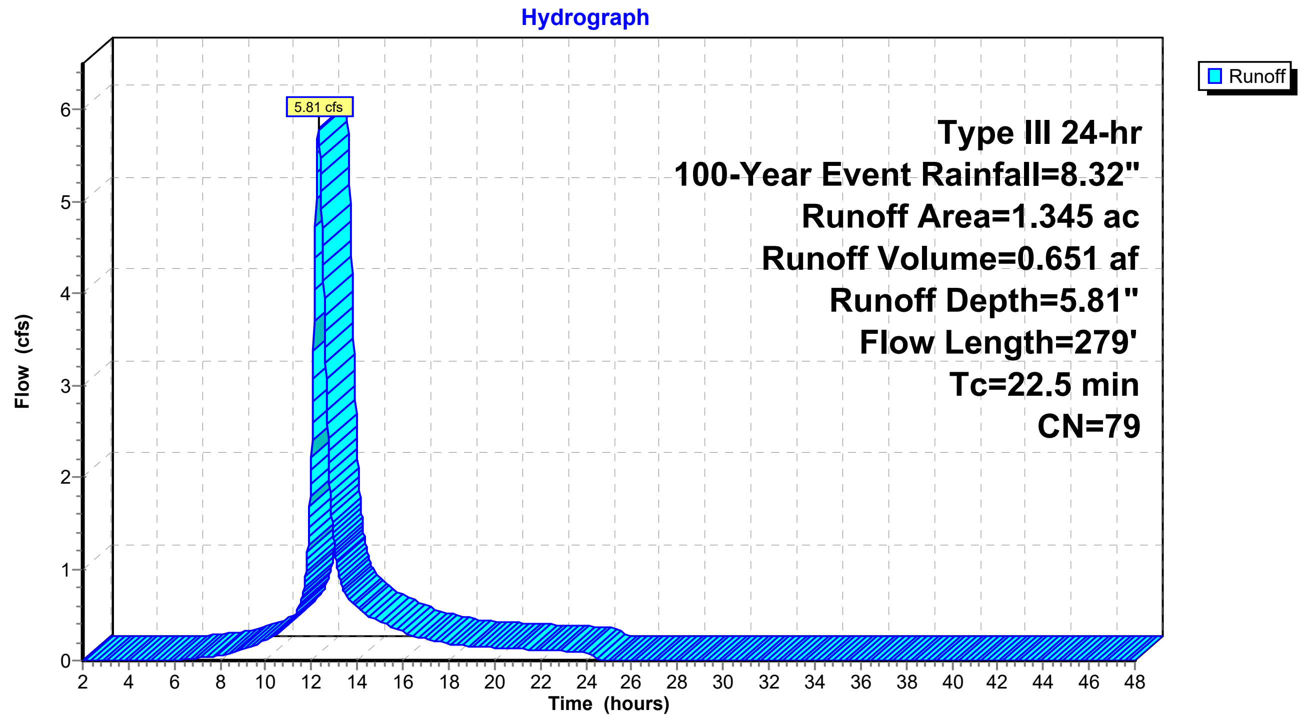
Runoff = 5.81 cfs @ 12.30 hrs, Volume= 0.651 af, Depth= 5.81"
Routed to Link AP-5 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
1.023	80	>75% Grass cover, Good, HSG D
0.322	77	Woods, Good, HSG D
1.345	79	Weighted Average
1.345		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	25	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
11.3	28	0.0080	0.04		**Sheet Flow, woods** Woods: Light underbrush n= 0.400 P2= 3.15"
4.6	46	0.2000	0.17		**Sheet Flow, Brush** Woods: Light underbrush n= 0.400 P2= 3.15"
1.9	180	0.1000	1.58		**Shallow Concentrated Flow, SC Flow** Woodland Kv= 5.0 fps
22.5	279	Total			

Subcatchment 5A: Subarea 5A



Summary for Subcatchment 6: Subarea 6

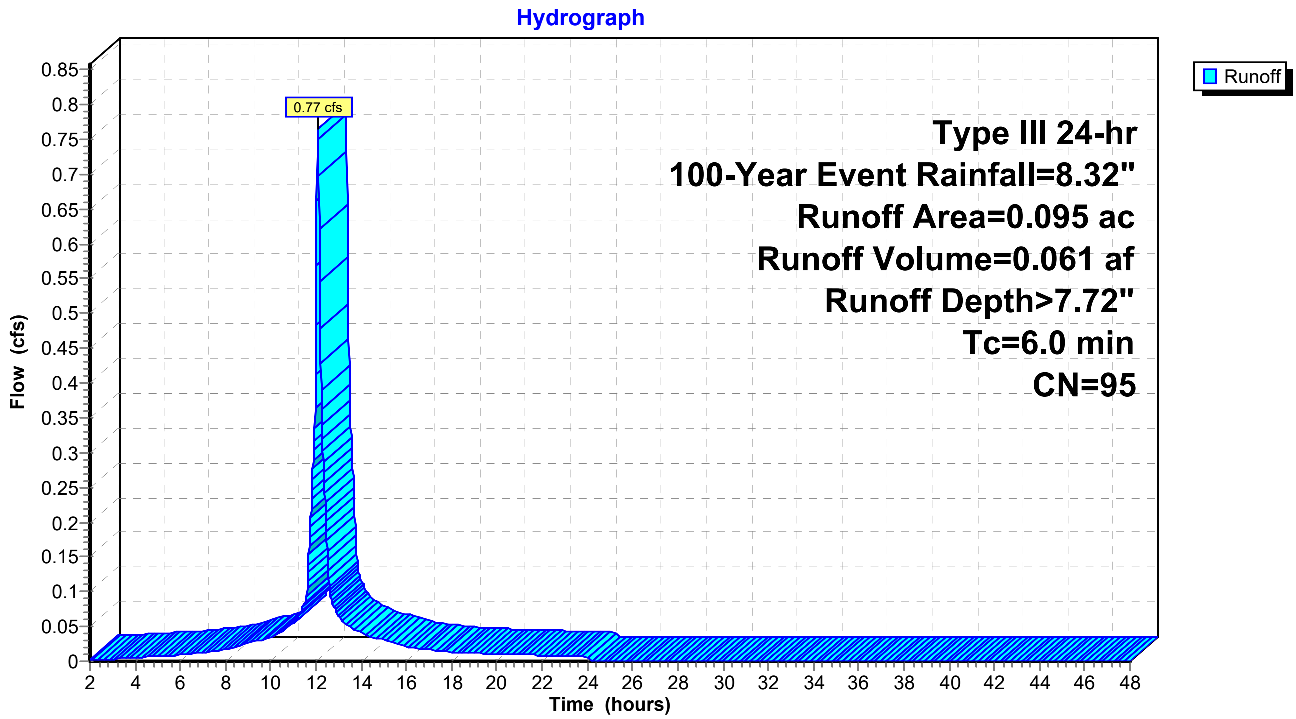
Runoff = 0.77 cfs @ 12.08 hrs, Volume= 0.061 af, Depth> 7.72"
Routed to Pond 10P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.017	80	>75% Grass cover, Good, HSG D
0.078	98	Paved parking, HSG C
0.095	95	Weighted Average
0.017		17.89% Pervious Area
0.078		82.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 6: Subarea 6



Summary for Subcatchment 7: Subarea 3

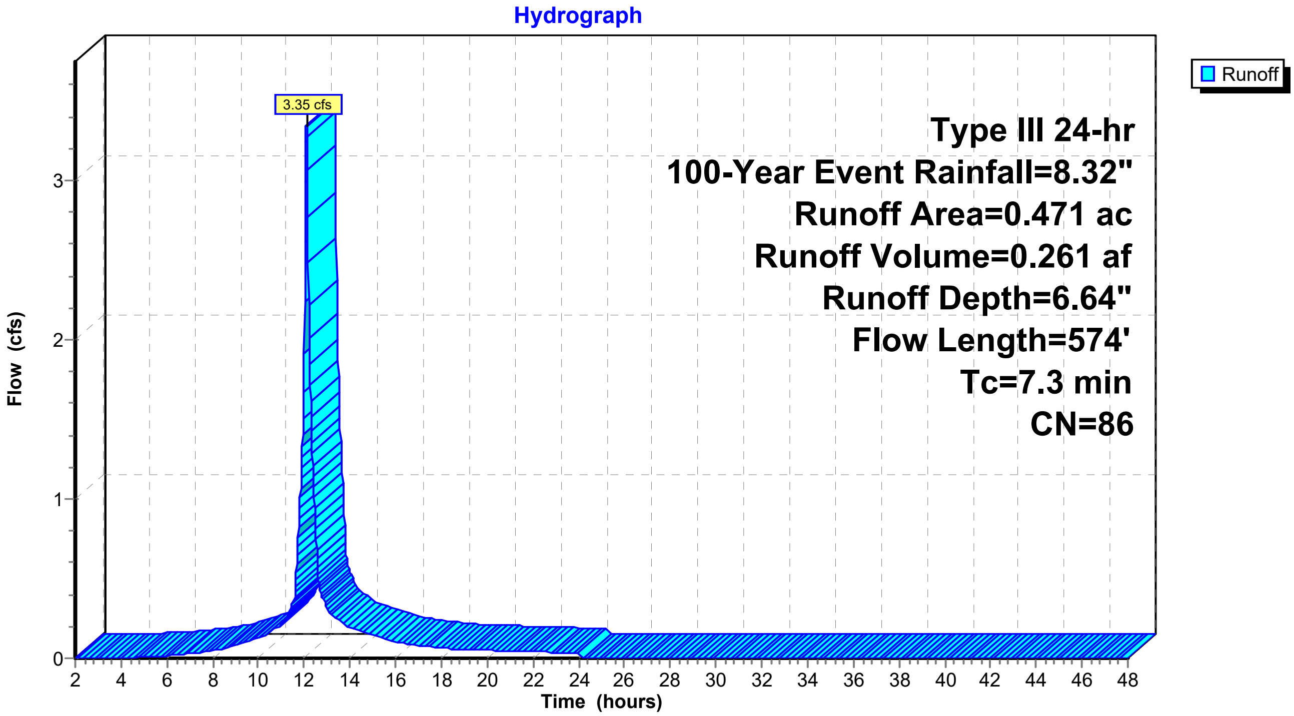
Runoff = 3.35 cfs @ 12.10 hrs, Volume= 0.261 af, Depth= 6.64"
Routed to Pond 1P : Infiltration Basin 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Event Rainfall=8.32"

Area (ac)	CN	Description
0.304	80	>75% Grass cover, Good, HSG D
0.167	98	Paved parking, HSG C
0.471	86	Weighted Average
0.304		64.54% Pervious Area
0.167		35.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	35	0.0200	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
7.3	574	Total			

Subcatchment 7: Subarea 3



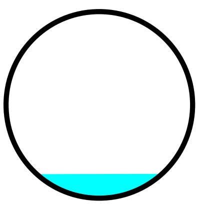
Summary for Reach 4R: UNDERDRAIN

Inflow Area = 0.165 ac, 69.59% Impervious, Inflow Depth > 4.90" for 100-Year Event event
Inflow = 0.05 cfs @ 11.18 hrs, Volume= 0.068 af
Outflow = 0.05 cfs @ 11.18 hrs, Volume= 0.068 af, Atten= 0%, Lag= 0.0 min
Routed to Link AP-5 : Q

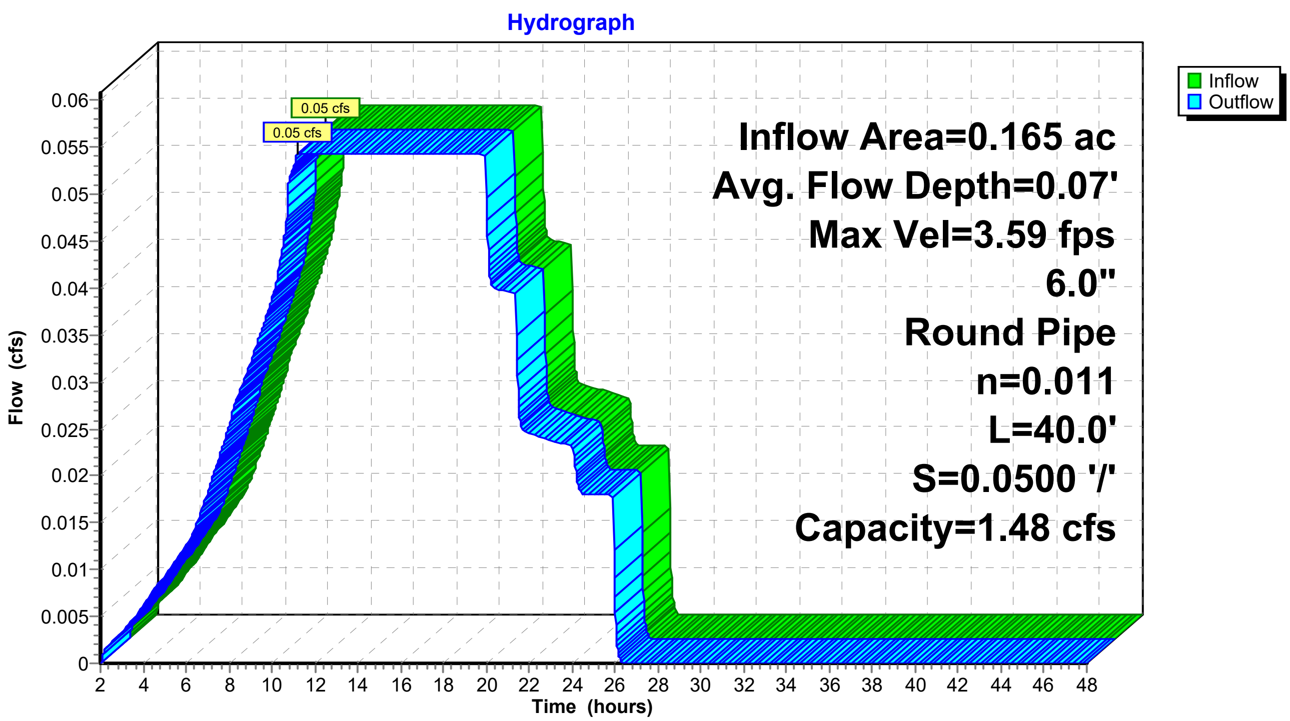
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.59 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.94 fps, Avg. Travel Time= 0.2 min

Peak Storage= 1 cf @ 11.18 hrs
Average Depth at Peak Storage= 0.07' , Surface Width= 0.34'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'



Reach 4R: UNDERDRAIN



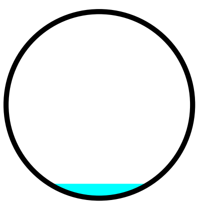
Summary for Reach 14R: UNDERDRAIN

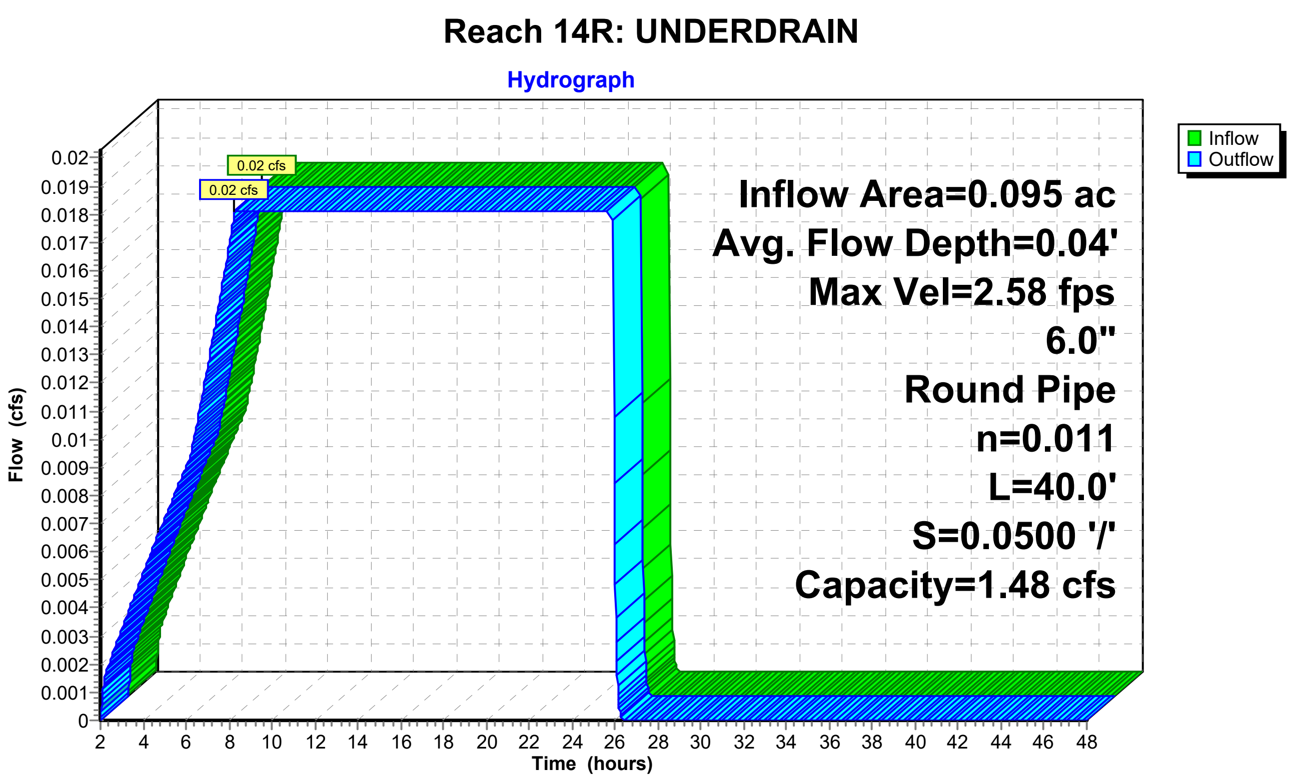
Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth > 3.88" for 100-Year Event event
Inflow = 0.02 cfs @ 8.24 hrs, Volume= 0.031 af
Outflow = 0.02 cfs @ 8.26 hrs, Volume= 0.031 af, Atten= 0%, Lag= 1.2 min
Routed to Reach 15R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.58 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.39 fps, Avg. Travel Time= 0.3 min

Peak Storage= 0 cf @ 8.26 hrs
Average Depth at Peak Storage= 0.04' , Surface Width= 0.27'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 244.50', Outlet Invert= 242.50'





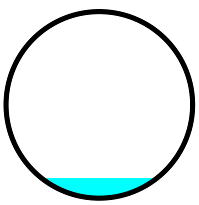
Summary for Reach 15R: UNDERDRAIN

Inflow Area = 0.130 ac, 74.16% Impervious, Inflow Depth > 4.61" for 100-Year Event event
Inflow = 0.04 cfs @ 10.76 hrs, Volume= 0.050 af
Outflow = 0.04 cfs @ 10.78 hrs, Volume= 0.050 af, Atten= 0%, Lag= 1.2 min
Routed to Reach 4R : UNDERDRAIN

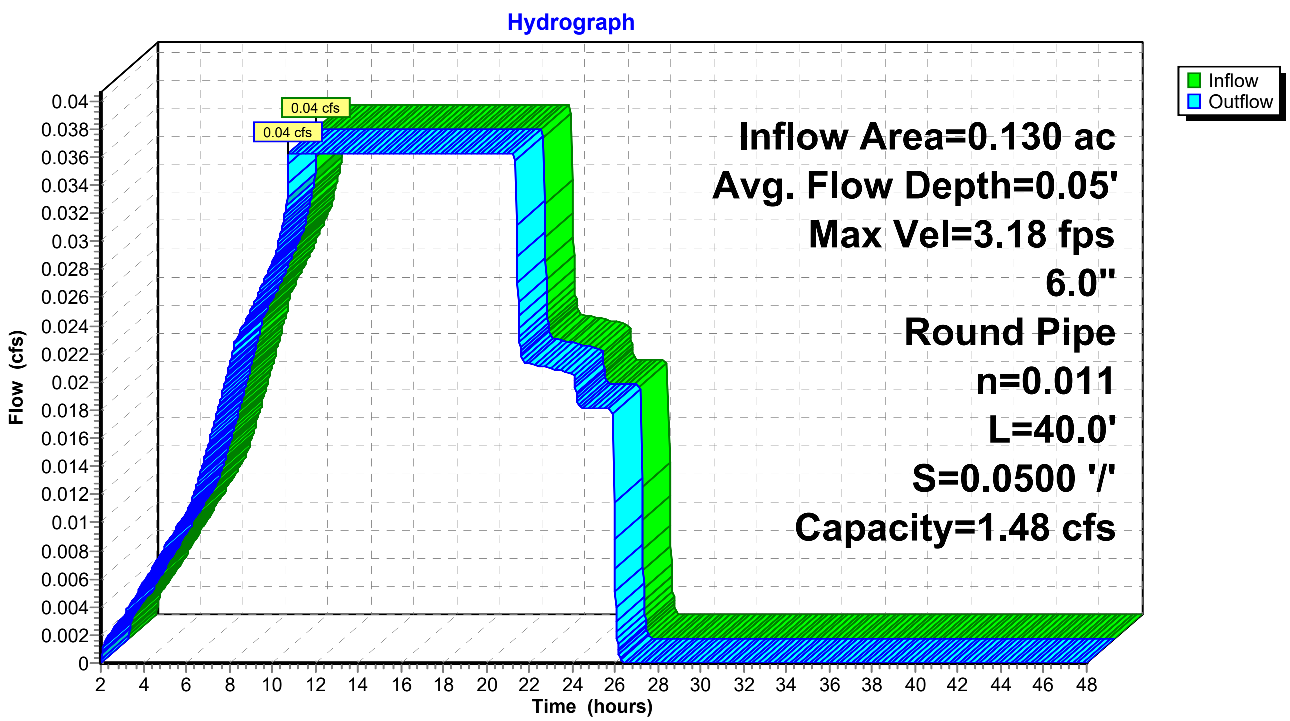
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.18 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.73 fps, Avg. Travel Time= 0.2 min

Peak Storage= 0 cf @ 10.78 hrs
Average Depth at Peak Storage= 0.05' , Surface Width= 0.31'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'



Reach 15R: UNDERDRAIN



Summary for Pond 1P: Infiltration Basin 3

Inflow Area = 0.471 ac, 35.46% Impervious, Inflow Depth = 6.64" for 100-Year Event event
Inflow = 3.35 cfs @ 12.10 hrs, Volume= 0.261 af
Outflow = 0.33 cfs @ 12.94 hrs, Volume= 0.261 af, Atten= 90%, Lag= 50.6 min
Discarded = 0.33 cfs @ 12.94 hrs, Volume= 0.261 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 260.95' @ 12.94 hrs Surf.Area= 2,874 sf Storage= 5,063 cf

Plug-Flow detention time= 165.6 min calculated for 0.261 af (100% of inflow)
Center-of-Mass det. time= 165.6 min (953.3 - 787.7)

Volume	Invert	Avail.Storage	Storage Description
#1	258.00'	8,592 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

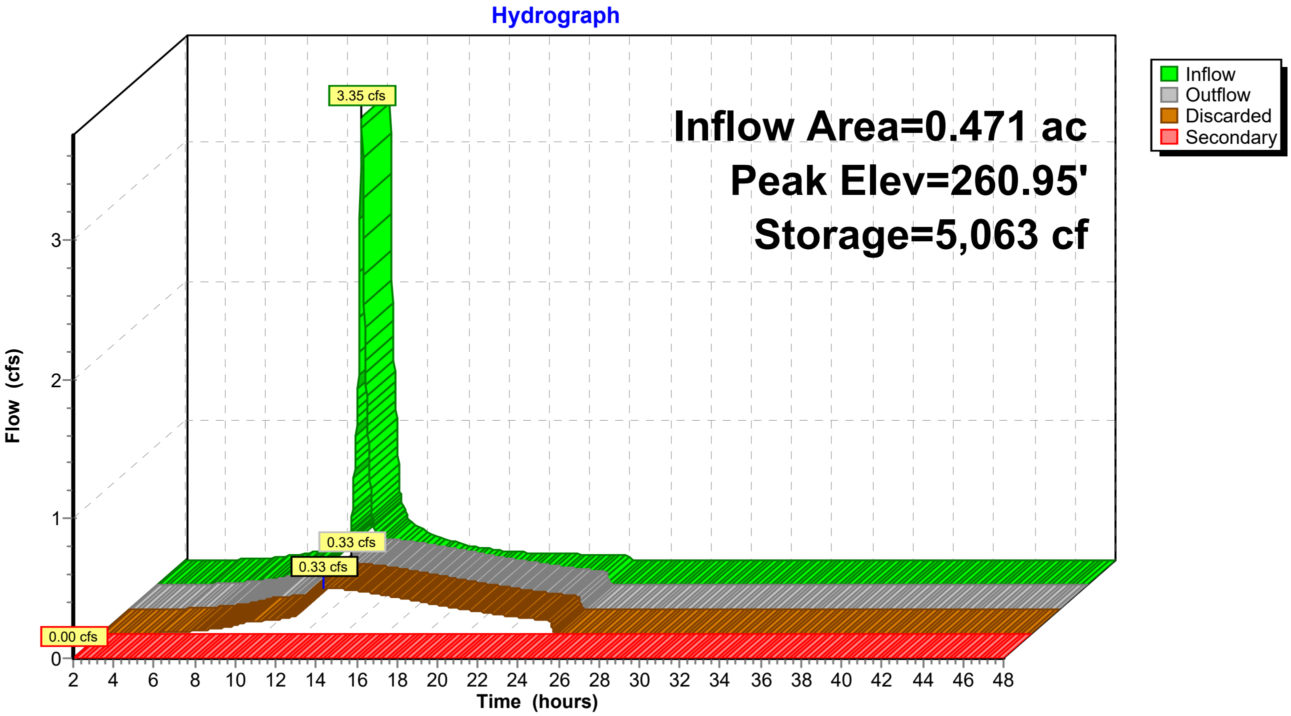
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
258.00	768	159.0	0	0	768
259.00	1,336	214.0	1,039	1,039	2,411
260.00	2,058	260.0	1,684	2,723	4,162
261.00	2,918	302.0	2,476	5,199	6,062
262.00	3,892	340.0	3,393	8,592	8,029

Device	Routing	Invert	Outlet Devices
#1	Discarded	258.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	261.00'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.33 cfs @ 12.94 hrs HW=260.95' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.33 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=258.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 1P: Infiltration Basin 3



Summary for Pond 2P: Infiltration Basin 1

Inflow Area = 1.245 ac, 66.51% Impervious, Inflow Depth > 7.32" for 100-Year Event event
Inflow = 7.41 cfs @ 12.17 hrs, Volume= 0.760 af
Outflow = 0.68 cfs @ 13.48 hrs, Volume= 0.760 af, Atten= 91%, Lag= 78.9 min
Discarded = 0.68 cfs @ 13.48 hrs, Volume= 0.760 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-4 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 263.65' @ 13.48 hrs Surf.Area= 7,320 sf Storage= 16,330 cf

Plug-Flow detention time= 266.1 min calculated for 0.760 af (100% of inflow)
Center-of-Mass det. time= 266.1 min (1,038.6 - 772.6)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	28,403 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

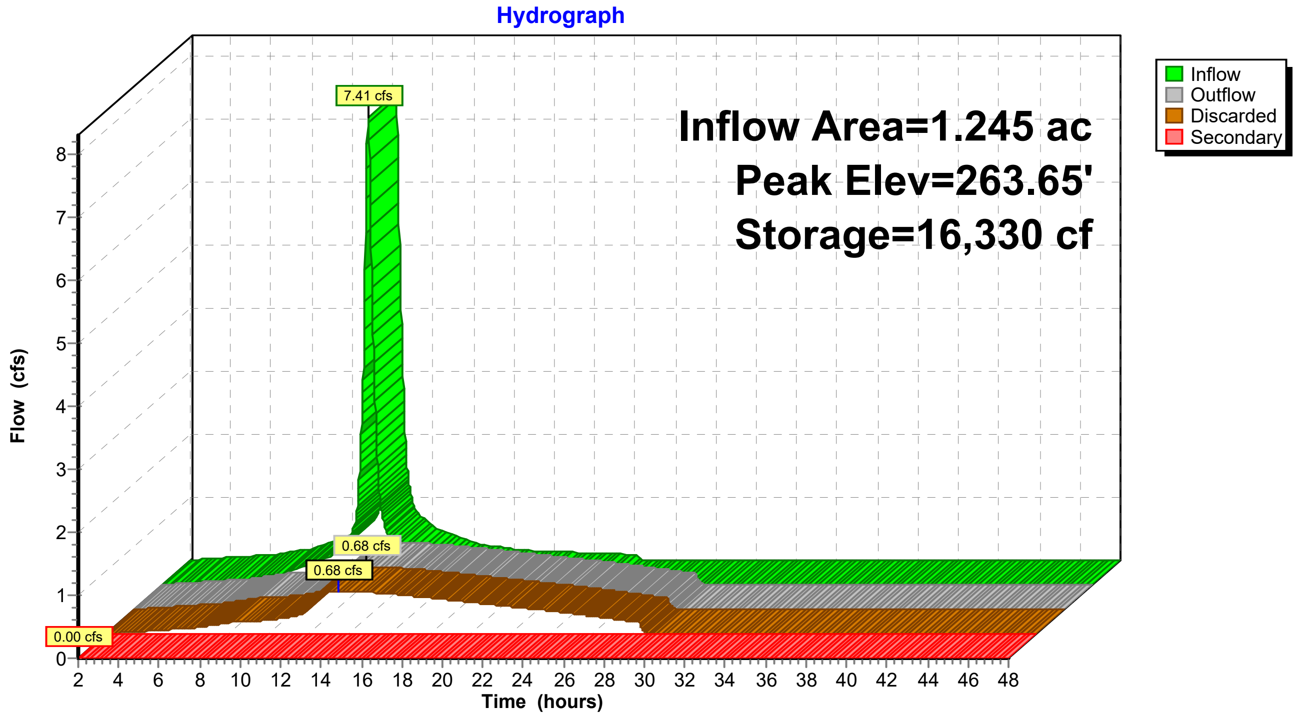
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	1,899	346.0	0	0	1,899
261.00	3,262	444.0	2,550	2,550	8,073
262.00	4,687	481.0	3,953	6,503	10,835
263.00	6,254	534.0	5,452	11,955	15,146
264.00	7,942	571.0	7,081	19,036	18,446
265.50	4,689	396.0	9,367	28,403	31,932

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	263.75'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.68 cfs @ 13.48 hrs HW=263.65' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.68 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Infiltration Basin 1



Summary for Pond 3P: Infiltration Basin 2

Inflow Area = 0.789 ac, 61.98% Impervious, Inflow Depth = 7.24" for 100-Year Event event
Inflow = 6.19 cfs @ 12.08 hrs, Volume= 0.476 af
Outflow = 0.52 cfs @ 13.02 hrs, Volume= 0.476 af, Atten= 92%, Lag= 56.0 min
Discarded = 0.52 cfs @ 13.02 hrs, Volume= 0.476 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-2 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 261.72' @ 13.02 hrs Surf.Area= 5,601 sf Storage= 8,247 cf

Plug-Flow detention time= 133.9 min calculated for 0.476 af (100% of inflow)
Center-of-Mass det. time= 133.9 min (905.4 - 771.5)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	16,256 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

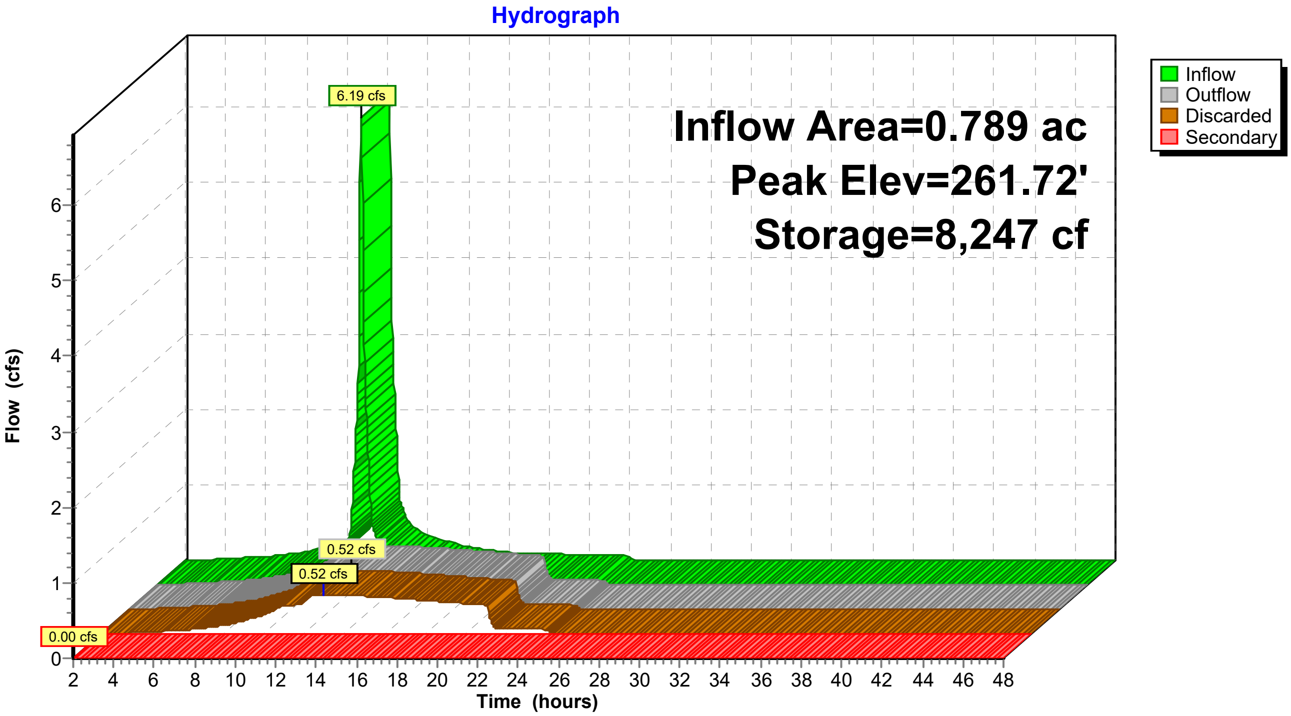
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	4,044	279.0	0	0	4,044
261.00	4,923	304.0	4,476	4,476	5,240
262.00	5,880	330.0	5,394	9,871	6,589
263.00	6,905	353.0	6,386	16,256	7,885

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	262.00'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.52 cfs @ 13.02 hrs HW=261.72' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.52 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 3P: Infiltration Basin 2



Summary for Pond 4P: Infiltration Basin 4

Inflow Area = 1.019 ac, 78.21% Impervious, Inflow Depth > 7.60" for 100-Year Event event
Inflow = 7.01 cfs @ 12.14 hrs, Volume= 0.645 af
Outflow = 6.82 cfs @ 12.17 hrs, Volume= 0.645 af, Atten= 3%, Lag= 1.6 min
Discarded = 0.65 cfs @ 12.17 hrs, Volume= 0.404 af
Primary = 6.17 cfs @ 12.17 hrs, Volume= 0.241 af
Routed to Pond 7P : Detention Basin
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 261.38' @ 12.17 hrs Surf.Area= 2,332 sf Storage= 2,838 cf

Plug-Flow detention time= 28.1 min calculated for 0.645 af (100% of inflow)
Center-of-Mass det. time= 28.1 min (793.1 - 765.0)

Volume	Invert	Avail.Storage	Storage Description
#1	259.00'	4,563 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
259.00	377	128.0	0	0	377
260.00	988	176.0	658	658	1,548
261.00	1,829	236.0	1,387	2,046	3,526
262.00	3,276	431.0	2,518	4,563	13,882

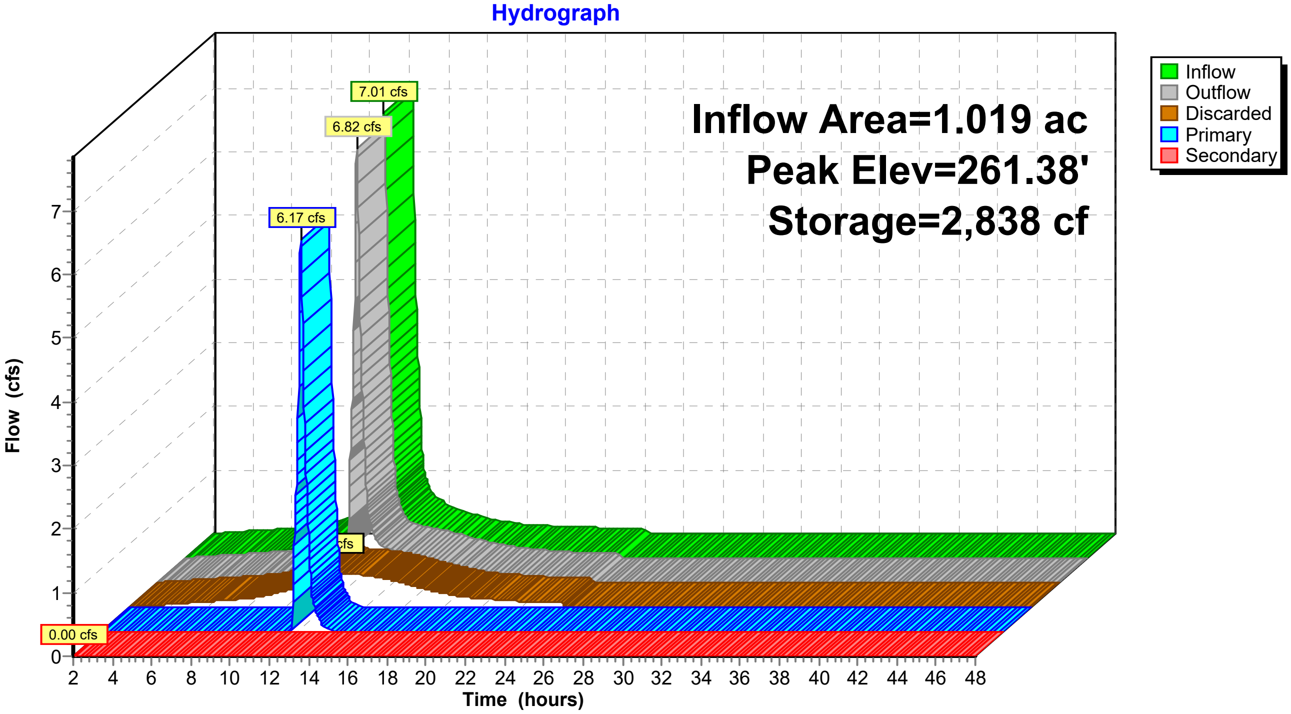
Device	Routing	Invert	Outlet Devices
#1	Discarded	259.00'	**12.000 in/hr Exfiltration over Surface area**
#2	Primary	259.00'	**18.0" Round Culvert** L= 47.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 259.00' / 255.20' S= 0.0809 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	261.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	261.40'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.65 cfs @ 12.17 hrs HW=261.38' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.65 cfs)

Primary OutFlow Max=6.14 cfs @ 12.17 hrs HW=261.38' (Free Discharge)
└─**2=Culvert** (Passes 6.14 cfs of 10.87 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 6.14 cfs @ 2.02 fps)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=259.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Infiltration Basin 4



Summary for Pond 5P: BIORETENTION POOL 1

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 5.40" for 100-Year Event event
Inflow = 2.33 cfs @ 12.08 hrs, Volume= 0.560 af
Outflow = 2.30 cfs @ 12.10 hrs, Volume= 0.560 af, Atten= 1%, Lag= 1.2 min
Primary = 0.12 cfs @ 12.10 hrs, Volume= 0.197 af
Routed to Pond 5PF : BIORETENTION FILTER
Secondary = 1.18 cfs @ 12.10 hrs, Volume= 0.276 af
Routed to Pond 7P : Detention Basin
Tertiary = 1.01 cfs @ 12.10 hrs, Volume= 0.088 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 249.58' @ 12.10 hrs Surf.Area= 2,496 sf Storage= 1,319 cf

Plug-Flow detention time= 44.5 min calculated for 0.560 af (100% of inflow)
Center-of-Mass det. time= 44.5 min (831.5 - 787.0)

Volume	Invert	Avail.Storage	Storage Description
#1	249.00'	2,444 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
249.00	2,084	225.0	0	0	2,084
250.00	2,823	249.0	2,444	2,444	3,020

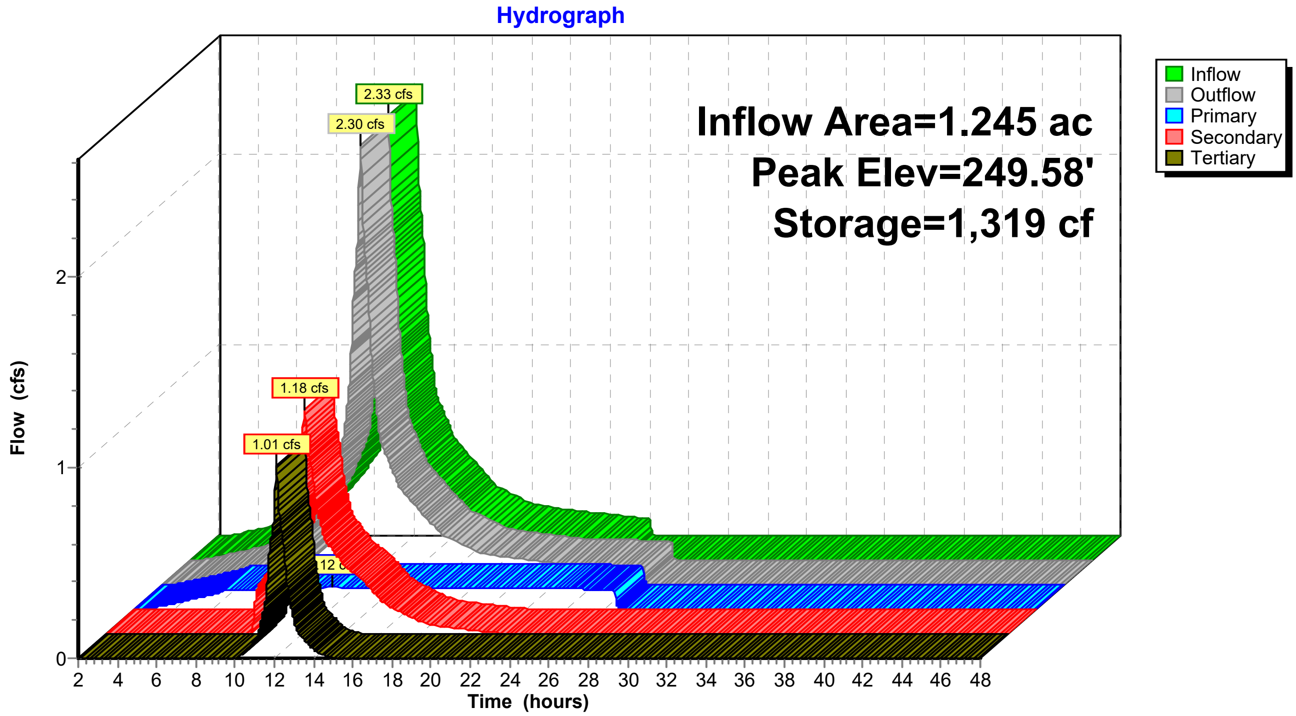
Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	249.45'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	249.50'	**20.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.12 cfs @ 12.10 hrs HW=249.58' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Secondary OutFlow Max=1.18 cfs @ 12.10 hrs HW=249.58' (Free Discharge)
└─**2=Culvert** (Passes 1.18 cfs of 6.09 cfs potential flow)
  └─**3=Orifice/Grate** (Weir Controls 1.18 cfs @ 1.16 fps)

Tertiary OutFlow Max=1.00 cfs @ 12.10 hrs HW=249.58' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 1.00 cfs @ 0.66 fps)

Pond 5P: BIORETENTION POOL 1



Summary for Pond 5PF: BIORETENTION FILTER

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 1.89" for 100-Year Event event
Inflow = 0.12 cfs @ 12.10 hrs, Volume= 0.197 af
Outflow = 0.09 cfs @ 6.80 hrs, Volume= 0.197 af, Atten= 21%, Lag= 0.0 min
Primary = 0.09 cfs @ 6.80 hrs, Volume= 0.197 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 247.62' @ 26.52 hrs Surf.Area= 1,965 sf Storage= 1,469 cf

Plug-Flow detention time= 137.0 min calculated for 0.197 af (100% of inflow)
Center-of-Mass det. time= 136.9 min (1,079.5 - 942.6)

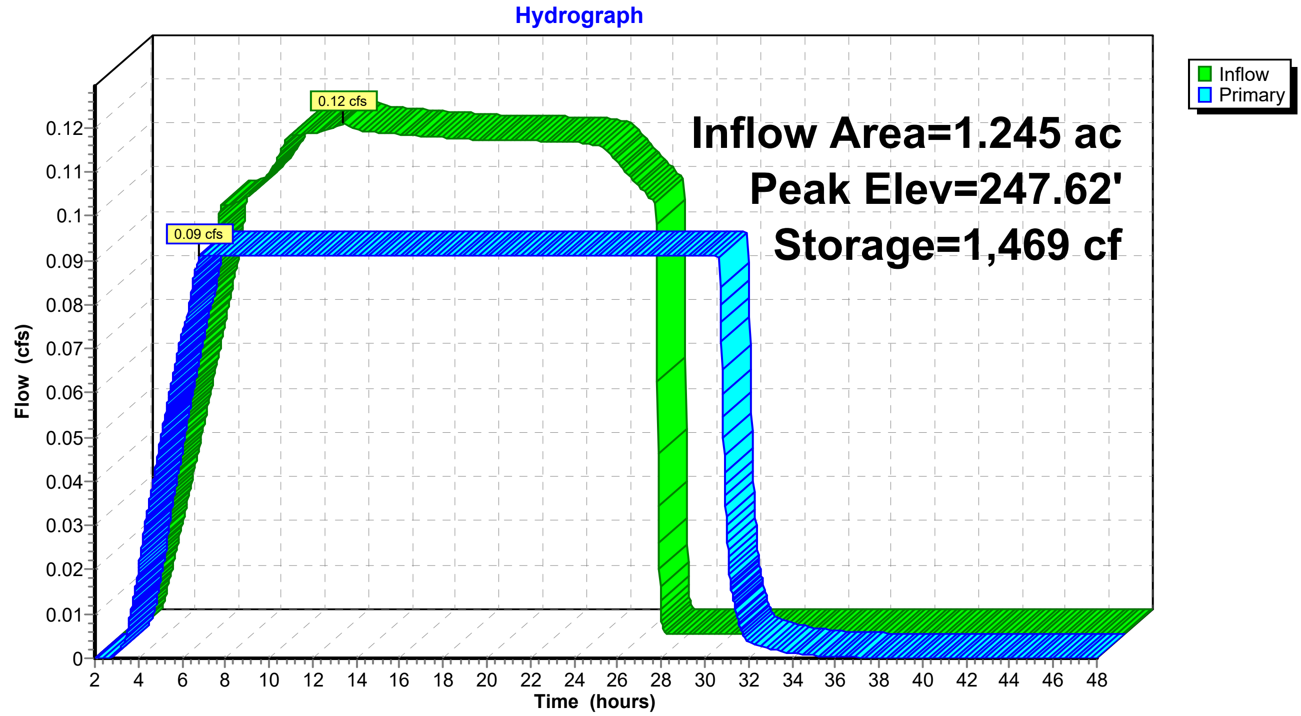
Volume	Invert	Avail.Storage	Storage Description
#1	245.75'	2,555 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 6,386 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.75	1,965	214.0	0	0	1,965
249.00	1,965	214.0	6,386	6,386	2,661

Device	Routing	Invert	Outlet Devices
#1	Primary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	245.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.09 cfs @ 6.80 hrs HW=245.91' (Free Discharge)
└─**1=Culvert** (Passes 0.09 cfs of 0.11 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 5PF: BIORETENTION FILTER



Summary for Pond 6P: BIORETENTION POOL 2

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth > 6.35" for 100-Year Event event
Inflow = 12.92 cfs @ 12.09 hrs, Volume= 1.579 af
Outflow = 12.24 cfs @ 12.12 hrs, Volume= 1.579 af, Atten= 5%, Lag= 1.7 min
Primary = 0.27 cfs @ 12.12 hrs, Volume= 0.461 af
Routed to Pond 6PF : BIORETENTION FILTER
Secondary = 6.72 cfs @ 12.12 hrs, Volume= 0.888 af
Routed to Pond 7P : Detention Basin
Tertiary = 5.25 cfs @ 12.12 hrs, Volume= 0.230 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 257.80' @ 12.12 hrs Surf.Area= 5,779 sf Storage= 4,282 cf

Plug-Flow detention time= 36.7 min calculated for 1.579 af (100% of inflow)
Center-of-Mass det. time= 36.7 min (804.3 - 767.6)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	5,437 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
257.00	4,885	362.0	0	0	4,885
258.00	6,009	386.0	5,437	5,437	6,362

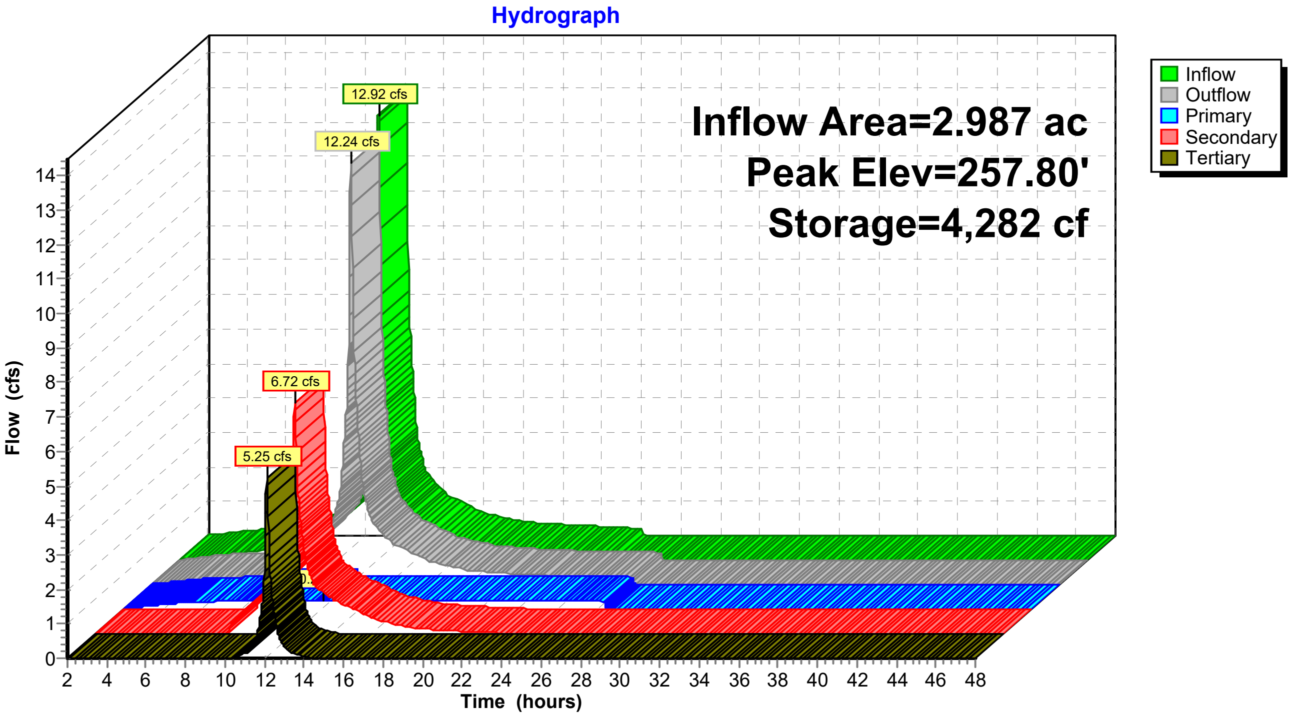
Device	Routing	Invert	Outlet Devices
#1	Primary	257.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	257.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	257.50'	**12.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.27 cfs @ 12.12 hrs HW=257.80' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.27 cfs)

Secondary OutFlow Max=6.69 cfs @ 12.12 hrs HW=257.80' (Free Discharge)
└—**2=Culvert** (Passes 6.69 cfs of 7.13 cfs potential flow)
  └—**3=Orifice/Grate** (Weir Controls 6.69 cfs @ 2.08 fps)

Tertiary OutFlow Max=5.23 cfs @ 12.12 hrs HW=257.80' (Free Discharge)
└—**4=Broad-Crested Rectangular Weir** (Weir Controls 5.23 cfs @ 1.34 fps)

Pond 6P: BIORETENTION POOL 2



Summary for Pond 6PF: BIORETENTION FILTER

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth > 1.85" for 100-Year Event event
Inflow = 0.27 cfs @ 12.12 hrs, Volume= 0.461 af
Outflow = 0.23 cfs @ 7.86 hrs, Volume= 0.461 af, Atten= 15%, Lag= 0.0 min
Primary = 0.23 cfs @ 7.86 hrs, Volume= 0.461 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 254.76' @ 26.36 hrs Surf.Area= 4,885 sf Storage= 1,967 cf

Plug-Flow detention time= 87.2 min calculated for 0.461 af (100% of inflow)
Center-of-Mass det. time= 87.5 min (990.6 - 903.1)

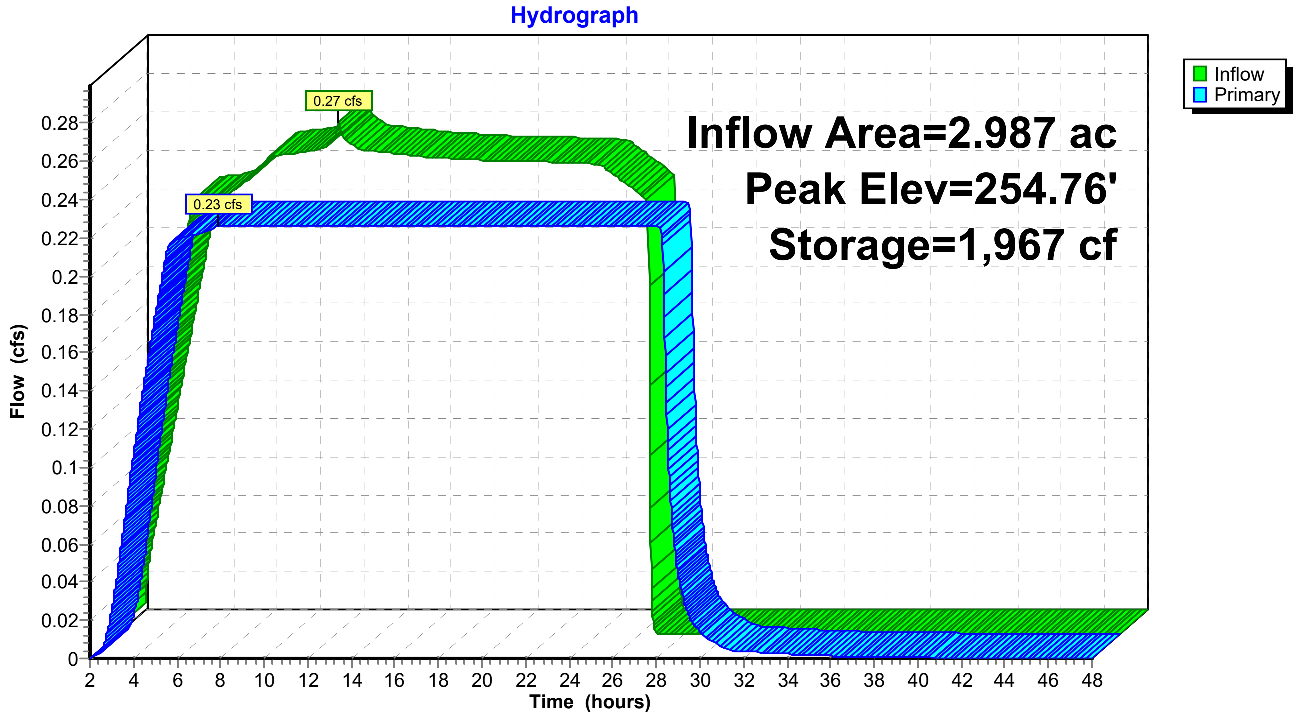
Volume	Invert	Avail.Storage	Storage Description
#1	253.75'	6,351 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 15,876 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.75	4,885	363.0	0	0	4,885
257.00	4,885	363.0	15,876	15,876	6,065

Device	Routing	Invert	Outlet Devices
#1	Primary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	253.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.23 cfs @ 7.86 hrs HW=254.01' (Free Discharge)
└─**1=Culvert** (Passes 0.23 cfs of 0.28 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 6PF: BIORETENTION FILTER



Summary for Pond 7P: Detention Basin

Inflow Area = 5.739 ac, 67.68% Impervious, Inflow Depth = 6.53" for 100-Year Event event
Inflow = 40.57 cfs @ 12.10 hrs, Volume= 3.124 af
Outflow = 17.47 cfs @ 12.34 hrs, Volume= 3.124 af, Atten= 57%, Lag= 14.2 min
Primary = 17.47 cfs @ 12.34 hrs, Volume= 3.124 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 244.27' @ 12.34 hrs Surf.Area= 10,293 sf Storage= 35,635 cf

Plug-Flow detention time= 43.9 min calculated for 3.122 af (100% of inflow)
Center-of-Mass det. time= 43.9 min (856.5 - 812.6)

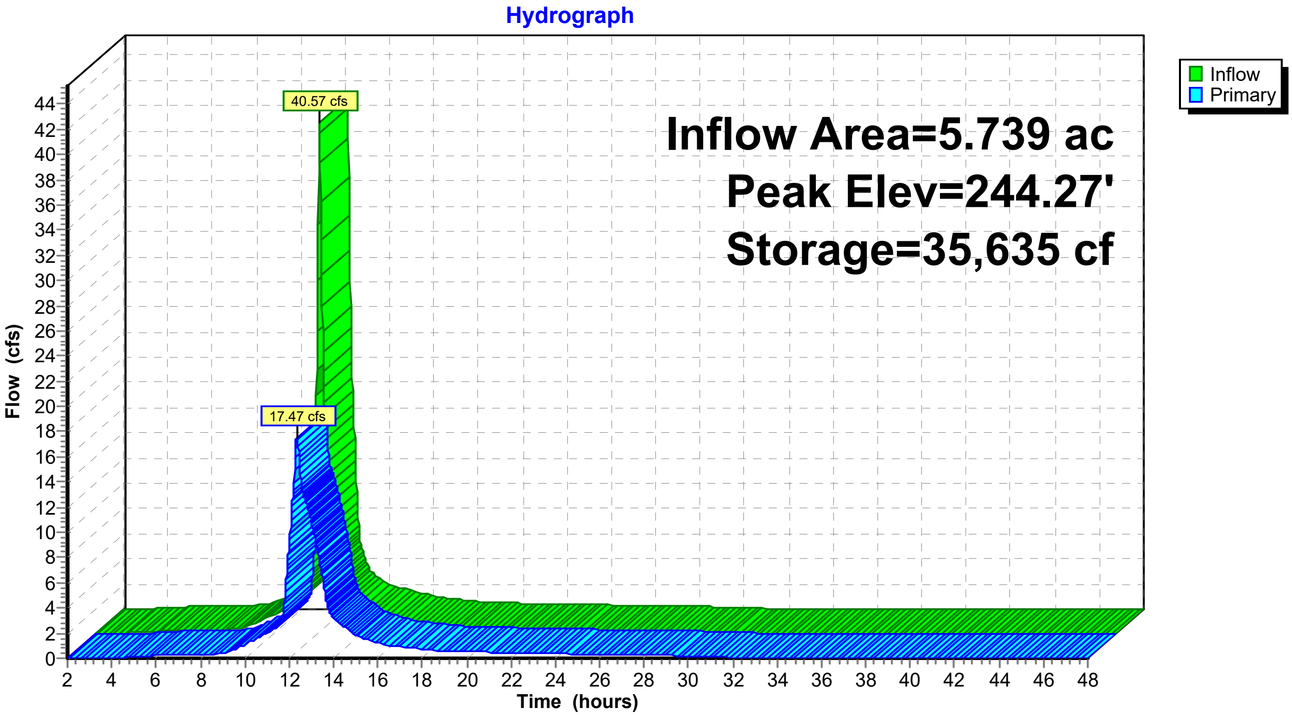
Volume	Invert	Avail.Storage	Storage Description
#1	239.00'	43,611 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
239.00	3,719	242.0	0	0	3,719
240.00	4,746	270.0	4,222	4,222	4,888
241.00	5,883	297.0	5,304	9,526	6,139
242.00	7,115	321.0	6,489	16,016	7,359
243.00	8,454	347.0	7,775	23,791	8,781
244.00	9,894	373.0	9,165	32,955	10,314
245.00	11,437	398.0	10,656	43,611	11,895

Device	Routing	Invert	Outlet Devices
#1	Primary	239.00'	**18.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 239.00' / 238.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	239.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	239.55'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	240.60'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	244.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=17.45 cfs @ 12.34 hrs HW=244.27' (Free Discharge)
└─**1=Culvert** (Passes 17.45 cfs of 18.08 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 2.12 cfs @ 10.78 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 5.09 cfs @ 10.17 fps)
  ├─**4=Orifice/Grate** (Orifice Controls 6.67 cfs @ 8.90 fps)
  └─**5=Orifice/Grate** (Weir Controls 3.57 cfs @ 1.68 fps)

Pond 7P: Detention Basin



Summary for Pond 8P: DIVERSION STRUCTURE

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 7.24" for 100-Year Event event
Inflow = 9.77 cfs @ 12.08 hrs, Volume= 0.751 af
Outflow = 9.77 cfs @ 12.08 hrs, Volume= 0.751 af, Atten= 0%, Lag= 0.0 min
Primary = 2.33 cfs @ 12.08 hrs, Volume= 0.560 af
Routed to Pond 5P : BIORETENTION POOL 1
Secondary = 7.43 cfs @ 12.08 hrs, Volume= 0.191 af
Routed to Pond 7P : Detention Basin

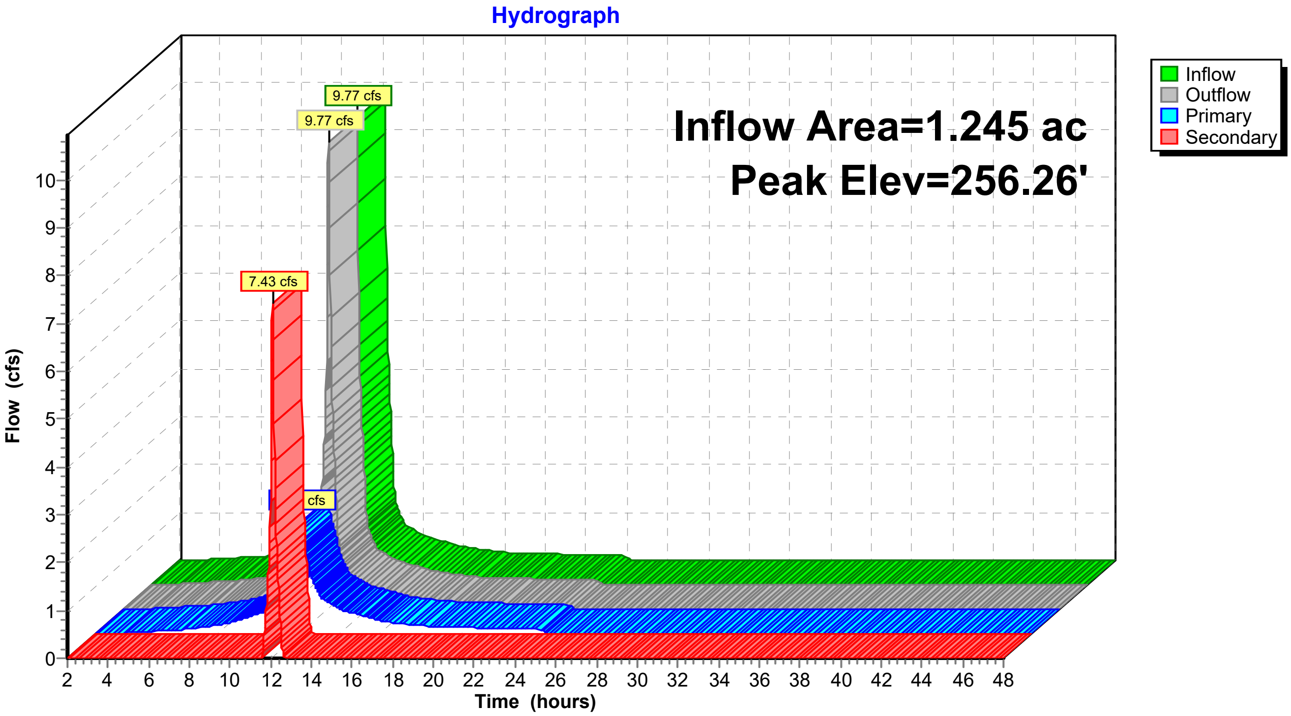
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 256.26' @ 12.08 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	254.00'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.00' / 251.50' S= 0.0625 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.35 sf
#2	Secondary	254.75'	**18.0" Round Culvert** L= 90.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.75' / 249.00' S= 0.0639 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=2.33 cfs @ 12.08 hrs HW=256.25' (Free Discharge)
└─**1=Culvert** (Inlet Controls 2.33 cfs @ 6.67 fps)

Secondary OutFlow Max=7.38 cfs @ 12.08 hrs HW=256.25' (Free Discharge)
└─**2=Culvert** (Inlet Controls 7.38 cfs @ 4.18 fps)

Pond 8P: DIVERSION STRUCTURE



Summary for Pond 9P: DIVERSION STRUCTURE

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth > 7.60" for 100-Year Event event
Inflow = 23.79 cfs @ 12.09 hrs, Volume= 1.891 af
Outflow = 23.79 cfs @ 12.09 hrs, Volume= 1.891 af, Atten= 0%, Lag= 0.0 min
Primary = 12.92 cfs @ 12.09 hrs, Volume= 1.579 af
Routed to Pond 6P : BIORETENTION POOL 2
Secondary = 10.87 cfs @ 12.09 hrs, Volume= 0.312 af
Routed to Pond 7P : Detention Basin

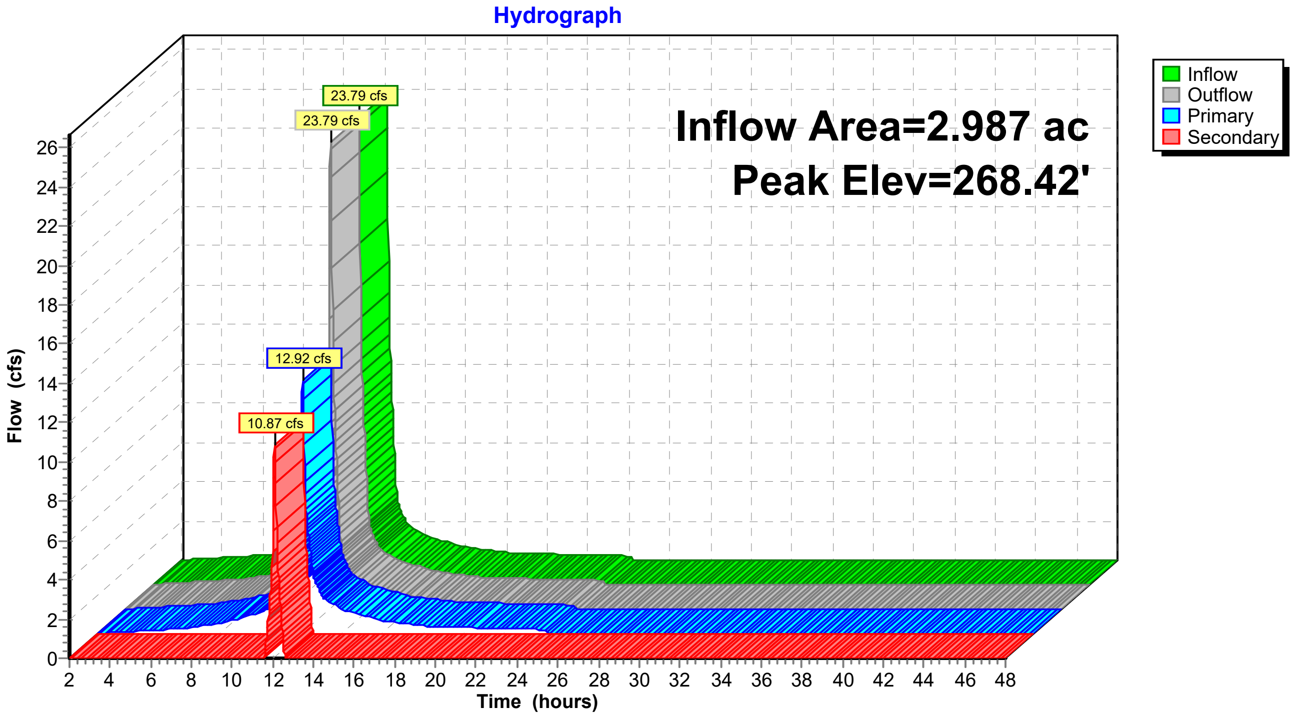
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 268.42' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	256.25'	**12.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 256.25' / 255.75' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	257.30'	**12.0" Round Culvert** L= 175.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 257.30' / 246.00' S= 0.0646 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=12.84 cfs @ 12.09 hrs HW=268.28' (Free Discharge)
└─**1=Culvert** (Inlet Controls 12.84 cfs @ 16.35 fps)

Secondary OutFlow Max=10.80 cfs @ 12.09 hrs HW=268.28' (Free Discharge)
└─**2=Culvert** (Inlet Controls 10.80 cfs @ 13.75 fps)

Pond 9P: DIVERSION STRUCTURE



Summary for Pond 10P: BIORETENTION POOL

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth > 7.72" for 100-Year Event event
Inflow = 0.77 cfs @ 12.08 hrs, Volume= 0.061 af
Outflow = 0.75 cfs @ 12.10 hrs, Volume= 0.061 af, Atten= 2%, Lag= 1.1 min
Primary = 0.03 cfs @ 12.10 hrs, Volume= 0.031 af
Routed to Pond 11P : DRY SWALE FILTER
Secondary = 0.71 cfs @ 12.10 hrs, Volume= 0.030 af
Routed to Pond 12P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 248.55' @ 12.10 hrs Surf.Area= 292 sf Storage= 132 cf

Plug-Flow detention time= 11.7 min calculated for 0.061 af (100% of inflow)
Center-of-Mass det. time= 11.6 min (768.3 - 756.6)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

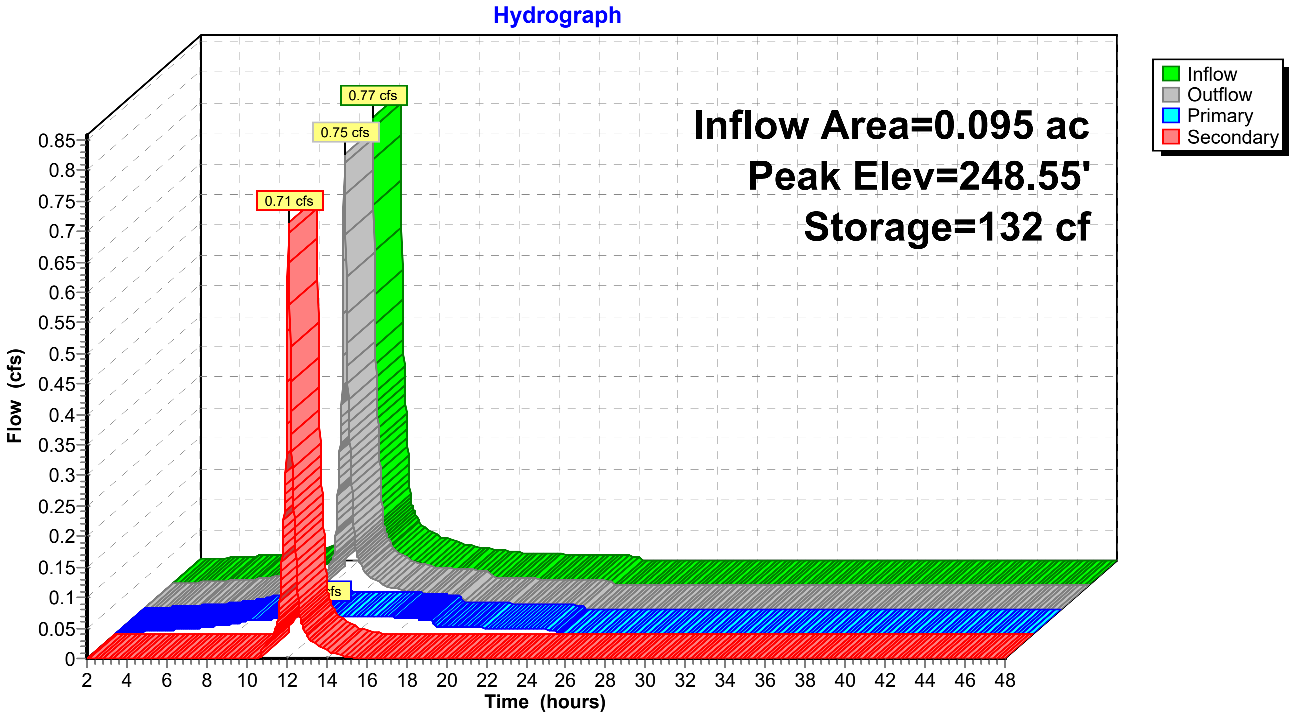
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
248.00	190	60.0	0	0	190
249.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	248.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	248.30'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.03 cfs @ 12.10 hrs HW=248.55' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.71 cfs @ 12.10 hrs HW=248.55' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.71 cfs @ 1.42 fps)

Pond 10P: BIORETENTION POOL



Summary for Pond 11P: DRY SWALE FILTER

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth > 3.88" for 100-Year Event event
Inflow = 0.03 cfs @ 12.10 hrs, Volume= 0.031 af
Outflow = 0.02 cfs @ 8.24 hrs, Volume= 0.031 af, Atten= 46%, Lag= 0.0 min
Primary = 0.02 cfs @ 8.24 hrs, Volume= 0.031 af
Routed to Reach 14R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.98' @ 17.97 hrs Surf.Area= 391 sf Storage= 310 cf

Plug-Flow detention time= 135.0 min calculated for 0.031 af (100% of inflow)
Center-of-Mass det. time= 134.9 min (937.8 - 802.9)

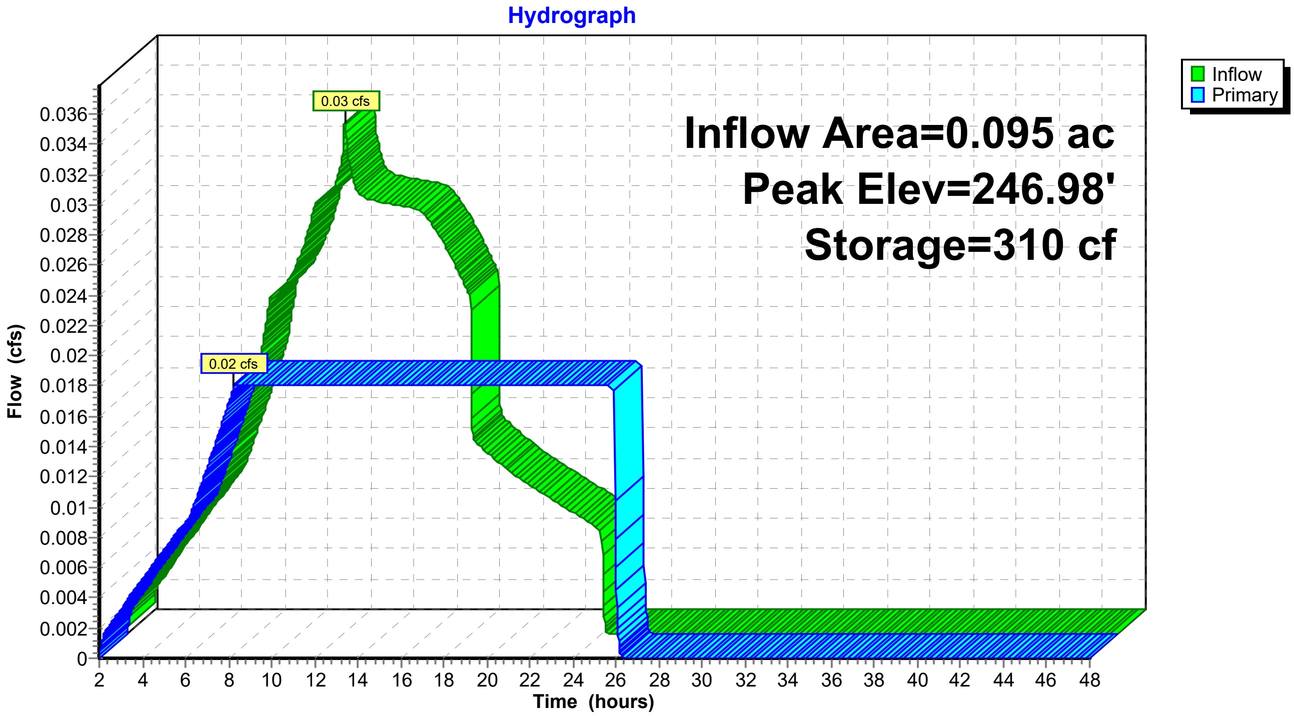
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 8.24 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 11P: DRY SWALE FILTER



Summary for Pond 12P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 17.36" for 100-Year Event event
Inflow = 0.98 cfs @ 12.10 hrs, Volume= 0.051 af
Outflow = 0.95 cfs @ 12.12 hrs, Volume= 0.051 af, Atten= 3%, Lag= 1.2 min
Primary = 0.04 cfs @ 12.12 hrs, Volume= 0.019 af
Routed to Pond 13P : DRY SWALE FILTER
Secondary = 0.91 cfs @ 12.12 hrs, Volume= 0.032 af
Routed to Pond 14P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.79' @ 12.12 hrs Surf.Area= 344 sf Storage= 209 cf

Plug-Flow detention time= 14.1 min calculated for 0.051 af (100% of inflow)
Center-of-Mass det. time= 14.1 min (765.3 - 751.2)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

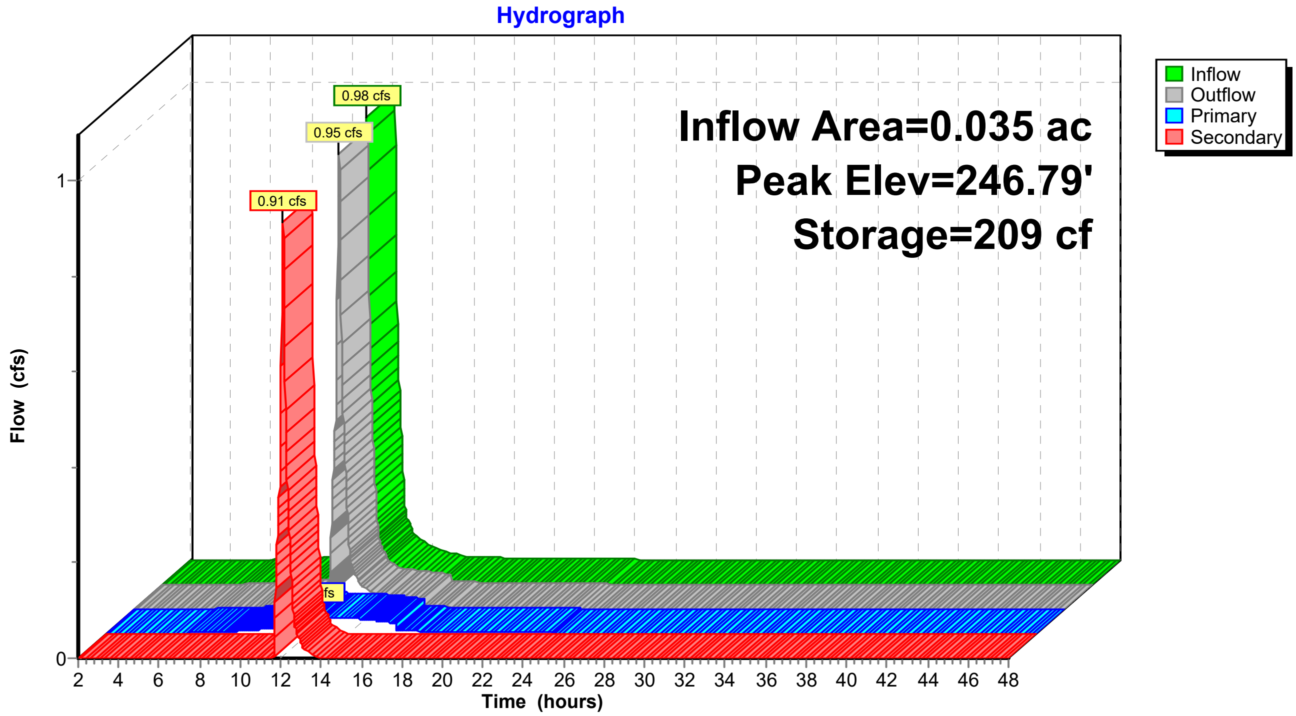
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.04 cfs @ 12.12 hrs HW=246.79' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.91 cfs @ 12.12 hrs HW=246.79' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.91 cfs @ 1.55 fps)

Pond 12P: BIORETENTION POOL



Summary for Pond 13P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 6.58" for 100-Year Event event
Inflow = 0.04 cfs @ 12.12 hrs, Volume= 0.019 af
Outflow = 0.02 cfs @ 10.76 hrs, Volume= 0.019 af, Atten= 55%, Lag= 0.0 min
Primary = 0.02 cfs @ 10.76 hrs, Volume= 0.019 af
Routed to Reach 15R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.60' @ 16.30 hrs Surf.Area= 391 sf Storage= 250 cf

Plug-Flow detention time= 102.5 min calculated for 0.019 af (100% of inflow)
Center-of-Mass det. time= 102.5 min (920.6 - 818.1)

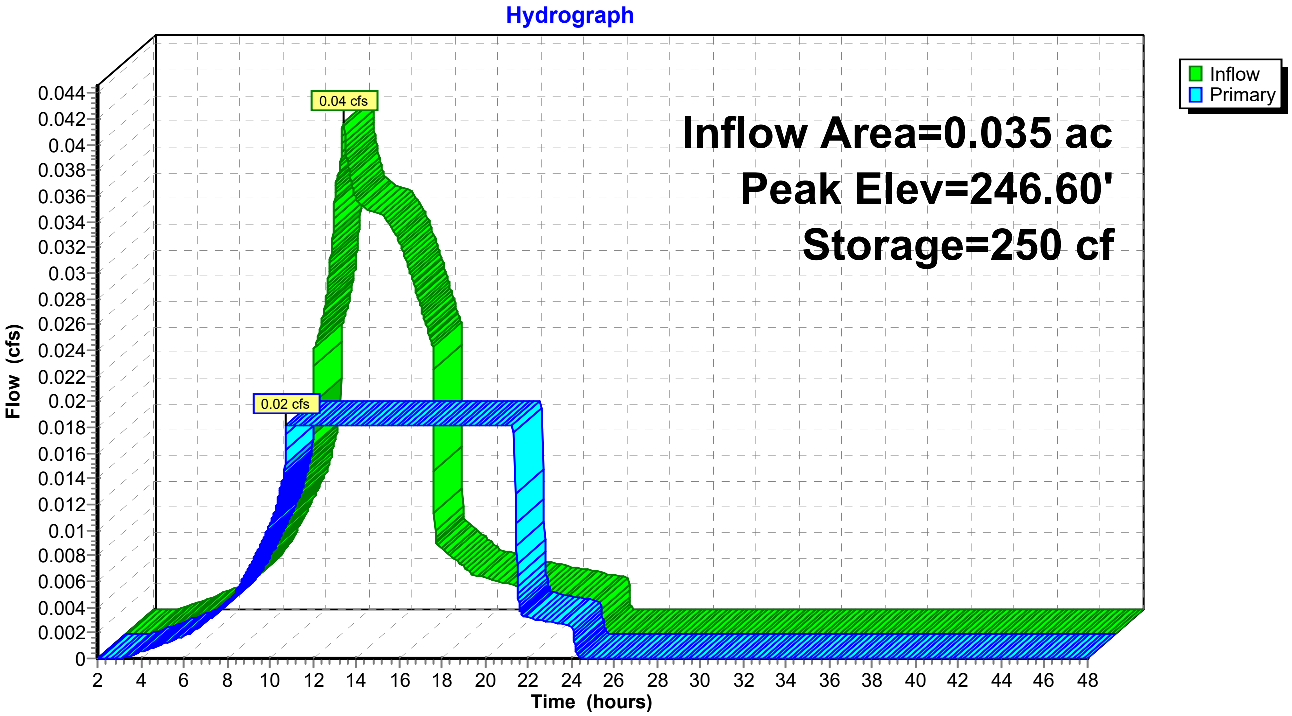
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 10.76 hrs HW=245.03' (Free Discharge)
└—**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └—**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 13P: DRY SWALE FILTER



Summary for Pond 14P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 17.78" for 100-Year Event event
Inflow = 1.17 cfs @ 12.11 hrs, Volume= 0.052 af
Outflow = 1.14 cfs @ 12.13 hrs, Volume= 0.052 af, Atten= 2%, Lag= 1.1 min
Primary = 0.04 cfs @ 12.13 hrs, Volume= 0.018 af
Routed to Pond 15P : DRY SWALE FILTER
Secondary = 1.10 cfs @ 12.13 hrs, Volume= 0.035 af
Routed to Link AP-5 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.83' @ 12.13 hrs Surf.Area= 352 sf Storage= 222 cf

Plug-Flow detention time= 10.6 min calculated for 0.052 af (100% of inflow)
Center-of-Mass det. time= 10.6 min (761.3 - 750.7)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

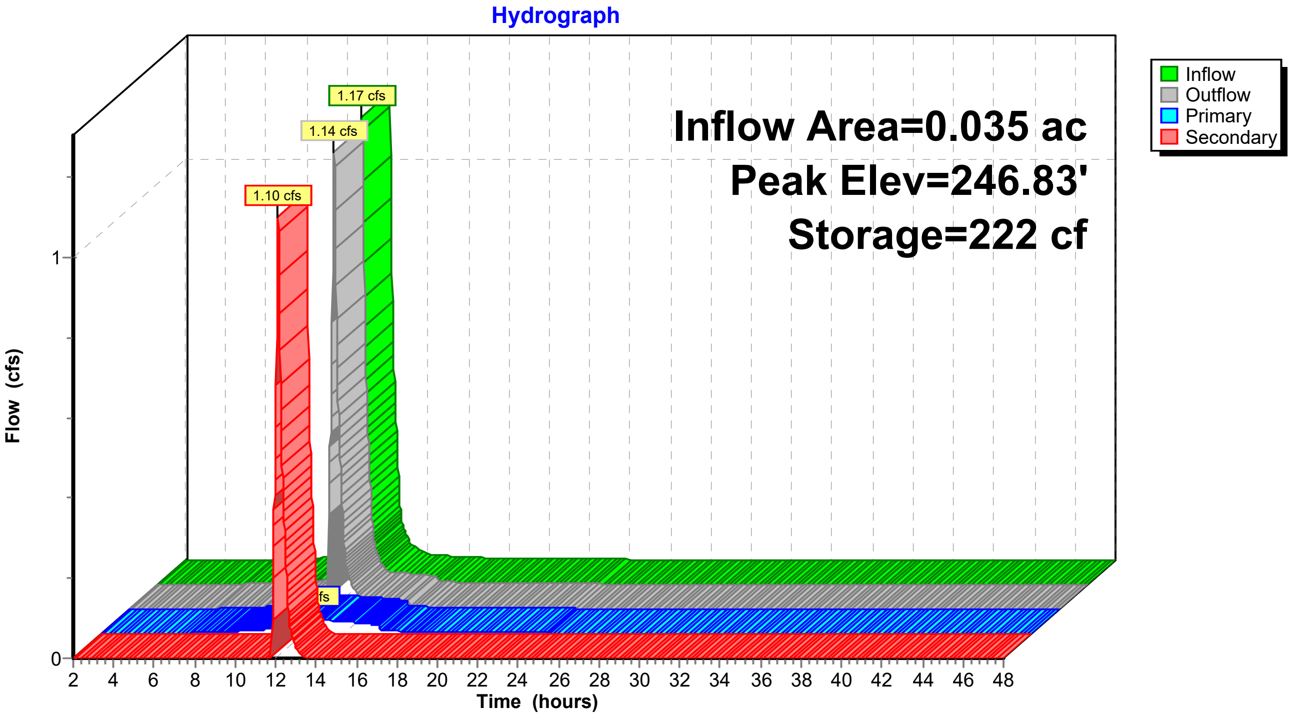
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.04 cfs @ 12.13 hrs HW=246.83' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=1.09 cfs @ 12.13 hrs HW=246.83' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 1.09 cfs @ 1.66 fps)

Pond 14P: BIORETENTION POOL



Summary for Pond 15P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 5.99" for 100-Year Event event
Inflow = 0.04 cfs @ 12.13 hrs, Volume= 0.018 af
Outflow = 0.02 cfs @ 11.16 hrs, Volume= 0.018 af, Atten= 56%, Lag= 0.0 min
Primary = 0.02 cfs @ 11.16 hrs, Volume= 0.018 af
Routed to Reach 4R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.26' @ 15.76 hrs Surf.Area= 391 sf Storage= 197 cf

Plug-Flow detention time= 75.6 min calculated for 0.018 af (100% of inflow)
Center-of-Mass det. time= 75.6 min (890.6 - 815.0)

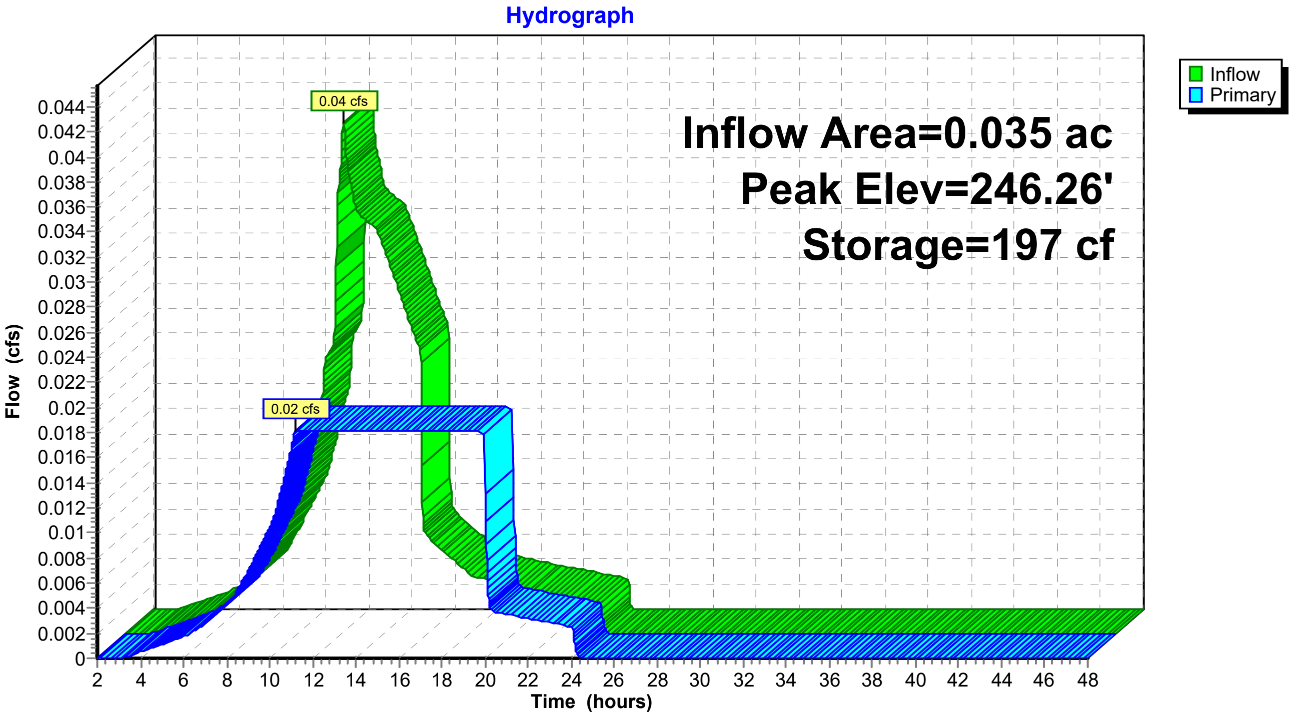
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 11.16 hrs HW=245.03' (Free Discharge)
↑—**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
↑—**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

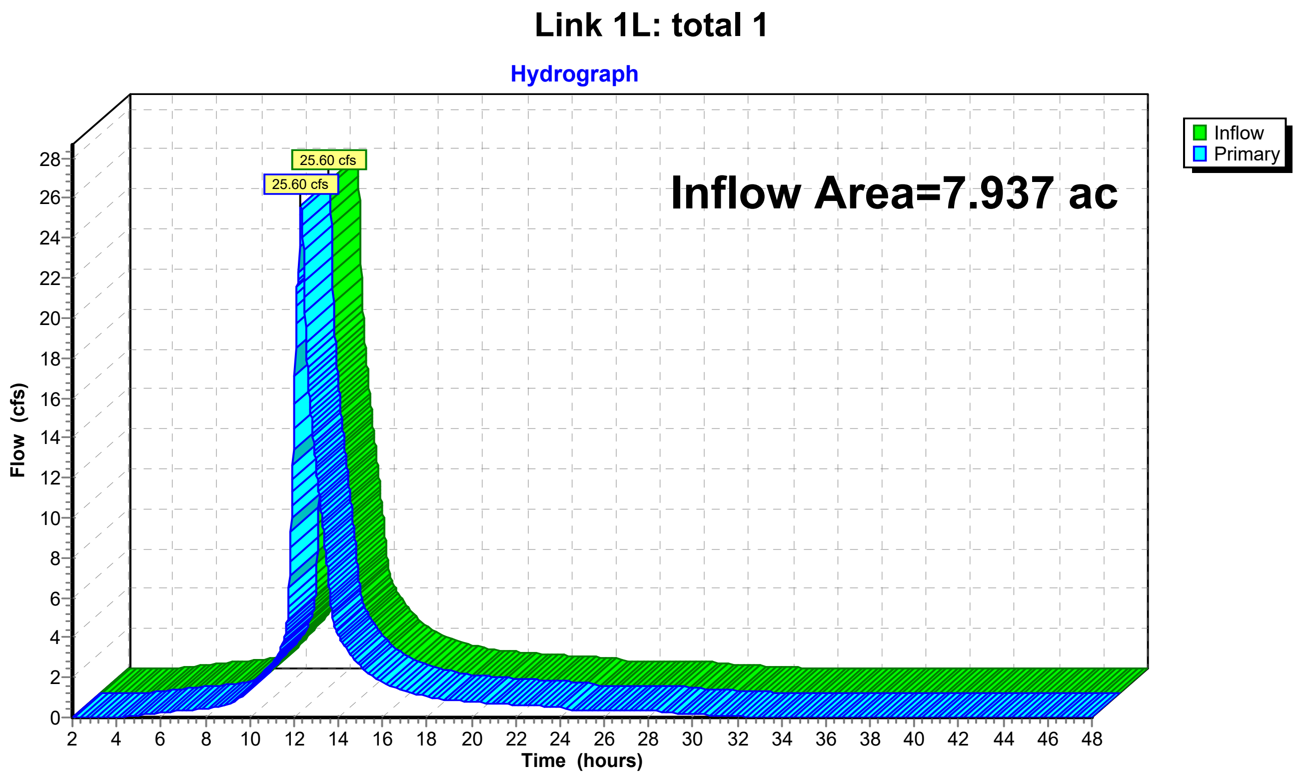
Pond 15P: DRY SWALE FILTER



Summary for Link 1L: total 1

Inflow Area =	7.937 ac,	50.38% Impervious,	Inflow Depth = 6.37"	for 100-Year Event event	
Inflow =	25.60 cfs @	12.32 hrs,	Volume=	4.216 af	
Primary =	25.60 cfs @	12.32 hrs,	Volume=	4.216 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

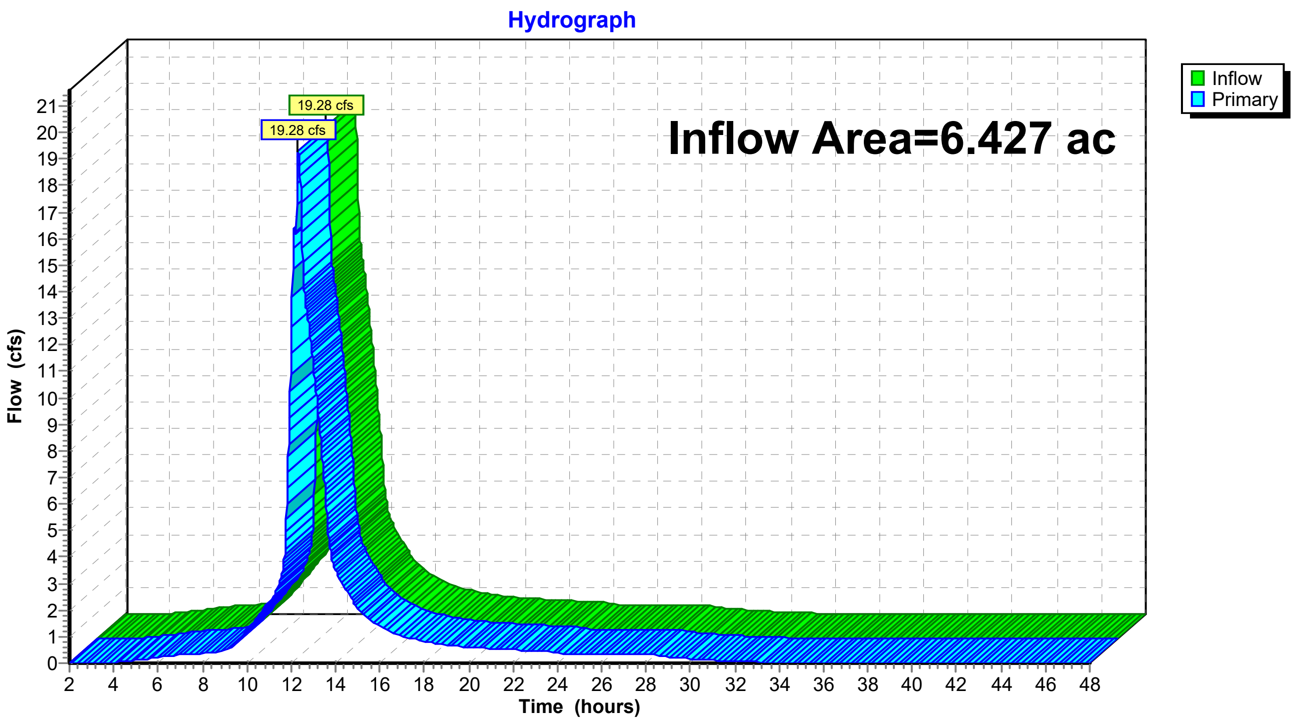


Summary for Link AP-1: Q

Inflow Area = 6.427 ac, 60.43% Impervious, Inflow Depth = 6.47" for 100-Year Event event
Inflow = 19.28 cfs @ 12.33 hrs, Volume= 3.463 af
Primary = 19.28 cfs @ 12.33 hrs, Volume= 3.463 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-1: Q

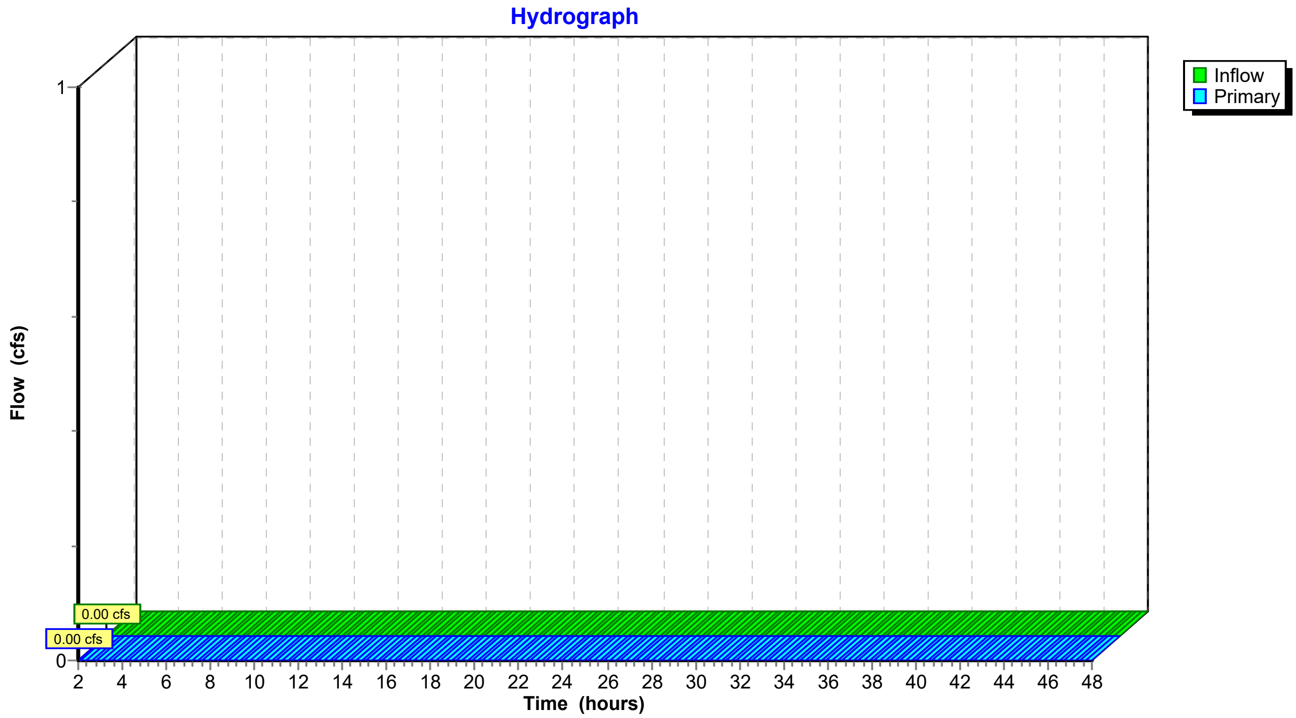


Summary for Link AP-2: Q

Inflow = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

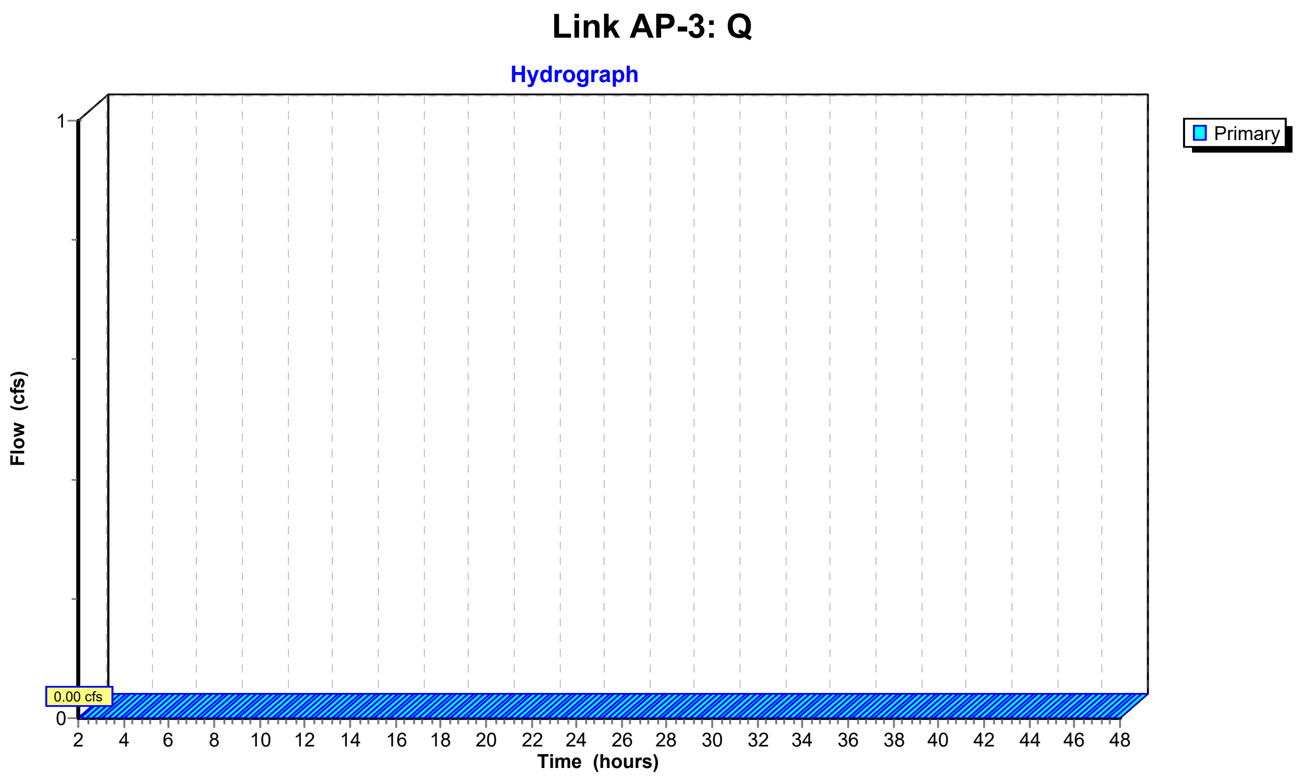
Link AP-2: Q



Summary for Link AP-3: Q

Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

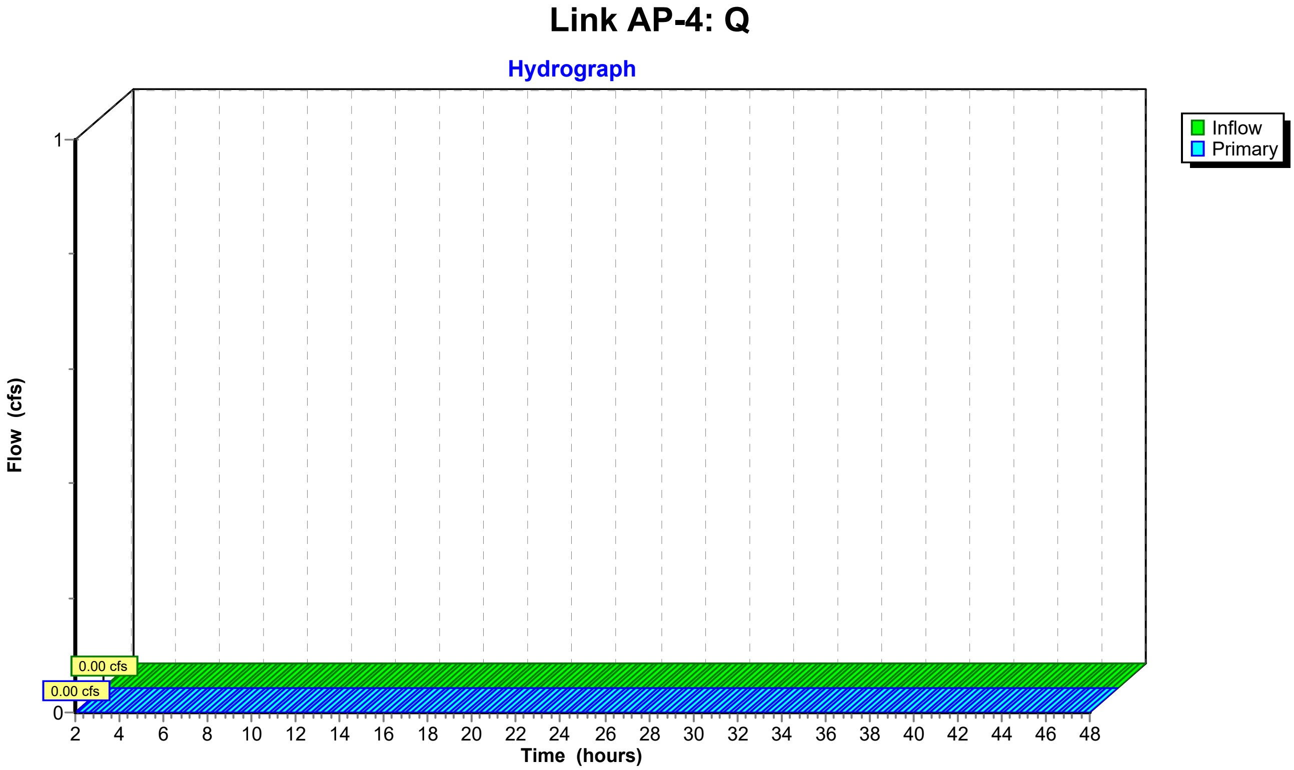


Summary for Link AP-4: Q

Inflow	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af
Primary	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

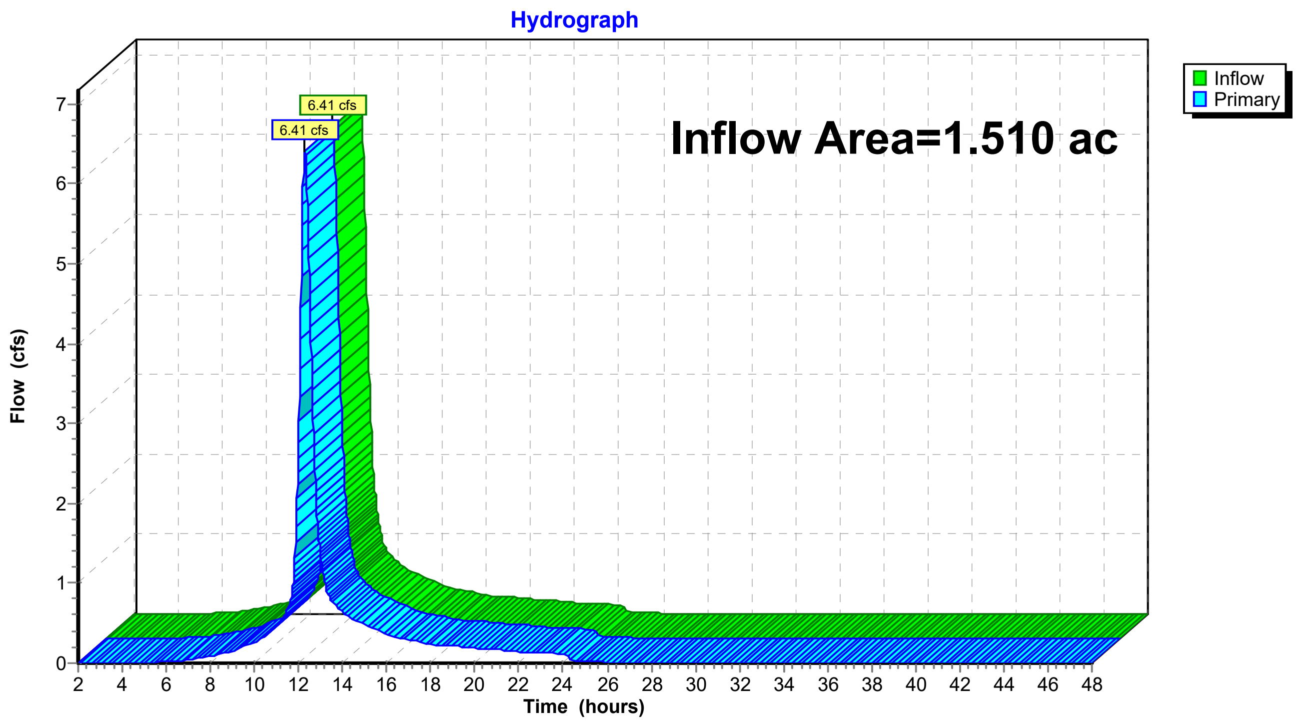


Summary for Link AP-5: Q

Inflow Area = 1.510 ac, 7.62% Impervious, Inflow Depth = 5.98" for 100-Year Event event
Inflow = 6.41 cfs @ 12.28 hrs, Volume= 0.753 af
Primary = 6.41 cfs @ 12.28 hrs, Volume= 0.753 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-5: Q



Time span=2.00-48.00 hrs, dt=0.02 hrs, 2301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment1: Subarea 1 Runoff Area=1.040 ac 79.62% Impervious Runoff Depth=0.80"
Flow Length=100' Slope=0.0080 '/' Tc=14.2 min CN=94 Runoff=0.76 cfs 0.070 af

Subcatchment1A: Subarea 1A Runoff Area=0.205 ac 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=80 Runoff=0.04 cfs 0.004 af

Subcatchment2: Subarea 2 Runoff Area=0.789 ac 61.98% Impervious Runoff Depth=0.62"
Tc=6.0 min CN=91 Runoff=0.57 cfs 0.041 af

Subcatchment2S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=0.52"
Tc=6.0 min CN=89 Runoff=0.02 cfs 0.002 af

Subcatchment3: Subarea 3 Runoff Area=1.019 ac 78.21% Impervious Runoff Depth=0.80"
Flow Length=592' Tc=10.8 min CN=94 Runoff=0.82 cfs 0.068 af

Subcatchment3S: Subarea 6 Runoff Area=1,533 sf 52.71% Impervious Runoff Depth=0.52"
Tc=6.0 min CN=89 Runoff=0.02 cfs 0.002 af

Subcatchment4: Subarea 4 Runoff Area=1.245 ac 60.80% Impervious Runoff Depth=0.62"
Flow Length=100' Tc=6.0 min CN=91 Runoff=0.90 cfs 0.064 af

Subcatchment4A: Subarea 4A Runoff Area=0.488 ac 0.00% Impervious Runoff Depth=0.22"
Tc=6.0 min CN=80 Runoff=0.09 cfs 0.009 af

Subcatchment4B: Subarea 4B Runoff Area=0.688 ac 0.00% Impervious Runoff Depth=0.22"
Flow Length=178' Tc=6.2 min CN=80 Runoff=0.12 cfs 0.012 af

Subcatchment5: Subarea 5 Runoff Area=2.987 ac 78.00% Impervious Runoff Depth=0.80"
Flow Length=35' Slope=0.0080 '/' Tc=6.2 min CN=94 Runoff=2.78 cfs 0.200 af

Subcatchment5A: Subarea 5A Runoff Area=1.345 ac 0.00% Impervious Runoff Depth=0.19"
Flow Length=279' Tc=22.5 min CN=79 Runoff=0.13 cfs 0.022 af

Subcatchment6: Subarea 6 Runoff Area=0.095 ac 82.11% Impervious Runoff Depth=0.87"
Tc=6.0 min CN=95 Runoff=0.10 cfs 0.007 af

Subcatchment7: Subarea 3 Runoff Area=0.471 ac 35.46% Impervious Runoff Depth=0.40"
Flow Length=574' Tc=7.3 min CN=86 Runoff=0.19 cfs 0.016 af

Reach 4R: UNDERDRAIN Avg. Flow Depth=0.06' Max Vel=3.54 fps Inflow=0.05 cfs 0.010 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.05 cfs 0.010 af

Reach 14R: UNDERDRAIN Avg. Flow Depth=0.04' Max Vel=2.58 fps Inflow=0.02 cfs 0.007 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.02 cfs 0.007 af

Reach 15R: UNDERDRAIN Avg. Flow Depth=0.05' Max Vel=3.15 fps Inflow=0.04 cfs 0.008 af
6.0" Round Pipe n=0.011 L=40.0' S=0.0500 '/' Capacity=1.48 cfs Outflow=0.04 cfs 0.008 af

Pond 1P: Infiltration Basin 3 Peak Elev=258.10' Storage=83 cf Inflow=0.19 cfs 0.016 af
Discarded=0.09 cfs 0.016 af Secondary=0.00 cfs 0.000 af Outflow=0.09 cfs 0.016 af

Pond 2P: Infiltration Basin 1 Peak Elev=260.39' Storage=845 cf Inflow=0.78 cfs 0.073 af
Discarded=0.22 cfs 0.073 af Secondary=0.00 cfs 0.000 af Outflow=0.22 cfs 0.073 af

Pond 3P: Infiltration Basin 2 Peak Elev=260.04' Storage=161 cf Inflow=0.57 cfs 0.041 af
Discarded=0.38 cfs 0.041 af Secondary=0.00 cfs 0.000 af Outflow=0.38 cfs 0.041 af

Pond 4P: Infiltration Basin 4 Peak Elev=260.04' Storage=701 cf Inflow=0.82 cfs 0.068 af
Discarded=0.28 cfs 0.068 af Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.28 cfs 0.068 af

Pond 5P: BIORETENTION POOL 1 Peak Elev=249.43' Storage=965 cf Inflow=0.90 cfs 0.064 af
Primary=0.11 cfs 0.064 af Secondary=0.00 cfs 0.000 af Tertiary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.064 af

Pond 5PF: BIORETENTION FILTER Peak Elev=246.27' Storage=407 cf Inflow=0.11 cfs 0.064 af
Outflow=0.09 cfs 0.064 af

Pond 6P: BIORETENTION POOL 2 Peak Elev=257.49' Storage=2,542 cf Inflow=2.78 cfs 0.200 af
Primary=0.25 cfs 0.169 af Secondary=0.75 cfs 0.030 af Tertiary=0.00 cfs 0.000 af Outflow=1.00 cfs 0.200 af

Pond 6PF: BIORETENTION FILTER Peak Elev=254.14' Storage=763 cf Inflow=0.25 cfs 0.169 af
Outflow=0.23 cfs 0.169 af

Pond 7P: Detention Basin Peak Elev=239.51' Storage=2,008 cf Inflow=1.11 cfs 0.273 af
Outflow=0.48 cfs 0.273 af

Pond 8P: DIVERSION STRUCTURE Peak Elev=254.61' Inflow=0.90 cfs 0.064 af
Primary=0.90 cfs 0.064 af Secondary=0.00 cfs 0.000 af Outflow=0.90 cfs 0.064 af

Pond 9P: DIVERSION STRUCTURE Peak Elev=257.29' Inflow=2.78 cfs 0.200 af
Primary=2.78 cfs 0.200 af Secondary=0.00 cfs 0.000 af Outflow=2.78 cfs 0.200 af

Pond 10P: BIORETENTION POOL Peak Elev=248.29' Storage=61 cf Inflow=0.10 cfs 0.007 af
Primary=0.03 cfs 0.007 af Secondary=0.00 cfs 0.000 af Outflow=0.03 cfs 0.007 af

Pond 11P: DRY SWALE FILTER Peak Elev=245.32' Storage=50 cf Inflow=0.03 cfs 0.007 af
Outflow=0.02 cfs 0.007 af

Pond 12P: BIORETENTION POOL Peak Elev=246.01' Storage=2 cf Inflow=0.02 cfs 0.002 af
Primary=0.02 cfs 0.002 af Secondary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.002 af

Pond 13P: DRY SWALE FILTER Peak Elev=245.03' Storage=4 cf Inflow=0.02 cfs 0.002 af
Outflow=0.02 cfs 0.002 af

Pond 14P: BIORETENTION POOL Peak Elev=246.01' Storage=2 cf Inflow=0.02 cfs 0.002 af
Primary=0.02 cfs 0.002 af Secondary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.002 af

Pond 15P: DRY SWALE FILTER Peak Elev=245.03' Storage=4 cf Inflow=0.02 cfs 0.002 af
Outflow=0.02 cfs 0.002 af

Link 1L: total 1	Inflow=0.63 cfs 0.317 af Primary=0.63 cfs 0.317 af
Link AP-1: Q	Inflow=0.51 cfs 0.285 af Primary=0.51 cfs 0.285 af
Link AP-2: Q	Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af
Link AP-3: Q	Primary=0.00 cfs 0.000 af
Link AP-4: Q	Inflow=0.00 cfs 0.000 af Primary=0.00 cfs 0.000 af
Link AP-5: Q	Inflow=0.17 cfs 0.032 af Primary=0.17 cfs 0.032 af

Total Runoff Area = 10.442 ac Runoff Volume = 0.515 af Average Runoff Depth = 0.59"
47.49% Pervious = 4.959 ac 52.51% Impervious = 5.483 ac

Summary for Subcatchment 1: Subarea 1

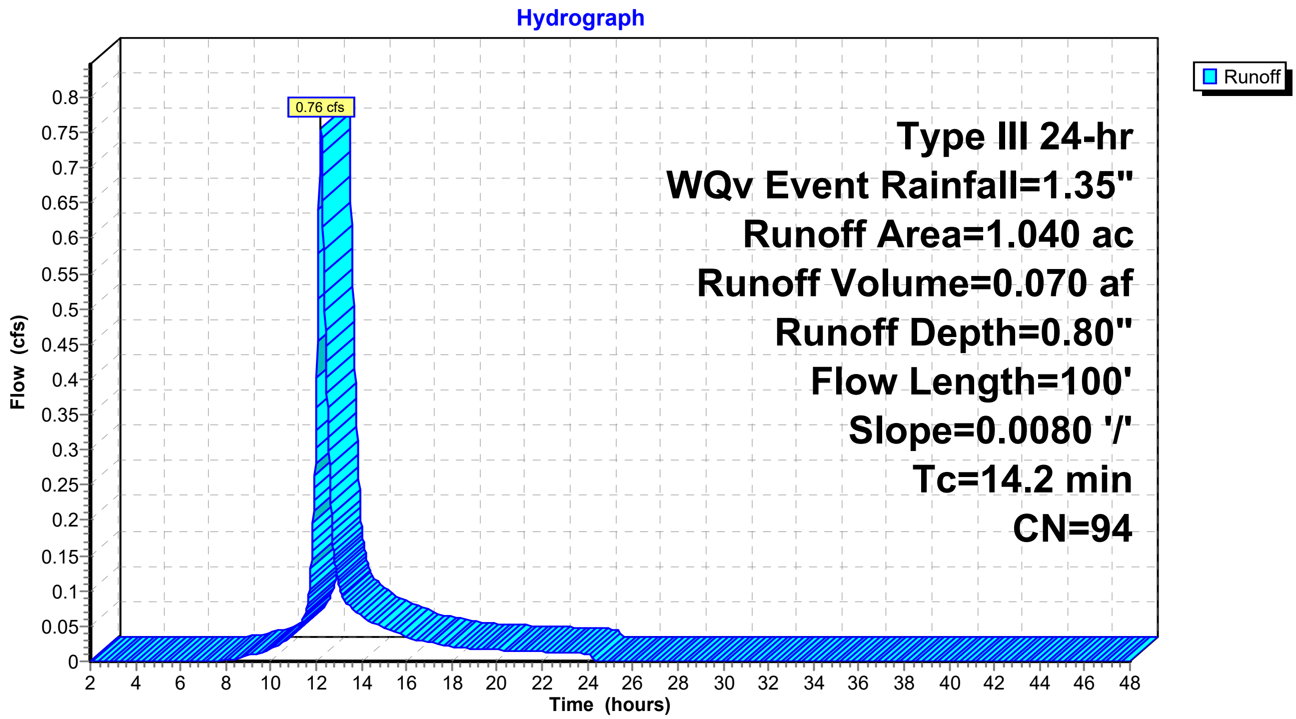
Runoff = 0.76 cfs @ 12.20 hrs, Volume= 0.070 af, Depth= 0.80"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.212	80	>75% Grass cover, Good, HSG D
0.828	98	Paved parking, HSG C
1.040	94	Weighted Average
0.212		20.38% Pervious Area
0.828		79.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	100	0.0080	0.12		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 1: Subarea 1



Summary for Subcatchment 1A: Subarea 1A

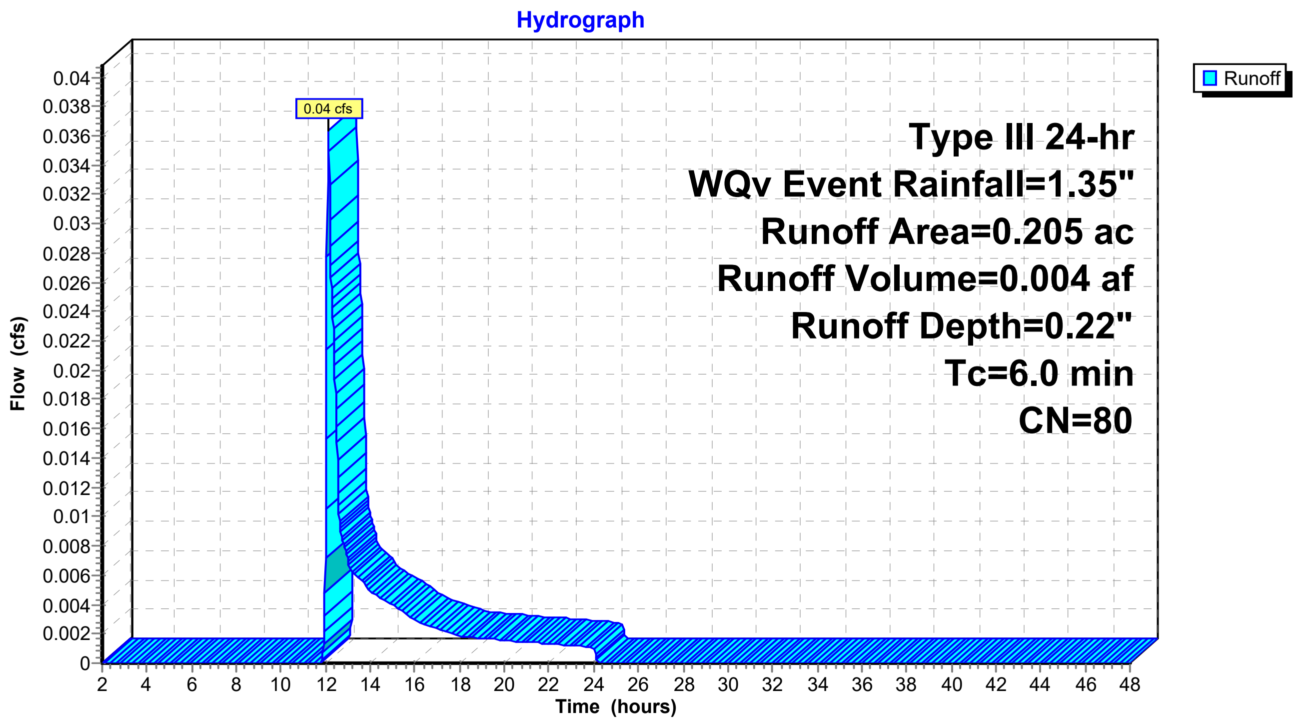
Runoff = 0.04 cfs @ 12.12 hrs, Volume= 0.004 af, Depth= 0.22"
Routed to Pond 2P : Infiltration Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.205	80	>75% Grass cover, Good, HSG D
0.205		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Minimm**

Subcatchment 1A: Subarea 1A



Summary for Subcatchment 2: Subarea 2

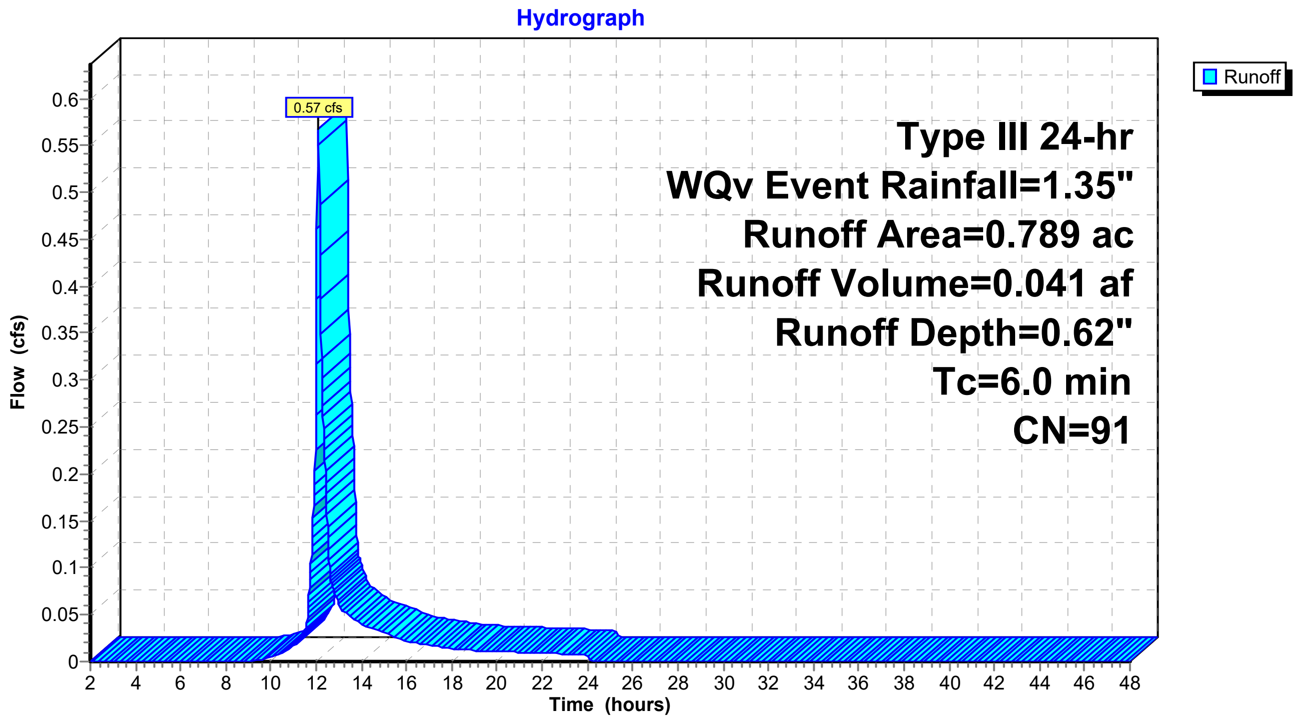
Runoff = 0.57 cfs @ 12.09 hrs, Volume= 0.041 af, Depth= 0.62"
Routed to Pond 3P : Infiltration Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.300	80	>75% Grass cover, Good, HSG D
0.489	98	Paved parking, HSG C
0.789	91	Weighted Average
0.300		38.02% Pervious Area
0.489		61.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MinTC**

Subcatchment 2: Subarea 2



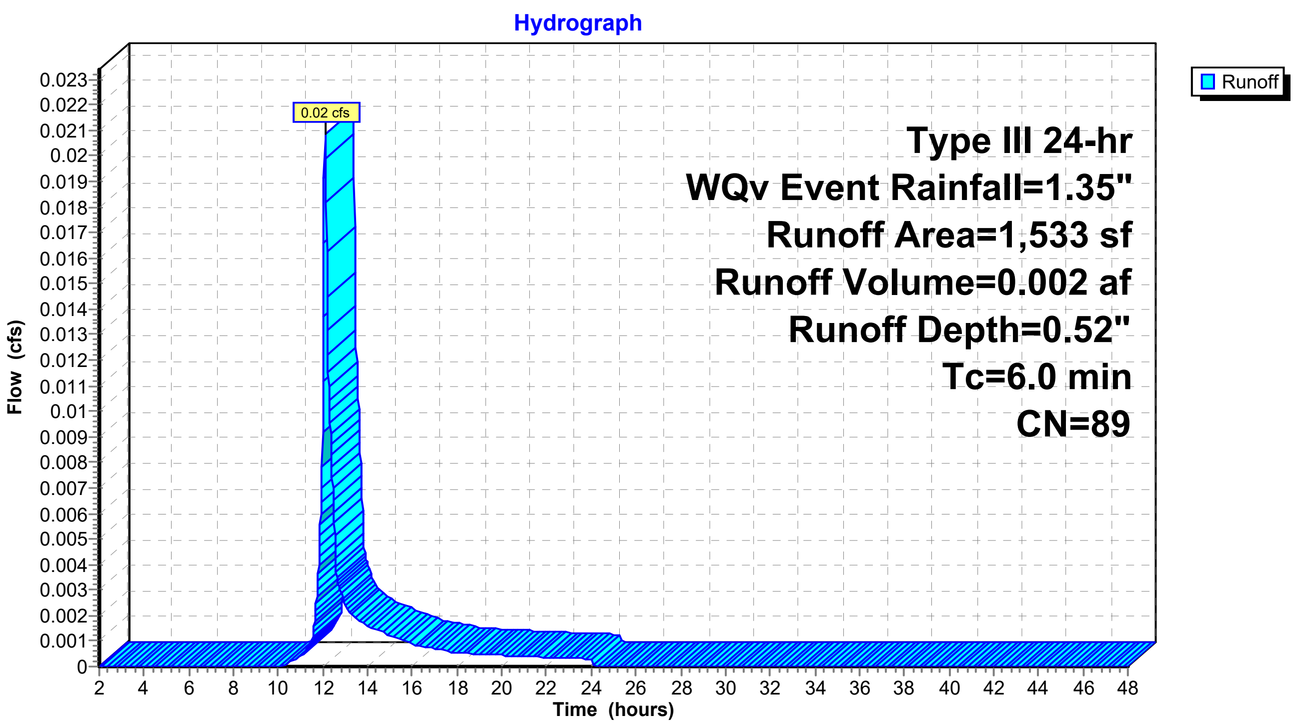
Summary for Subcatchment 2S: Subarea 6

Runoff = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af, Depth= 0.52"
Routed to Pond 12P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**



Summary for Subcatchment 3: Subarea 3

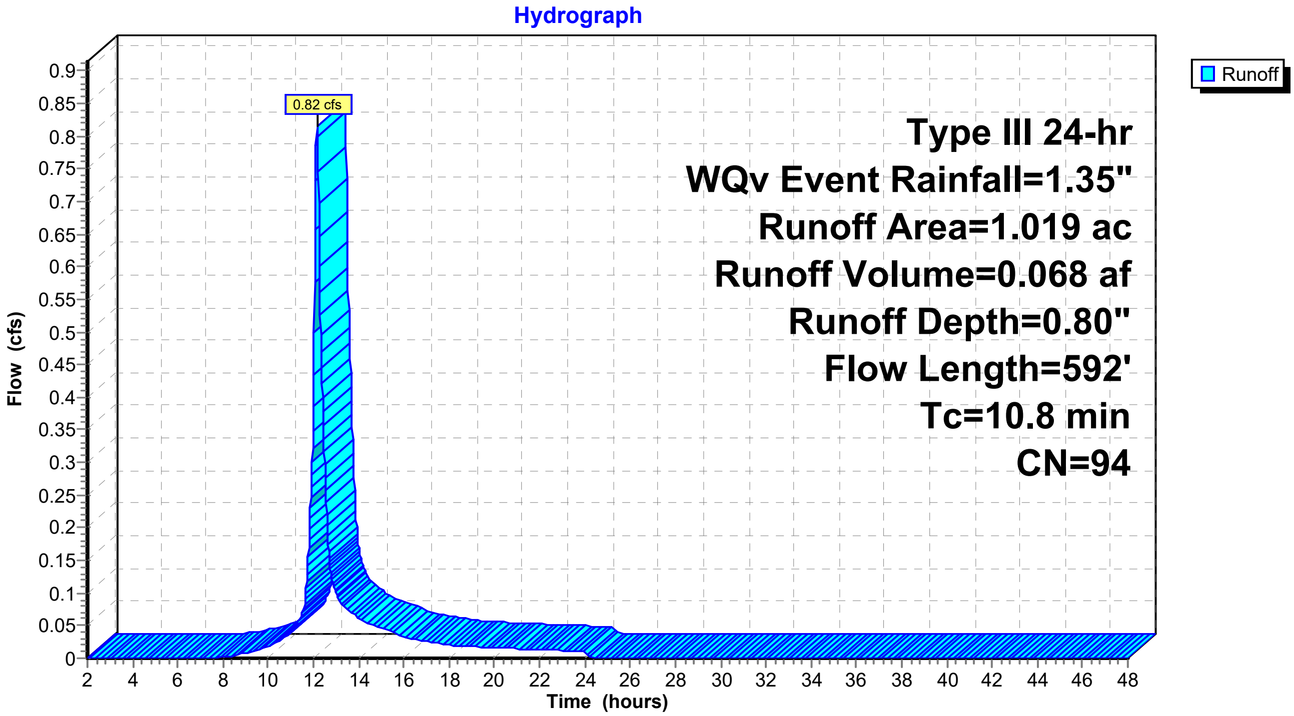
Runoff = 0.82 cfs @ 12.15 hrs, Volume= 0.068 af, Depth= 0.80"
Routed to Pond 4P : Infiltration Basin 4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.222	80	>75% Grass cover, Good, HSG D
0.797	98	Paved parking, HSG C
1.019	94	Weighted Average
0.222		21.79% Pervious Area
0.797		78.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	53	0.0100	0.11		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
10.8	592	Total			

Subcatchment 3: Subarea 3



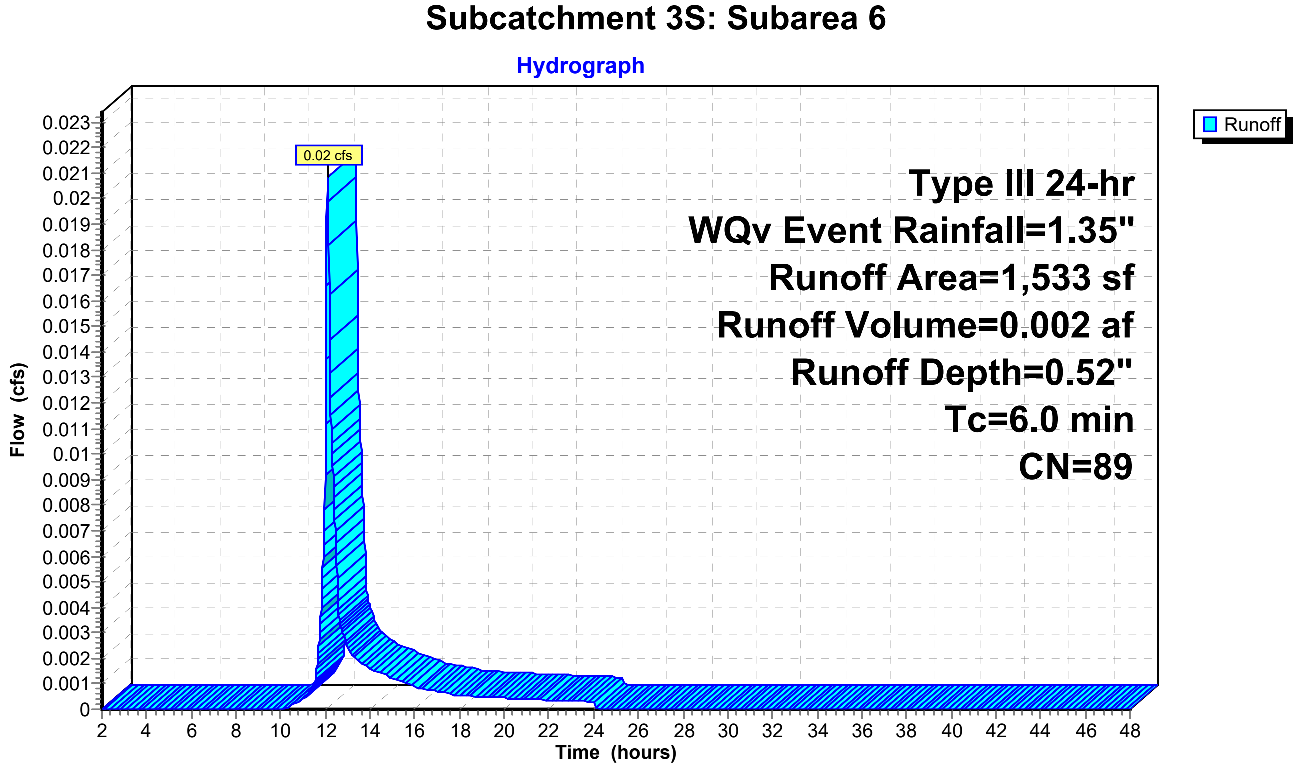
Summary for Subcatchment 3S: Subarea 6

Runoff = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af, Depth= 0.52"
Routed to Pond 14P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (sf)	CN	Description
725	80	>75% Grass cover, Good, HSG D
808	98	Paved parking, HSG C
1,533	89	Weighted Average
725		47.29% Pervious Area
808		52.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**



Summary for Subcatchment 4: Subarea 4

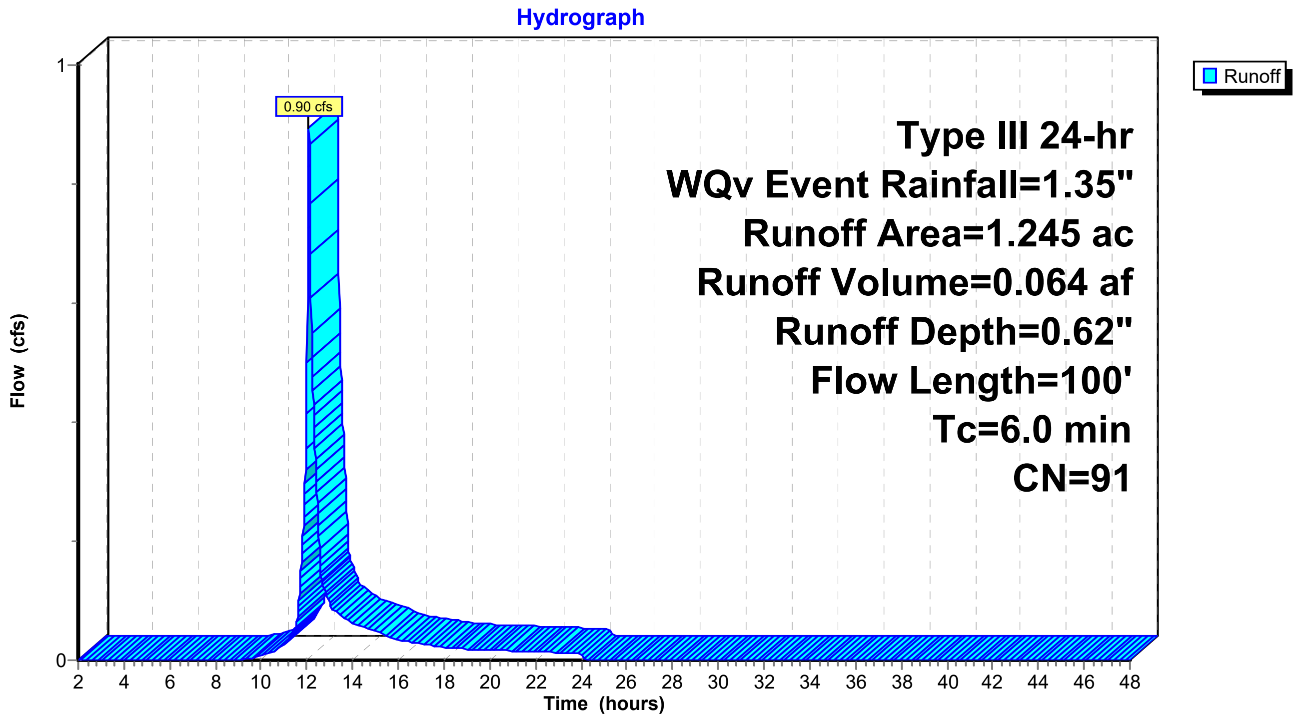
Runoff = 0.90 cfs @ 12.09 hrs, Volume= 0.064 af, Depth= 0.62"
Routed to Pond 8P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.757	98	Paved parking, HSG C
1.245	91	Weighted Average
0.488		39.20% Pervious Area
0.757		60.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.4	55	0.0900	0.27		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.9	45	0.2500	0.40		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
5.3	100	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4: Subarea 4



Summary for Subcatchment 4A: Subarea 4A

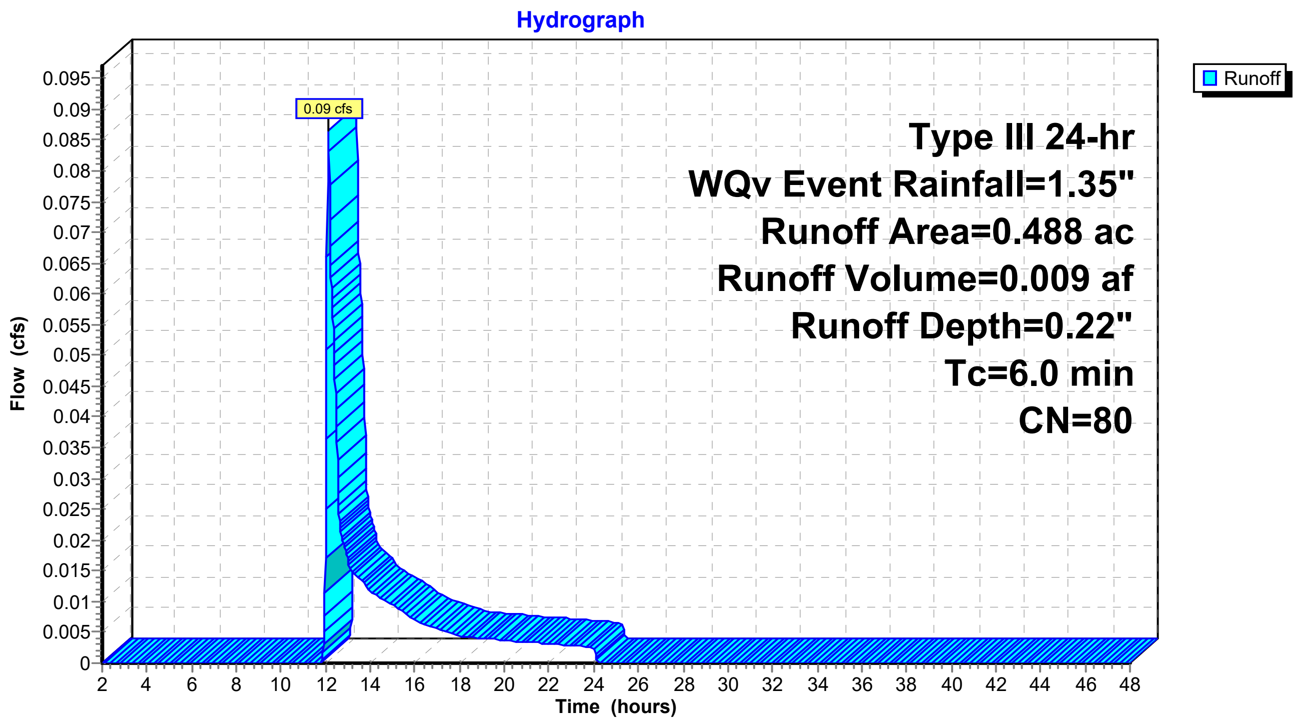
Runoff = 0.09 cfs @ 12.12 hrs, Volume= 0.009 af, Depth= 0.22"
Routed to Pond 7P : Detention Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.488	80	>75% Grass cover, Good, HSG D
0.488		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 4A: Subarea 4A



Summary for Subcatchment 4B: Subarea 4B

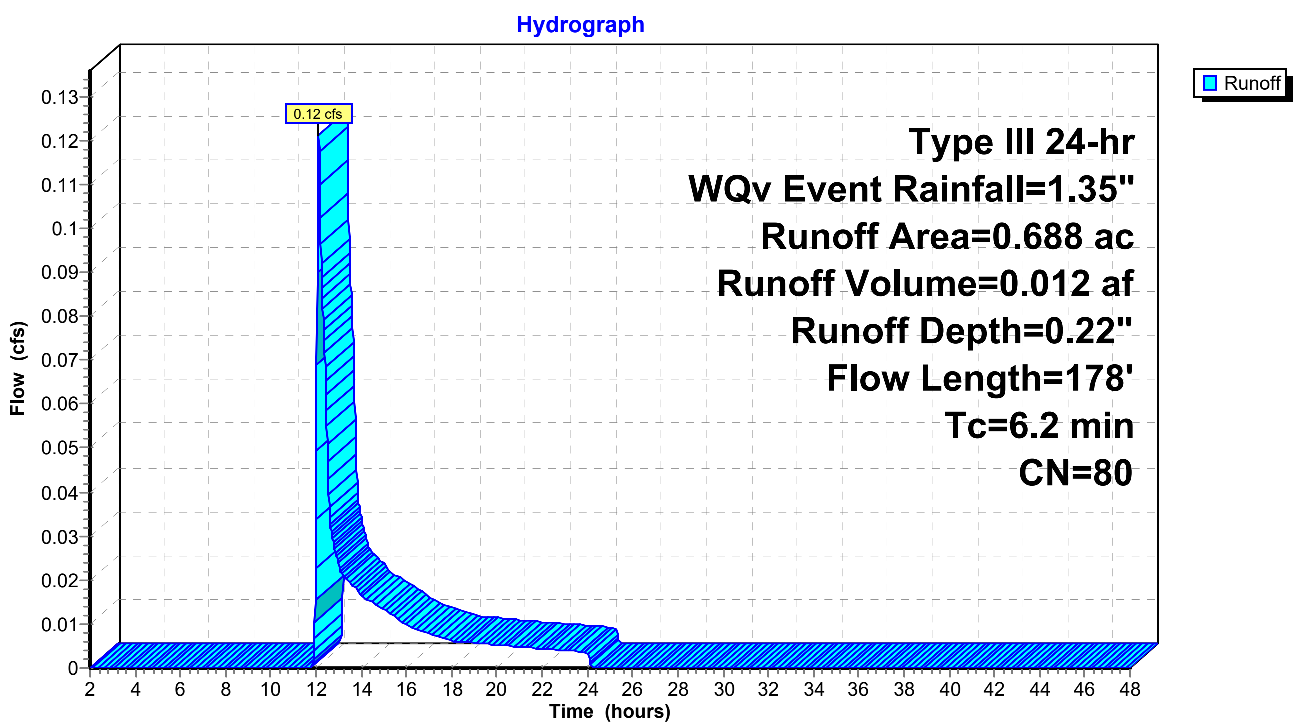
Runoff = 0.12 cfs @ 12.12 hrs, Volume= 0.012 af, Depth= 0.22"
Routed to Link AP-1 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.654	80	>75% Grass cover, Good, HSG D
0.034	77	Woods, Good, HSG D
0.688	80	Weighted Average
0.688		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.0900	0.31		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.8	78	0.0100	1.61		**Shallow Concentrated Flow, Lawn** Unpaved Kv= 16.1 fps
6.2	178	Total			

Subcatchment 4B: Subarea 4B



Summary for Subcatchment 5: Subarea 5

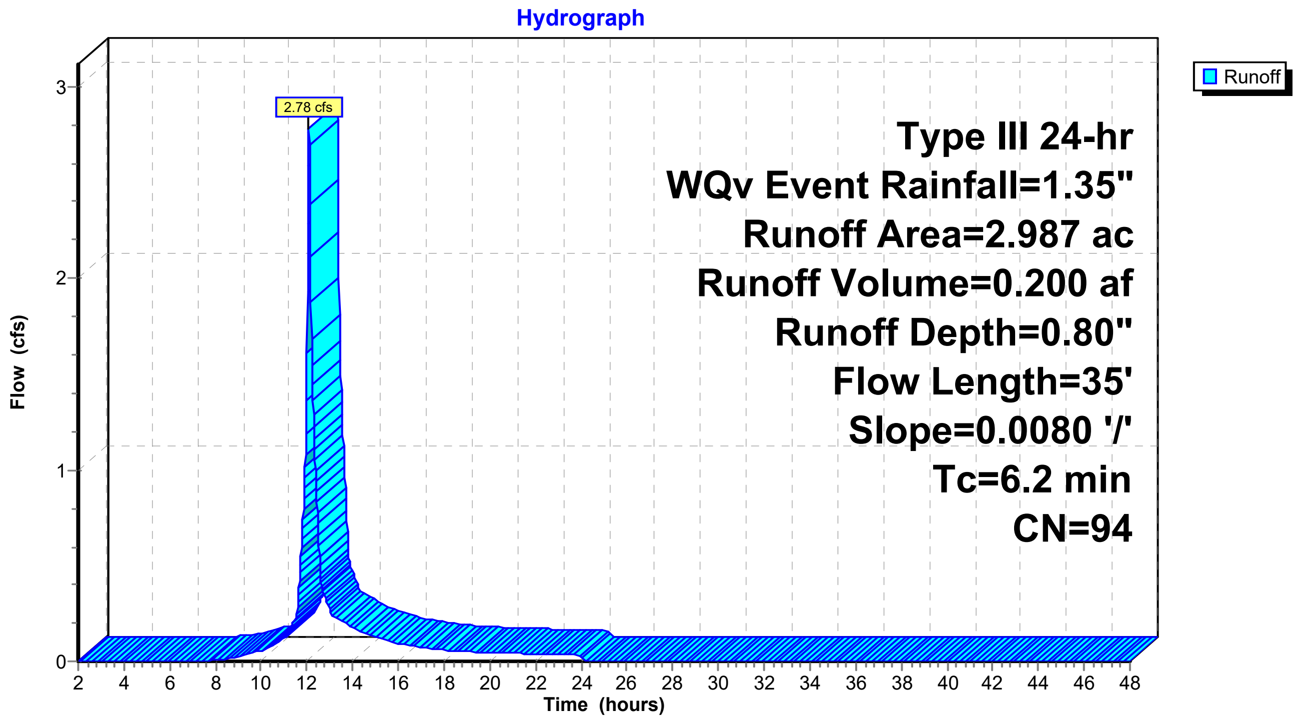
Runoff = 2.78 cfs @ 12.09 hrs, Volume= 0.200 af, Depth= 0.80"
Routed to Pond 9P : DIVERSION STRUCTURE

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.657	80	>75% Grass cover, Good, HSG D
2.330	98	Paved parking, HSG C
2.987	94	Weighted Average
0.657		22.00% Pervious Area
2.330		78.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	35	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"

Subcatchment 5: Subarea 5



Summary for Subcatchment 5A: Subarea 5A

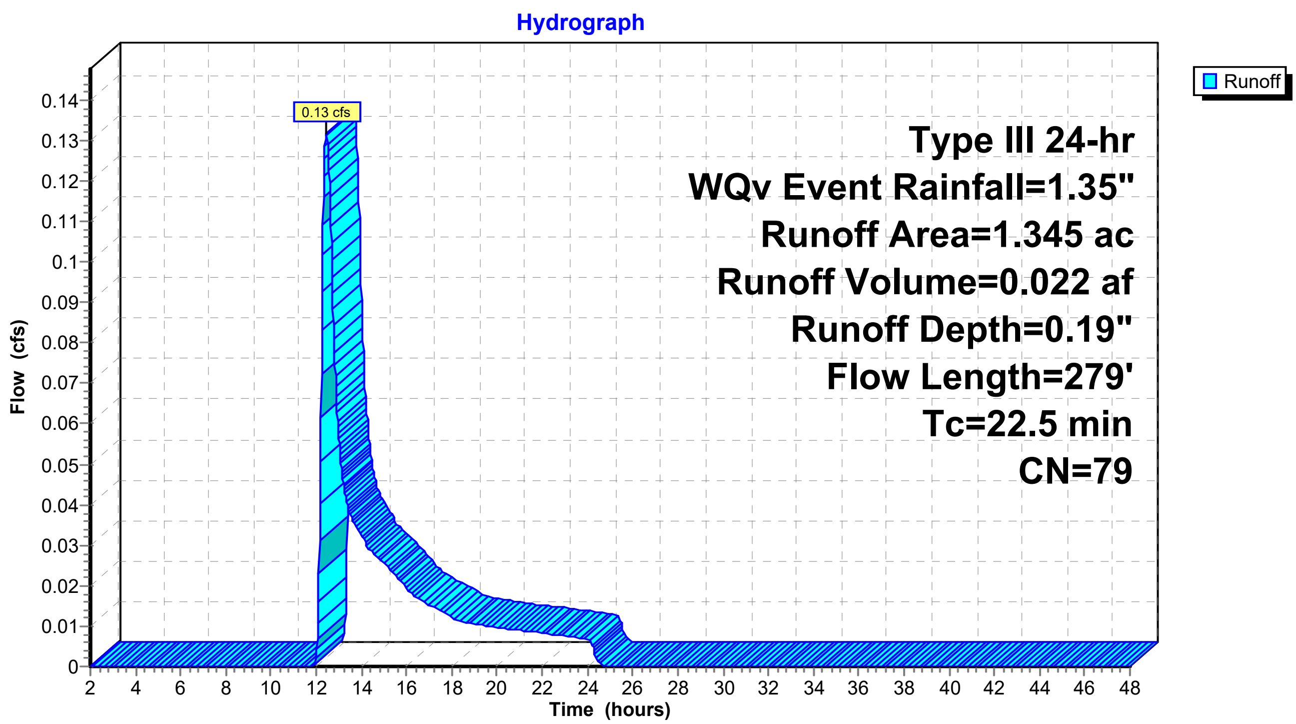
Runoff = 0.13 cfs @ 12.43 hrs, Volume= 0.022 af, Depth= 0.19"
Routed to Link AP-5 : Q

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
1.023	80	>75% Grass cover, Good, HSG D
0.322	77	Woods, Good, HSG D
1.345	79	Weighted Average
1.345		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	25	0.0080	0.09		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
11.3	28	0.0080	0.04		**Sheet Flow, woods** Woods: Light underbrush n= 0.400 P2= 3.15"
4.6	46	0.2000	0.17		**Sheet Flow, Brush** Woods: Light underbrush n= 0.400 P2= 3.15"
1.9	180	0.1000	1.58		**Shallow Concentrated Flow, SC Flow** Woodland Kv= 5.0 fps
22.5	279	Total			

Subcatchment 5A: Subarea 5A



Summary for Subcatchment 6: Subarea 6

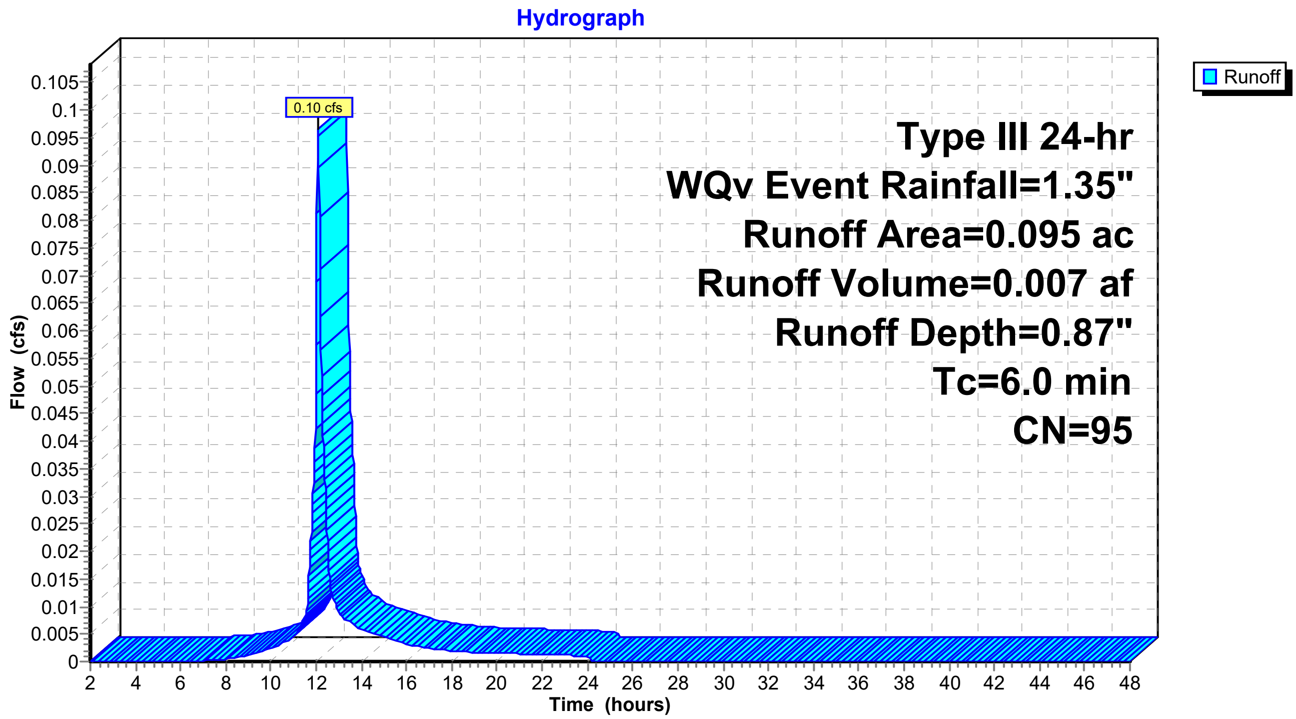
Runoff = 0.10 cfs @ 12.09 hrs, Volume= 0.007 af, Depth= 0.87"
Routed to Pond 10P : BIORETENTION POOL

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.017	80	>75% Grass cover, Good, HSG D
0.078	98	Paved parking, HSG C
0.095	95	Weighted Average
0.017		17.89% Pervious Area
0.078		82.11% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, MIN**

Subcatchment 6: Subarea 6



Summary for Subcatchment 7: Subarea 3

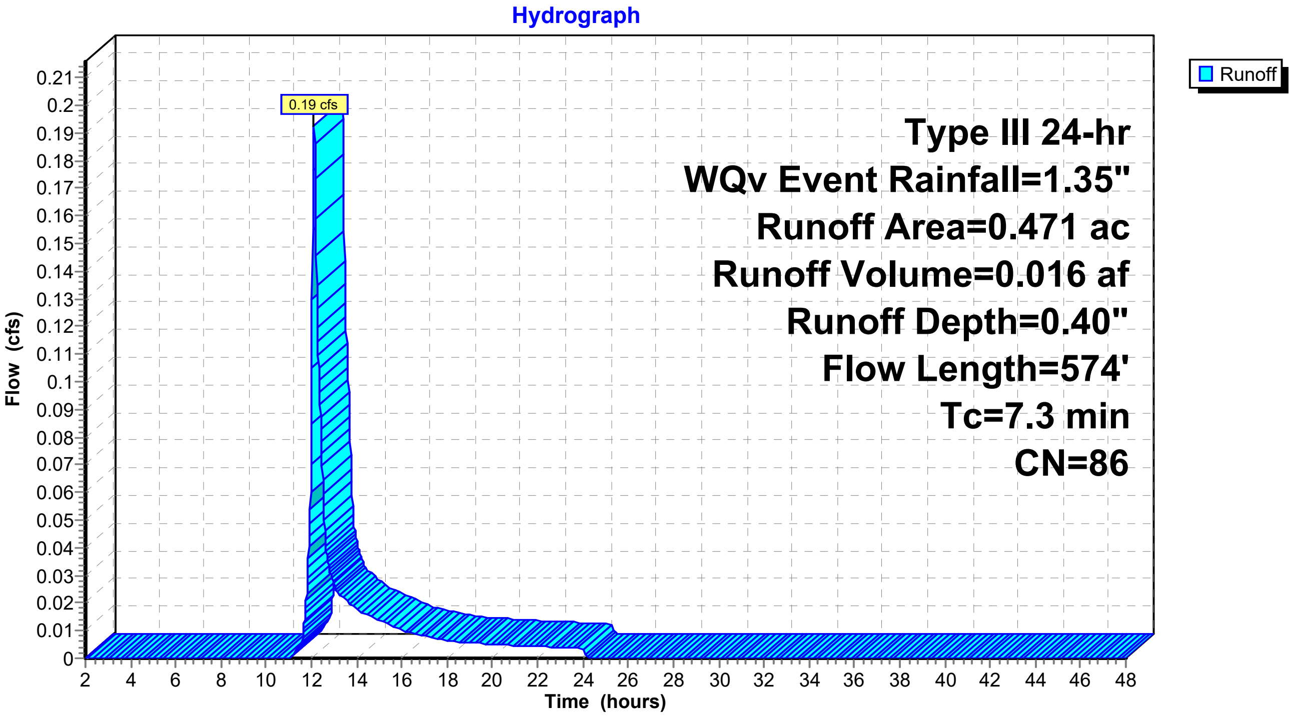
Runoff = 0.19 cfs @ 12.12 hrs, Volume= 0.016 af, Depth= 0.40"
Routed to Pond 1P : Infiltration Basin 3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Type III 24-hr WQv Event Rainfall=1.35"

Area (ac)	CN	Description
0.304	80	>75% Grass cover, Good, HSG D
0.167	98	Paved parking, HSG C
0.471	86	Weighted Average
0.304		64.54% Pervious Area
0.167		35.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	35	0.0200	0.14		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
1.4	30	0.2500	0.36		**Sheet Flow, Lawn** Grass: Short n= 0.150 P2= 3.15"
0.6	77	0.0100	2.03		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
1.0	432	0.0100	7.03	12.41	**Pipe Channel, Pipe** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.011 Concrete pipe, straight & clean
7.3	574	Total			

Subcatchment 7: Subarea 3



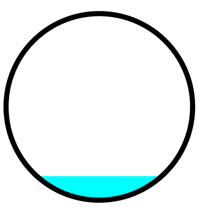
Summary for Reach 4R: UNDERDRAIN

Inflow Area = 0.165 ac, 69.59% Impervious, Inflow Depth = 0.72" for WQv Event event
Inflow = 0.05 cfs @ 12.18 hrs, Volume= 0.010 af
Outflow = 0.05 cfs @ 12.18 hrs, Volume= 0.010 af, Atten= 0%, Lag= 0.1 min
Routed to Link AP-5 : Q

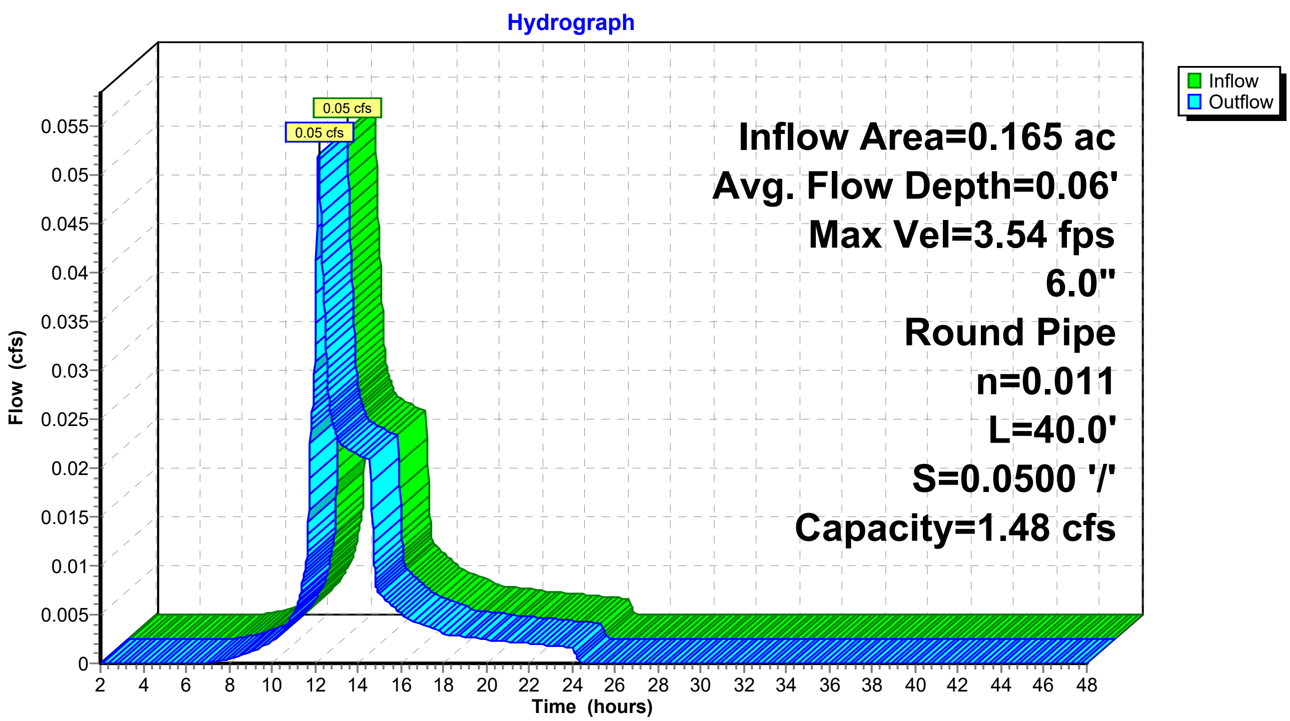
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.54 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.65 fps, Avg. Travel Time= 0.4 min

Peak Storage= 1 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.06' , Surface Width= 0.33'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'



Reach 4R: UNDERDRAIN



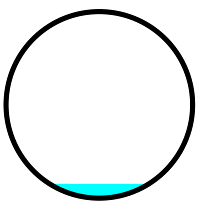
Summary for Reach 14R: UNDERDRAIN

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 0.87" for WQv Event event
Inflow = 0.02 cfs @ 11.82 hrs, Volume= 0.007 af
Outflow = 0.02 cfs @ 11.82 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 15R : UNDERDRAIN

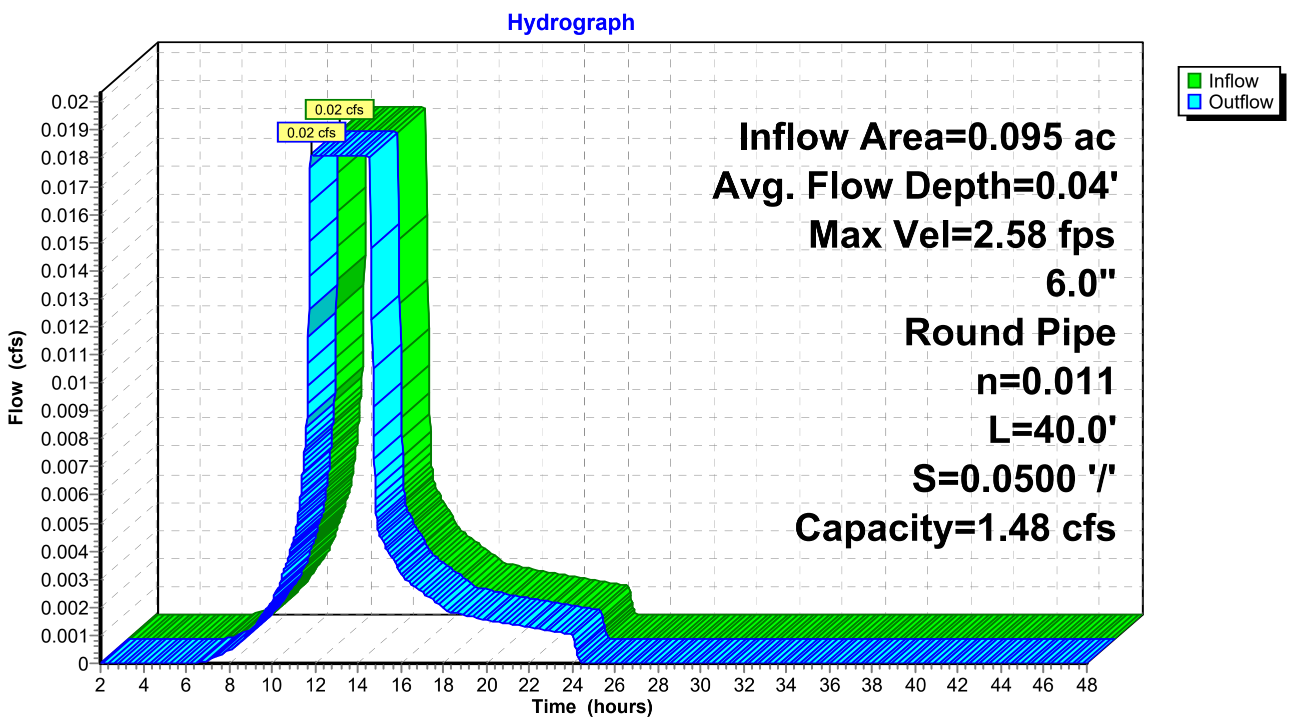
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 2.58 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.50 fps, Avg. Travel Time= 0.4 min

Peak Storage= 0 cf @ 11.82 hrs
Average Depth at Peak Storage= 0.04' , Surface Width= 0.27'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 244.50', Outlet Invert= 242.50'



Reach 14R: UNDERDRAIN



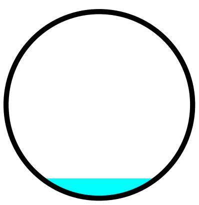
Summary for Reach 15R: UNDERDRAIN

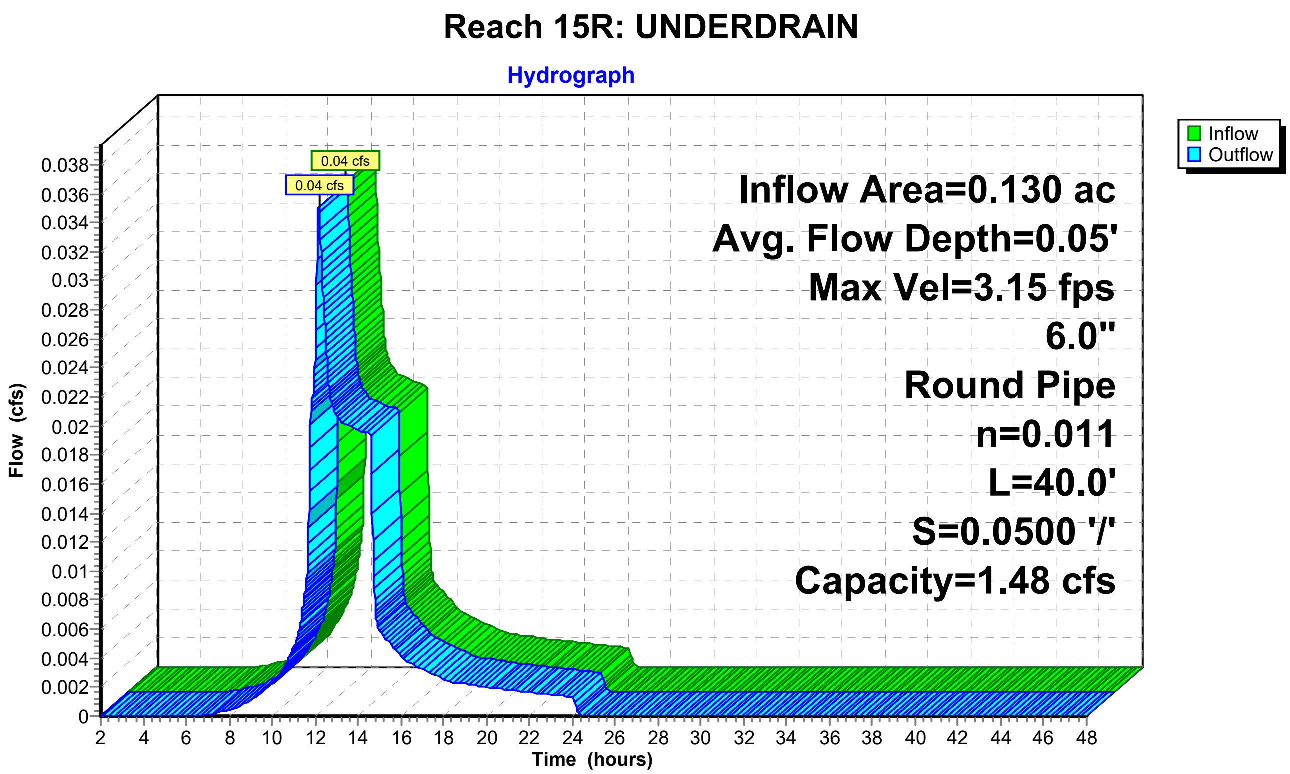
Inflow Area = 0.130 ac, 74.16% Impervious, Inflow Depth = 0.78" for WQv Event event
Inflow = 0.04 cfs @ 12.17 hrs, Volume= 0.008 af
Outflow = 0.04 cfs @ 12.18 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.2 min
Routed to Reach 4R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Max. Velocity= 3.15 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.58 fps, Avg. Travel Time= 0.4 min

Peak Storage= 0 cf @ 12.18 hrs
Average Depth at Peak Storage= 0.05' , Surface Width= 0.31'
Bank-Full Depth= 0.50' Flow Area= 0.2 sf, Capacity= 1.48 cfs

6.0" Round Pipe
n= 0.011 Concrete pipe, straight & clean
Length= 40.0' Slope= 0.0500 '/'
Inlet Invert= 242.50', Outlet Invert= 240.50'





Summary for Pond 1P: Infiltration Basin 3

Inflow Area = 0.471 ac, 35.46% Impervious, Inflow Depth = 0.40" for WQv Event event
Inflow = 0.19 cfs @ 12.12 hrs, Volume= 0.016 af
Outflow = 0.09 cfs @ 12.37 hrs, Volume= 0.016 af, Atten= 51%, Lag= 15.0 min
Discarded = 0.09 cfs @ 12.37 hrs, Volume= 0.016 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 258.10' @ 12.37 hrs Surf.Area= 820 sf Storage= 83 cf

Plug-Flow detention time= 7.8 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 7.7 min (877.2 - 869.4)

Volume	Invert	Avail.Storage	Storage Description
#1	258.00'	8,592 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

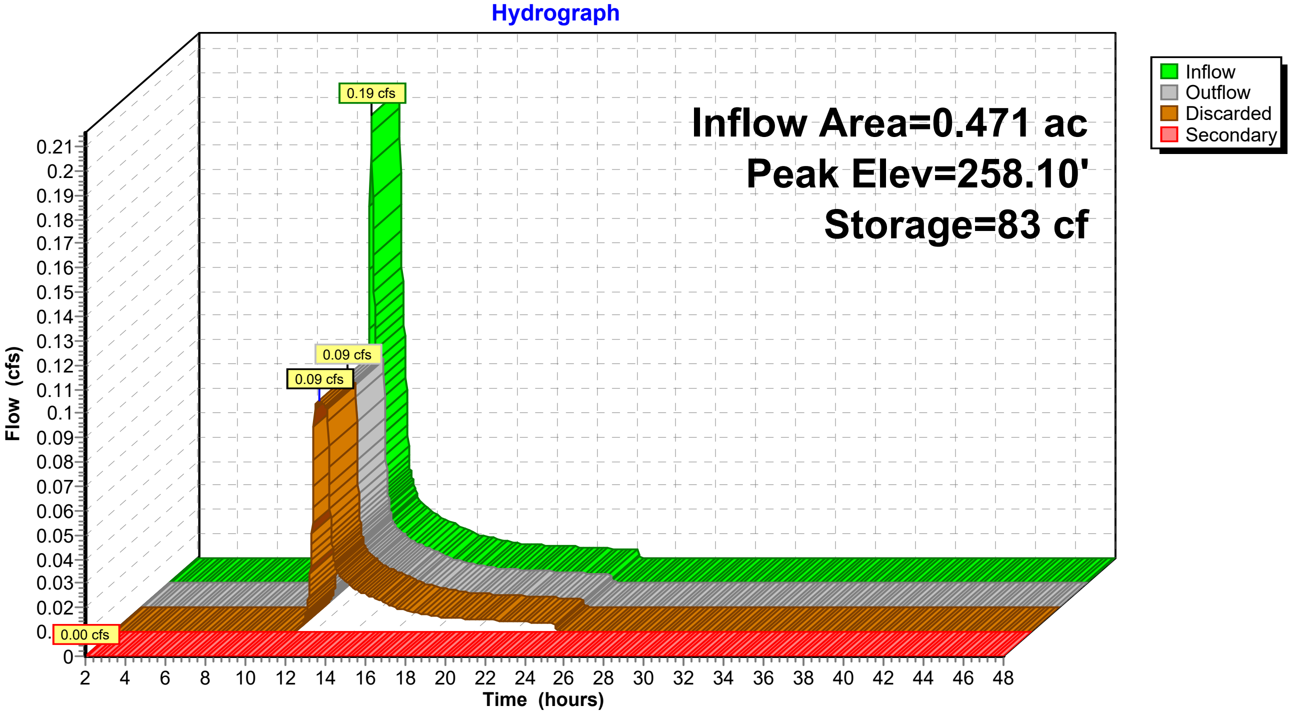
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
258.00	768	159.0	0	0	768
259.00	1,336	214.0	1,039	1,039	2,411
260.00	2,058	260.0	1,684	2,723	4,162
261.00	2,918	302.0	2,476	5,199	6,062
262.00	3,892	340.0	3,393	8,592	8,029

Device	Routing	Invert	Outlet Devices
#1	Discarded	258.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	261.00'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.09 cfs @ 12.37 hrs HW=258.10' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=258.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Infiltration Basin 3



Summary for Pond 2P: Infiltration Basin 1

Inflow Area = 1.245 ac, 66.51% Impervious, Inflow Depth = 0.71" for WQv Event event
Inflow = 0.78 cfs @ 12.19 hrs, Volume= 0.073 af
Outflow = 0.22 cfs @ 12.65 hrs, Volume= 0.073 af, Atten= 72%, Lag= 27.7 min
Discarded = 0.22 cfs @ 12.65 hrs, Volume= 0.073 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-4 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 260.39' @ 12.65 hrs Surf.Area= 2,393 sf Storage= 845 cf

Plug-Flow detention time= 28.8 min calculated for 0.073 af (100% of inflow)
Center-of-Mass det. time= 28.8 min (859.7 - 830.9)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	28,403 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

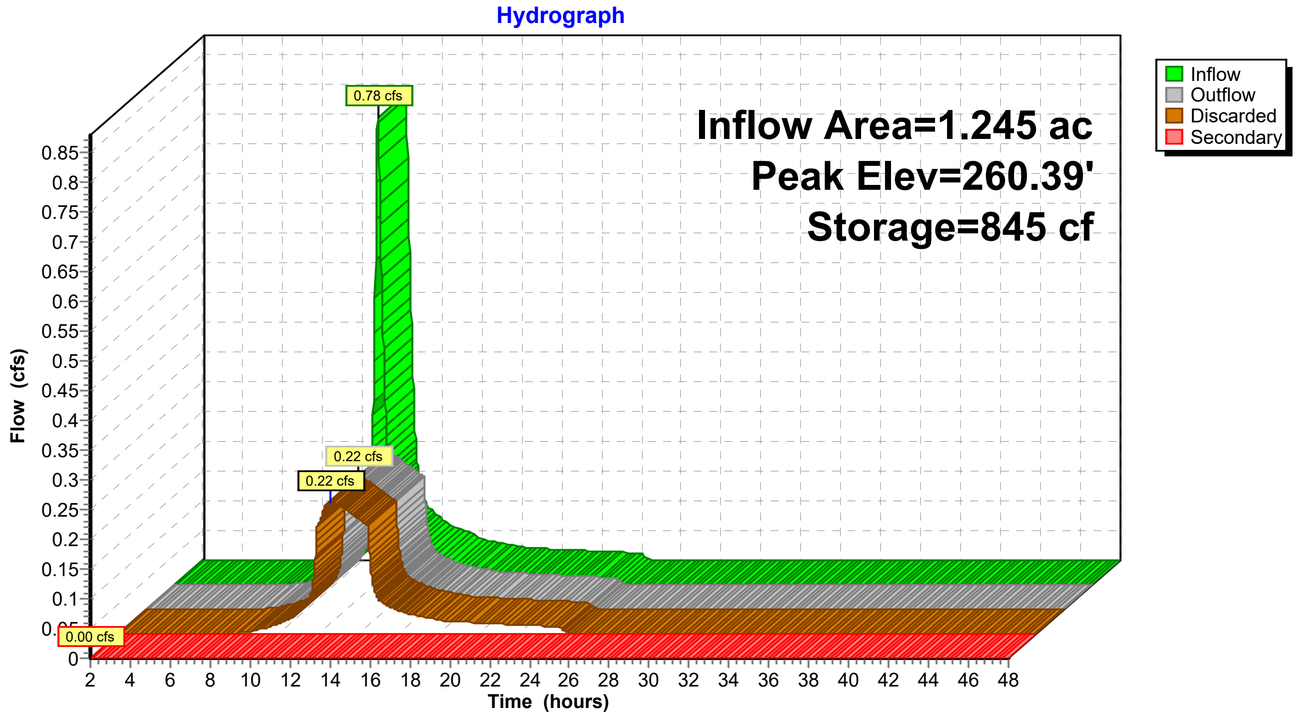
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	1,899	346.0	0	0	1,899
261.00	3,262	444.0	2,550	2,550	8,073
262.00	4,687	481.0	3,953	6,503	10,835
263.00	6,254	534.0	5,452	11,955	15,146
264.00	7,942	571.0	7,081	19,036	18,446
265.50	4,689	396.0	9,367	28,403	31,932

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	263.75'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.22 cfs @ 12.65 hrs HW=260.39' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.22 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Infiltration Basin 1



Summary for Pond 3P: Infiltration Basin 2

Inflow Area = 0.789 ac, 61.98% Impervious, Inflow Depth = 0.62" for WQv Event event
Inflow = 0.57 cfs @ 12.09 hrs, Volume= 0.041 af
Outflow = 0.38 cfs @ 12.19 hrs, Volume= 0.041 af, Atten= 34%, Lag= 5.6 min
Discarded = 0.38 cfs @ 12.19 hrs, Volume= 0.041 af
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-2 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 260.04' @ 12.19 hrs Surf.Area= 4,077 sf Storage= 161 cf

Plug-Flow detention time= 5.6 min calculated for 0.041 af (100% of inflow)
Center-of-Mass det. time= 5.6 min (845.1 - 839.5)

Volume	Invert	Avail.Storage	Storage Description
#1	260.00'	16,256 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

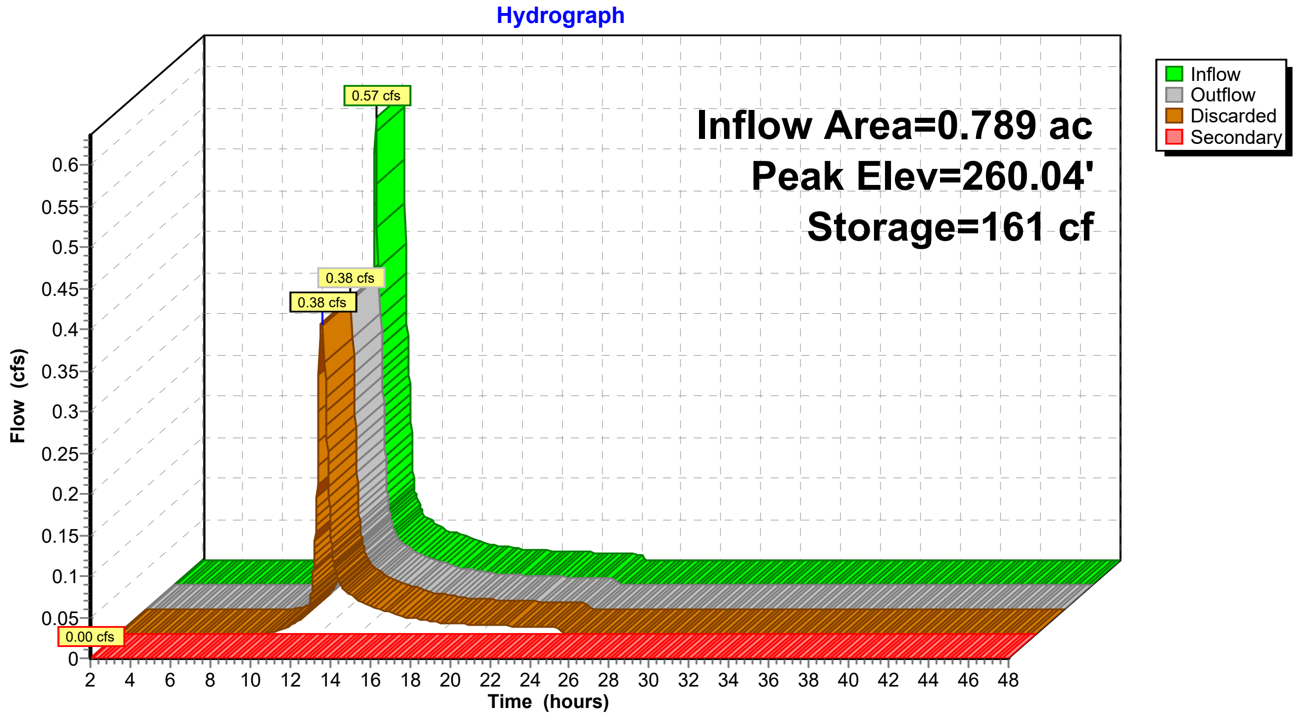
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
260.00	4,044	279.0	0	0	4,044
261.00	4,923	304.0	4,476	4,476	5,240
262.00	5,880	330.0	5,394	9,871	6,589
263.00	6,905	353.0	6,386	16,256	7,885

Device	Routing	Invert	Outlet Devices
#1	Discarded	260.00'	**4.000 in/hr Exfiltration over Surface area**
#2	Secondary	262.00'	**4.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.38 cfs @ 12.19 hrs HW=260.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.38 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=260.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Infiltration Basin 2



Summary for Pond 4P: Infiltration Basin 4

Inflow Area = 1.019 ac, 78.21% Impervious, Inflow Depth = 0.80" for WQv Event event
Inflow = 0.82 cfs @ 12.15 hrs, Volume= 0.068 af
Outflow = 0.28 cfs @ 12.51 hrs, Volume= 0.068 af, Atten= 65%, Lag= 21.9 min
Discarded = 0.28 cfs @ 12.51 hrs, Volume= 0.068 af
Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 260.04' @ 12.51 hrs Surf.Area= 1,018 sf Storage= 701 cf

Plug-Flow detention time= 18.3 min calculated for 0.068 af (100% of inflow)
Center-of-Mass det. time= 18.3 min (842.2 - 823.8)

Volume	Invert	Avail.Storage	Storage Description
#1	259.00'	4,563 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
259.00	377	128.0	0	0	377
260.00	988	176.0	658	658	1,548
261.00	1,829	236.0	1,387	2,046	3,526
262.00	3,276	431.0	2,518	4,563	13,882

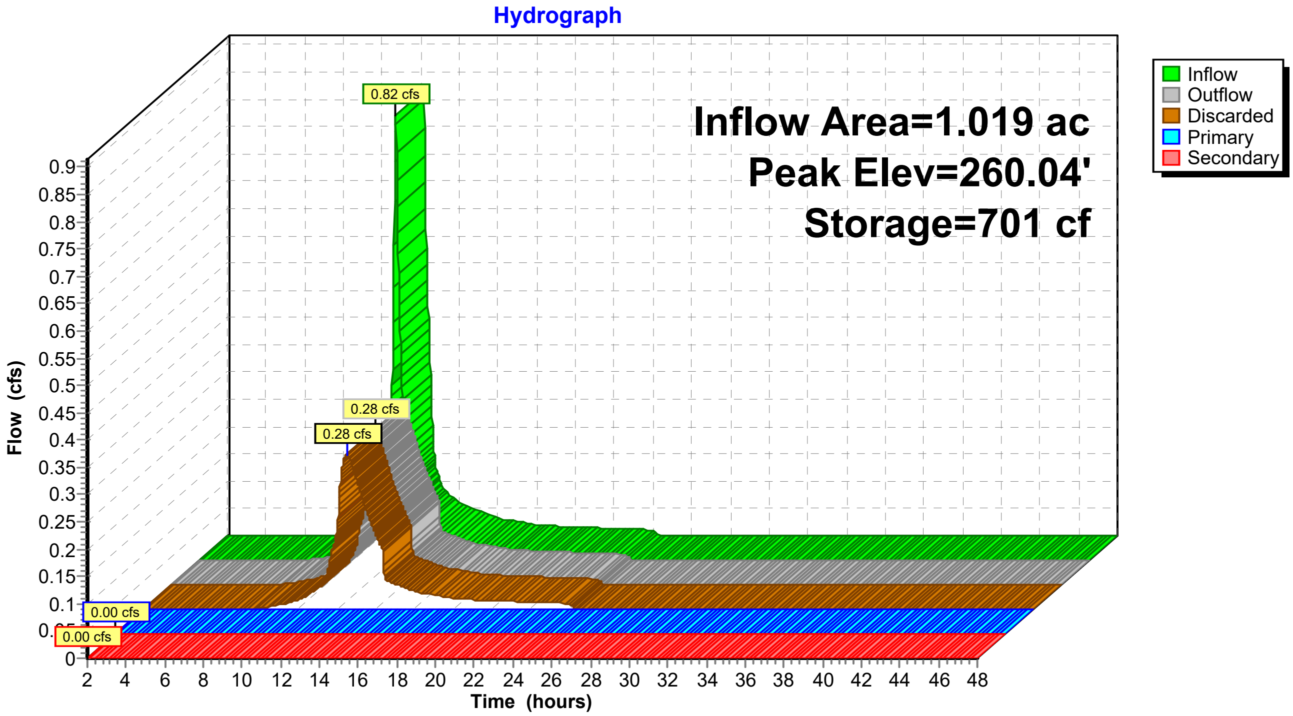
Device	Routing	Invert	Outlet Devices
#1	Discarded	259.00'	**12.000 in/hr Exfiltration over Surface area**
#2	Primary	259.00'	**18.0" Round Culvert** L= 47.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 259.00' / 255.20' S= 0.0809 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	261.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Secondary	261.40'	**6.0' long + 4.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.28 cfs @ 12.51 hrs HW=260.04' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.00 cfs @ 2.00 hrs HW=259.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)
 └─**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=259.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Infiltration Basin 4



Summary for Pond 5P: BIORETENTION POOL 1

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 0.62" for WQv Event event
Inflow = 0.90 cfs @ 12.09 hrs, Volume= 0.064 af
Outflow = 0.11 cfs @ 12.86 hrs, Volume= 0.064 af, Atten= 88%, Lag= 46.0 min
Primary = 0.11 cfs @ 12.86 hrs, Volume= 0.064 af
Routed to Pond 5PF : BIORETENTION FILTER
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin
Tertiary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 249.43' @ 12.86 hrs Surf.Area= 2,389 sf Storage= 965 cf

Plug-Flow detention time= 73.3 min calculated for 0.064 af (100% of inflow)
Center-of-Mass det. time= 73.2 min (912.7 - 839.5)

Volume	Invert	Avail.Storage	Storage Description
#1	249.00'	2,444 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
249.00	2,084	225.0	0	0	2,084
250.00	2,823	249.0	2,444	2,444	3,020

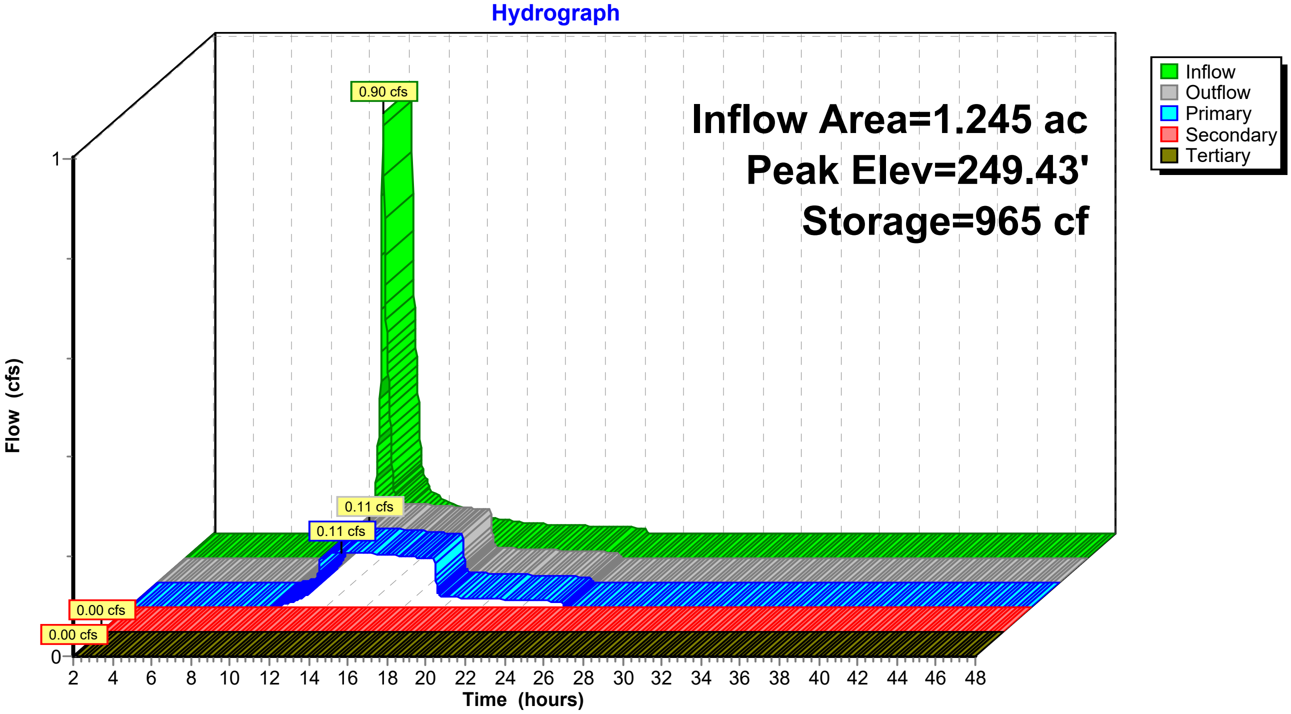
Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	249.45'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	249.50'	**20.0' long x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.11 cfs @ 12.86 hrs HW=249.43' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=249.00' (Free Discharge)
└─**2=Culvert** (Passes 0.00 cfs of 5.53 cfs potential flow)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)

Tertiary OutFlow Max=0.00 cfs @ 2.00 hrs HW=249.00' (Free Discharge)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: BIORETENTION POOL 1



Summary for Pond 5PF: BIORETENTION FILTER

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 0.62" for WQv Event event
Inflow = 0.11 cfs @ 12.86 hrs, Volume= 0.064 af
Outflow = 0.09 cfs @ 12.24 hrs, Volume= 0.064 af, Atten= 18%, Lag= 0.0 min
Primary = 0.09 cfs @ 12.24 hrs, Volume= 0.064 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.27' @ 17.58 hrs Surf.Area= 1,965 sf Storage= 407 cf

Plug-Flow detention time= 50.3 min calculated for 0.064 af (100% of inflow)
Center-of-Mass det. time= 50.1 min (962.8 - 912.7)

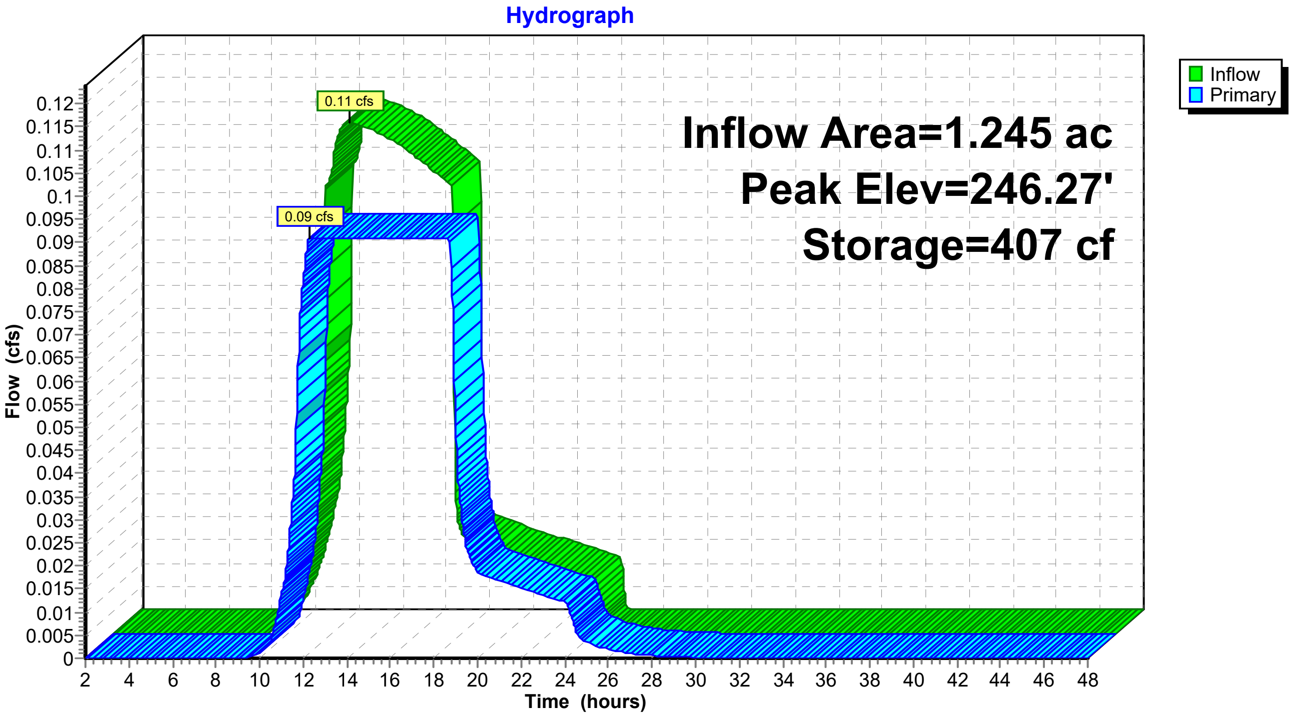
Volume	Invert	Avail.Storage	Storage Description
#1	245.75'	2,555 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 6,386 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.75	1,965	214.0	0	0	1,965
249.00	1,965	214.0	6,386	6,386	2,661

Device	Routing	Invert	Outlet Devices
#1	Primary	245.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 245.75' / 245.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	245.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.09 cfs @ 12.24 hrs HW=245.91' (Free Discharge)
└─**1=Culvert** (Passes 0.09 cfs of 0.11 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond 5PF: BIORETENTION FILTER



Summary for Pond 6P: BIORETENTION POOL 2

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 0.80" for WQv Event event
Inflow = 2.78 cfs @ 12.09 hrs, Volume= 0.200 af
Outflow = 1.00 cfs @ 12.38 hrs, Volume= 0.200 af, Atten= 64%, Lag= 17.3 min
Primary = 0.25 cfs @ 12.38 hrs, Volume= 0.169 af
Routed to Pond 6PF : BIORETENTION FILTER
Secondary = 0.75 cfs @ 12.38 hrs, Volume= 0.030 af
Routed to Pond 7P : Detention Basin
Tertiary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 257.49' @ 12.38 hrs Surf.Area= 5,425 sf Storage= 2,542 cf

Plug-Flow detention time= 62.2 min calculated for 0.200 af (100% of inflow)
Center-of-Mass det. time= 62.2 min (881.8 - 819.6)

Volume	Invert	Avail.Storage	Storage Description
#1	257.00'	5,437 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
257.00	4,885	362.0	0	0	4,885
258.00	6,009	386.0	5,437	5,437	6,362

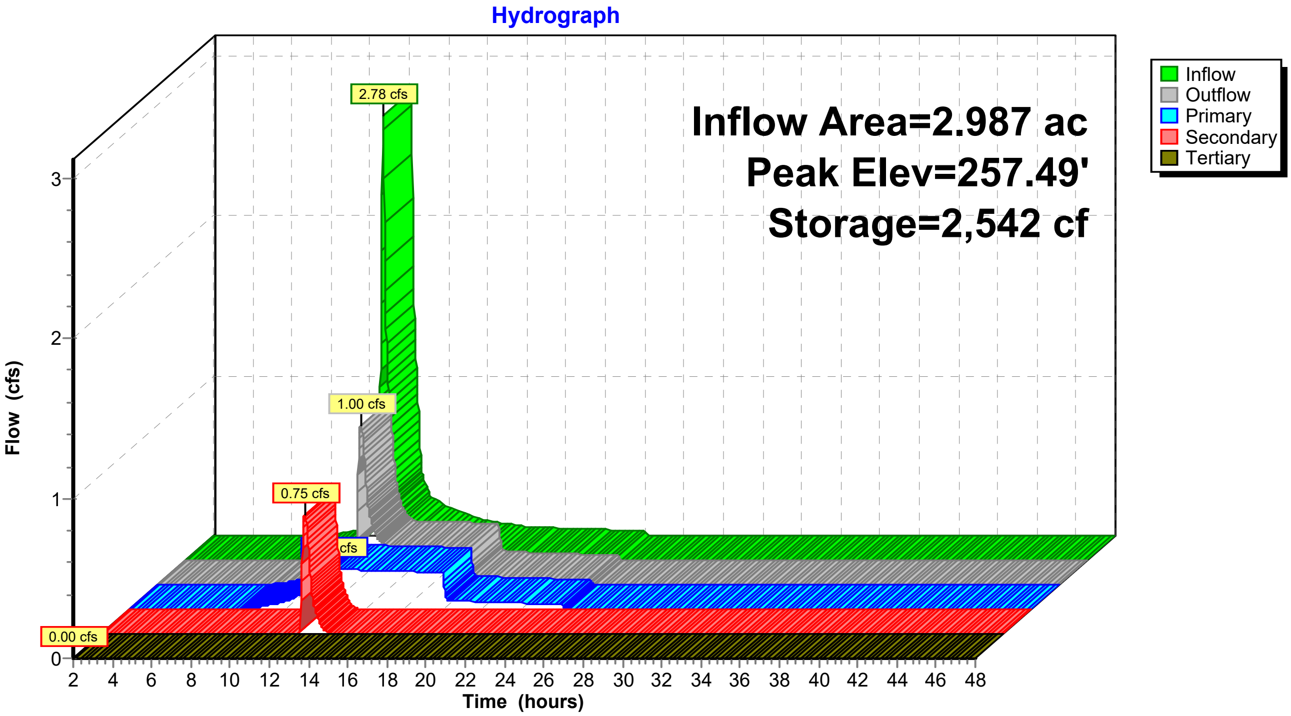
Device	Routing	Invert	Outlet Devices
#1	Primary	257.00'	**2.000 in/hr Exfiltration over Surface area**
#2	Secondary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#3	Device 2	257.40'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Tertiary	257.50'	**12.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.25 cfs @ 12.38 hrs HW=257.49' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.25 cfs)

Secondary OutFlow Max=0.75 cfs @ 12.38 hrs HW=257.49' (Free Discharge)
└—**2=Culvert** (Passes 0.75 cfs of 6.81 cfs potential flow)
  └—**3=Orifice/Grate** (Weir Controls 0.75 cfs @ 1.00 fps)

Tertiary OutFlow Max=0.00 cfs @ 2.00 hrs HW=257.00' (Free Discharge)
└—**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: BIORETENTION POOL 2



Summary for Pond 6PF: BIORETENTION FILTER

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 0.68" for WQv Event event
Inflow = 0.25 cfs @ 12.38 hrs, Volume= 0.169 af
Outflow = 0.23 cfs @ 12.76 hrs, Volume= 0.169 af, Atten= 10%, Lag= 22.9 min
Primary = 0.23 cfs @ 12.76 hrs, Volume= 0.169 af
Routed to Pond 7P : Detention Basin

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 254.14' @ 18.00 hrs Surf.Area= 4,885 sf Storage= 763 cf

Plug-Flow detention time= 53.1 min calculated for 0.169 af (100% of inflow)
Center-of-Mass det. time= 53.5 min (958.5 - 904.9)

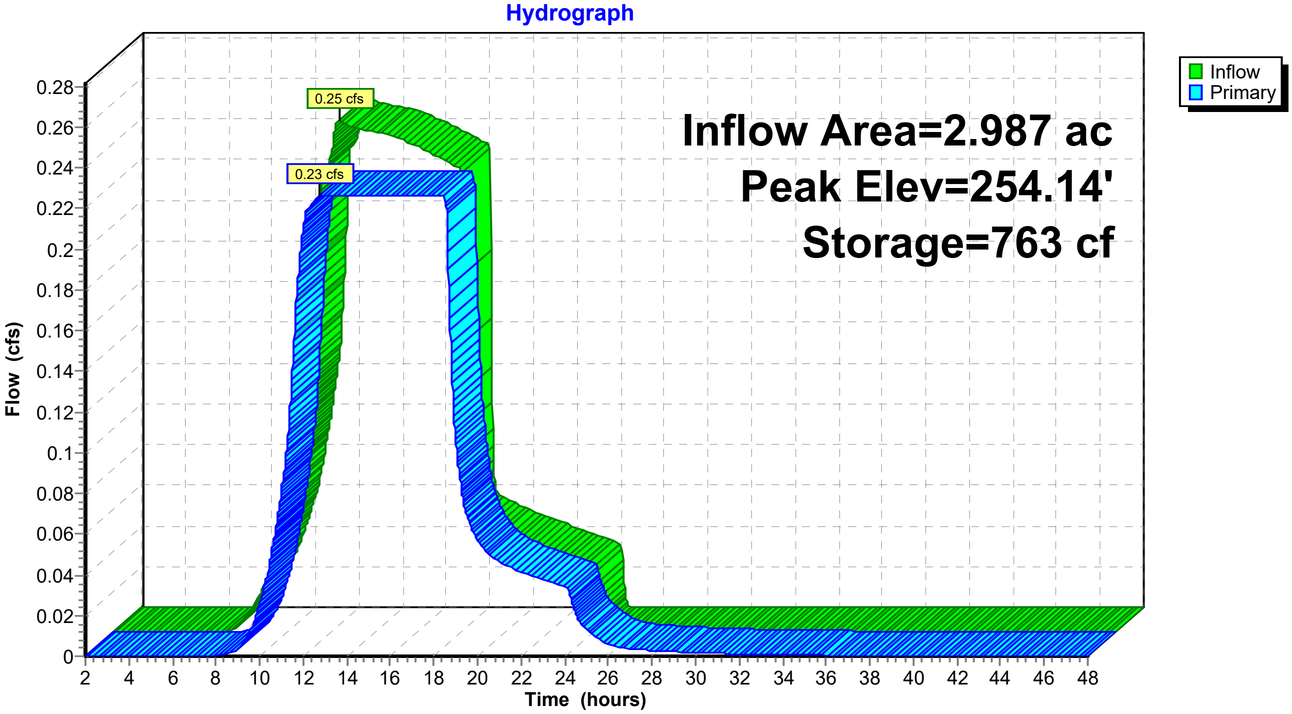
Volume	Invert	Avail.Storage	Storage Description
#1	253.75'	6,351 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 15,876 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
253.75	4,885	363.0	0	0	4,885
257.00	4,885	363.0	15,876	15,876	6,065

Device	Routing	Invert	Outlet Devices
#1	Primary	253.75'	**12.0" Round Culvert** L= 25.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 253.75' / 253.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Device 1	253.75'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.23 cfs @ 12.76 hrs HW=254.01' (Free Discharge)
└─**1=Culvert** (Passes 0.23 cfs of 0.28 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.23 cfs)

Pond 6PF: BIORETENTION FILTER



Summary for Pond 7P: Detention Basin

Inflow Area = 5.739 ac, 67.68% Impervious, Inflow Depth = 0.57" for WQv Event event
Inflow = 1.11 cfs @ 12.38 hrs, Volume= 0.273 af
Outflow = 0.48 cfs @ 12.93 hrs, Volume= 0.273 af, Atten= 57%, Lag= 33.1 min
Primary = 0.48 cfs @ 12.93 hrs, Volume= 0.273 af
Routed to Link AP-1 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 239.51' @ 12.93 hrs Surf.Area= 4,223 sf Storage= 2,008 cf

Plug-Flow detention time= 91.2 min calculated for 0.273 af (100% of inflow)
Center-of-Mass det. time= 90.4 min (1,025.3 - 934.9)

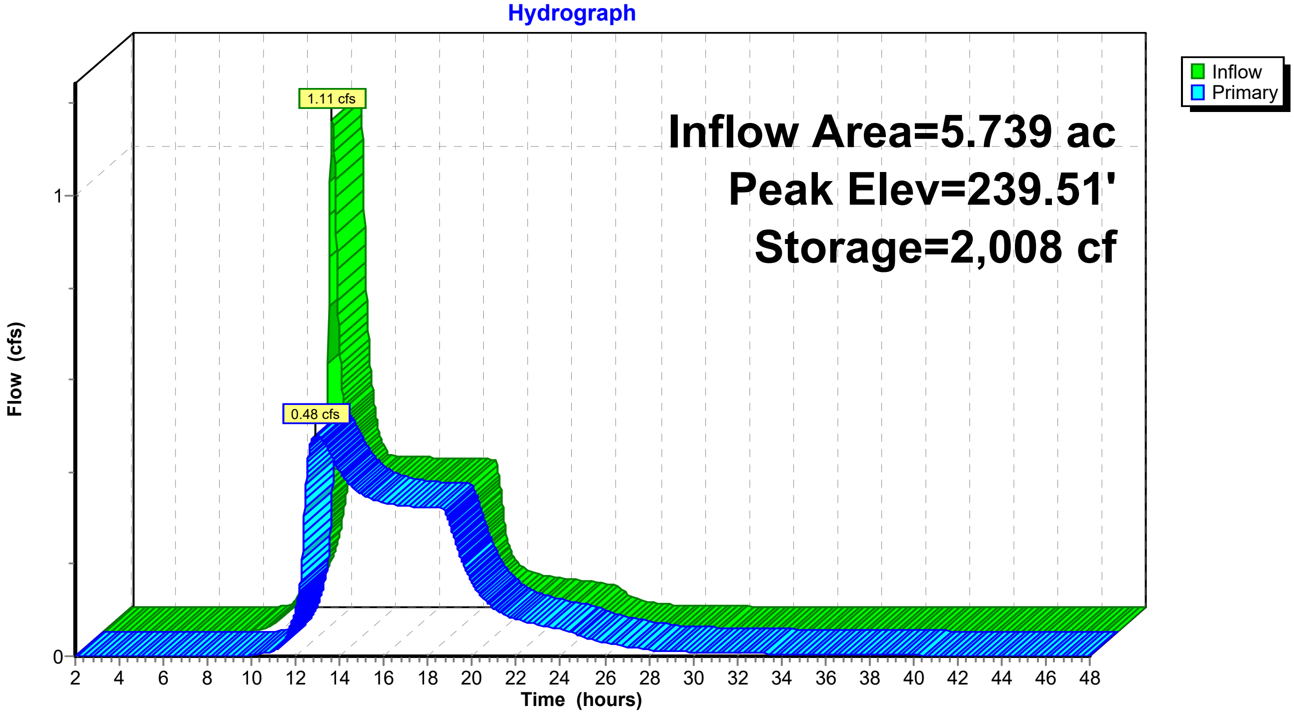
Volume	Invert	Avail.Storage	Storage Description
#1	239.00'	43,611 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
239.00	3,719	242.0	0	0	3,719
240.00	4,746	270.0	4,222	4,222	4,888
241.00	5,883	297.0	5,304	9,526	6,139
242.00	7,115	321.0	6,489	16,016	7,359
243.00	8,454	347.0	7,775	23,791	8,781
244.00	9,894	373.0	9,165	32,955	10,314
245.00	11,437	398.0	10,656	43,611	11,895

Device	Routing	Invert	Outlet Devices
#1	Primary	239.00'	**18.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 239.00' / 238.50' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	239.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	239.55'	**12.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	240.60'	**18.0" W x 6.0" H Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	244.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.48 cfs @ 12.93 hrs HW=239.51' (Free Discharge)
└—**1=Culvert** (Passes 0.48 cfs of 1.27 cfs potential flow)
  —**2=Orifice/Grate** (Orifice Controls 0.48 cfs @ 2.44 fps)
  —**3=Orifice/Grate** (Controls 0.00 cfs)
  —**4=Orifice/Grate** (Controls 0.00 cfs)
  —**5=Orifice/Grate** (Controls 0.00 cfs)

Pond 7P: Detention Basin



Summary for Pond 8P: DIVERSION STRUCTURE

Inflow Area = 1.245 ac, 60.80% Impervious, Inflow Depth = 0.62" for WQv Event event
Inflow = 0.90 cfs @ 12.09 hrs, Volume= 0.064 af
Outflow = 0.90 cfs @ 12.09 hrs, Volume= 0.064 af, Atten= 0%, Lag= 0.0 min
Primary = 0.90 cfs @ 12.09 hrs, Volume= 0.064 af
Routed to Pond 5P : BIORETENTION POOL 1
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

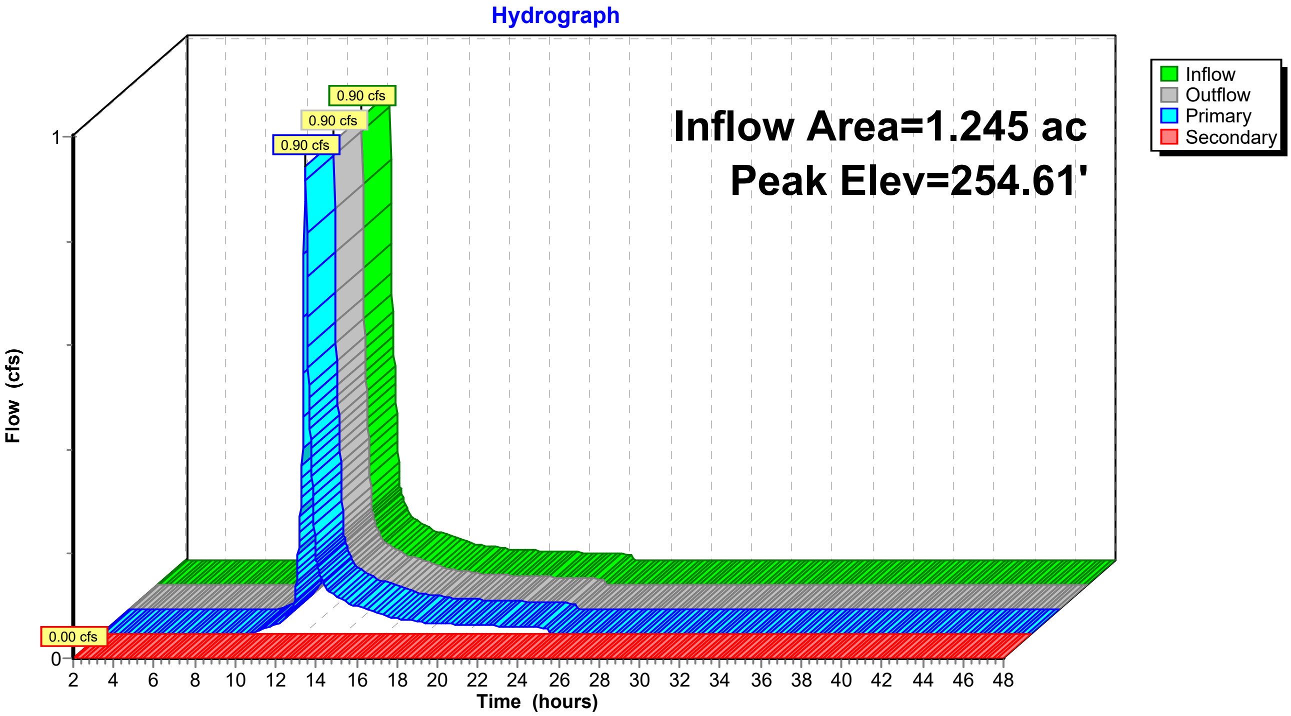
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 254.61' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	254.00'	**8.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.00' / 251.50' S= 0.0625 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.35 sf
#2	Secondary	254.75'	**18.0" Round Culvert** L= 90.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 254.75' / 249.00' S= 0.0639 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=0.89 cfs @ 12.09 hrs HW=254.61' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.89 cfs @ 2.66 fps)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=254.00' (Free Discharge)
↑—**2=Culvert** (Controls 0.00 cfs)

Pond 8P: DIVERSION STRUCTURE



Summary for Pond 9P: DIVERSION STRUCTURE

Inflow Area = 2.987 ac, 78.00% Impervious, Inflow Depth = 0.80" for WQv Event event
Inflow = 2.78 cfs @ 12.09 hrs, Volume= 0.200 af
Outflow = 2.78 cfs @ 12.09 hrs, Volume= 0.200 af, Atten= 0%, Lag= 0.0 min
Primary = 2.78 cfs @ 12.09 hrs, Volume= 0.200 af
Routed to Pond 6P : BIORETENTION POOL 2
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 7P : Detention Basin

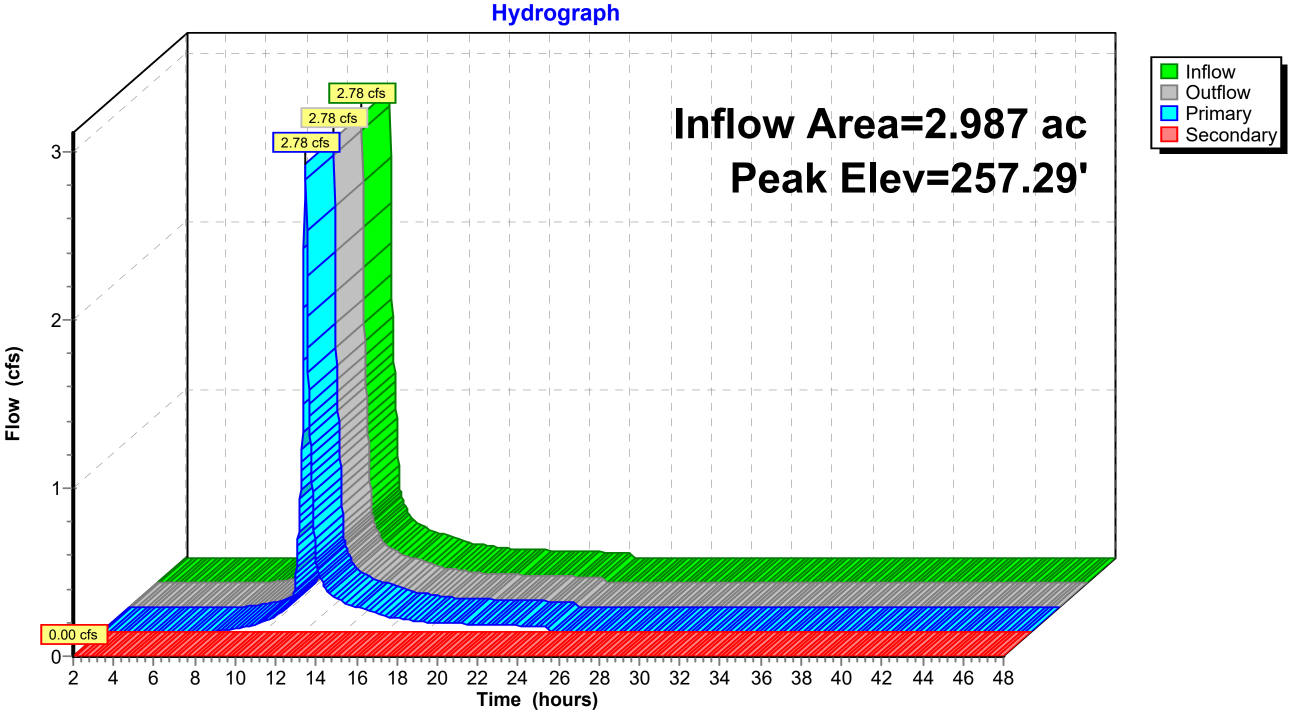
Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 257.29' @ 12.09 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	256.25'	**12.0" Round Culvert** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 256.25' / 255.75' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
#2	Secondary	257.30'	**12.0" Round Culvert** L= 175.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 257.30' / 246.00' S= 0.0646 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.76 cfs @ 12.09 hrs HW=257.28' (Free Discharge)
└—**1=Culvert** (Inlet Controls 2.76 cfs @ 3.52 fps)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=256.25' (Free Discharge)
└—**2=Culvert** (Controls 0.00 cfs)

Pond 9P: DIVERSION STRUCTURE



Summary for Pond 10P: BIORETENTION POOL

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 0.87" for WQv Event event
Inflow = 0.10 cfs @ 12.09 hrs, Volume= 0.007 af
Outflow = 0.03 cfs @ 12.44 hrs, Volume= 0.007 af, Atten= 71%, Lag= 21.1 min
Primary = 0.03 cfs @ 12.44 hrs, Volume= 0.007 af
Routed to Pond 11P : DRY SWALE FILTER
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 12P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 248.29' @ 12.44 hrs Surf.Area= 240 sf Storage= 61 cf

Plug-Flow detention time= 12.6 min calculated for 0.007 af (100% of inflow)
Center-of-Mass det. time= 12.6 min (824.1 - 811.5)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

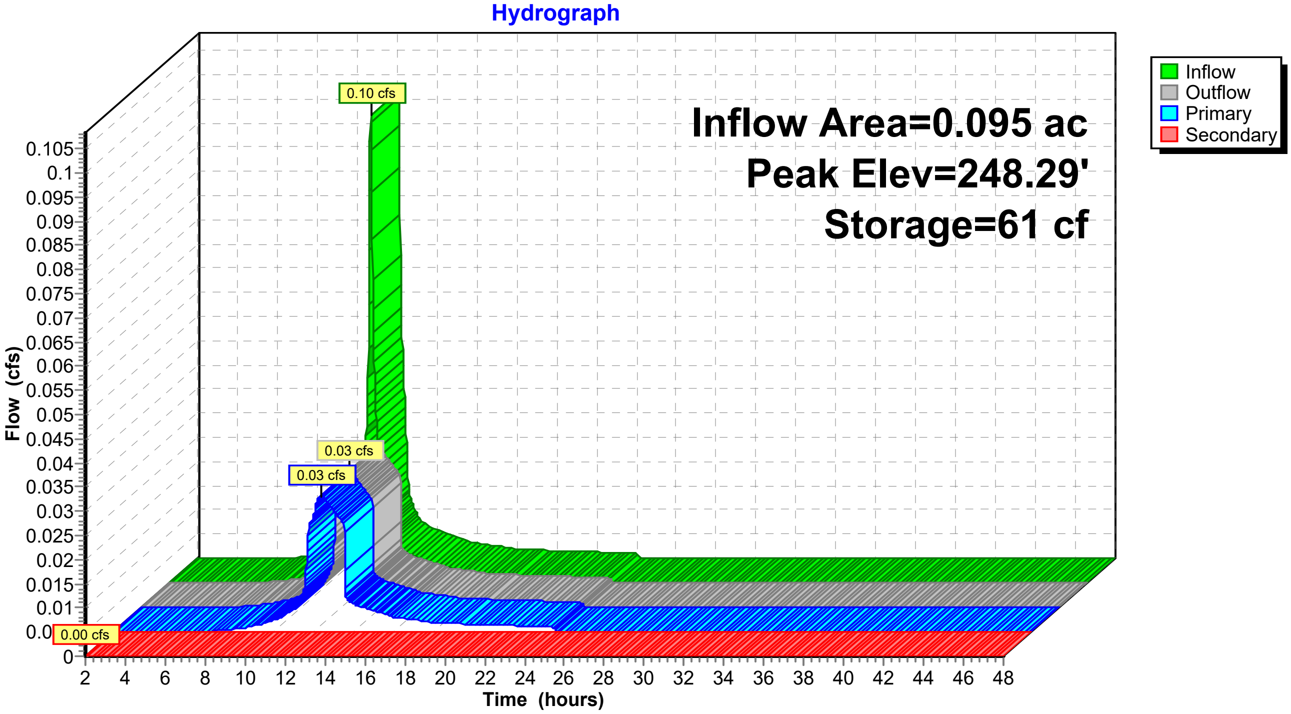
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
248.00	190	60.0	0	0	190
249.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	248.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	248.30'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.03 cfs @ 12.44 hrs HW=248.29' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=248.00' (Free Discharge)
└—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 10P: BIORETENTION POOL



Summary for Pond 11P: DRY SWALE FILTER

Inflow Area = 0.095 ac, 82.11% Impervious, Inflow Depth = 0.87" for WQv Event event
Inflow = 0.03 cfs @ 12.44 hrs, Volume= 0.007 af
Outflow = 0.02 cfs @ 11.82 hrs, Volume= 0.007 af, Atten= 35%, Lag= 0.0 min
Primary = 0.02 cfs @ 11.82 hrs, Volume= 0.007 af
Routed to Reach 14R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.32' @ 13.58 hrs Surf.Area= 391 sf Storage= 50 cf

Plug-Flow detention time= 17.7 min calculated for 0.007 af (100% of inflow)
Center-of-Mass det. time= 17.7 min (841.8 - 824.1)

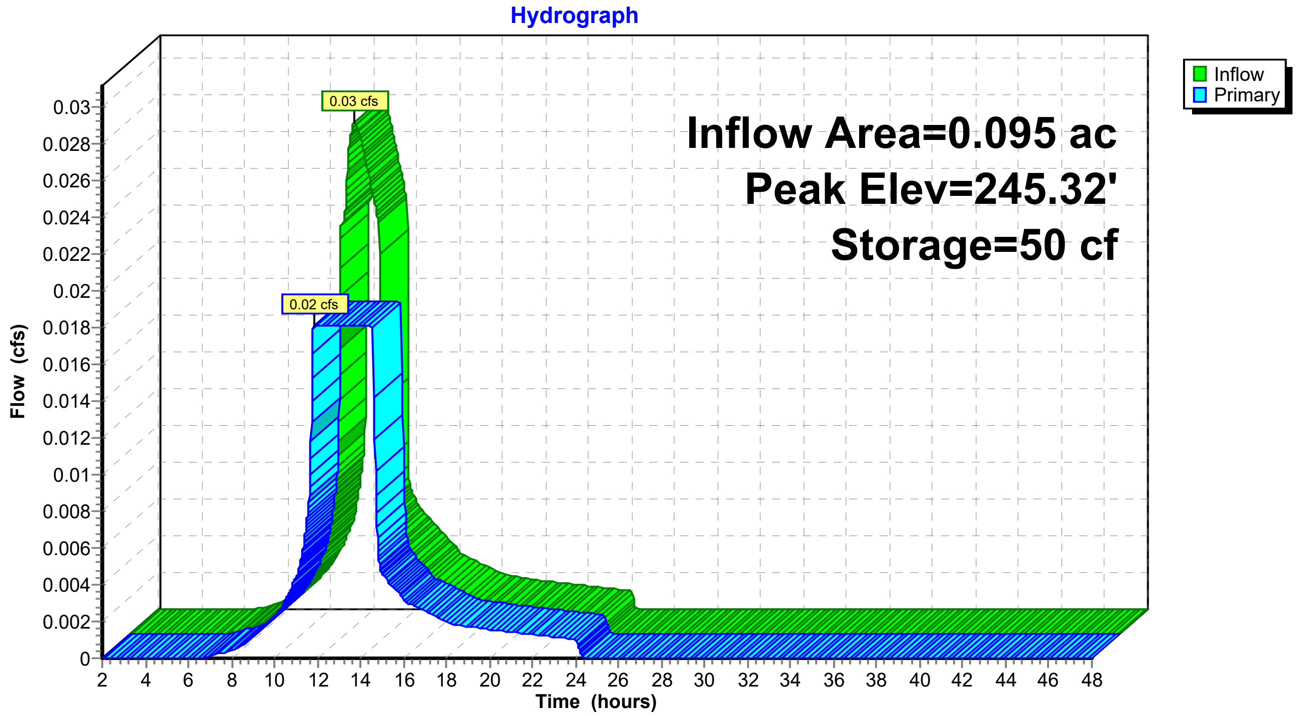
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 11.82 hrs HW=245.03' (Free Discharge)
↑—**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
↑—**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 11P: DRY SWALE FILTER



Summary for Pond 12P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 0.52" for WQv Event event
Inflow = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af
Outflow = 0.02 cfs @ 12.12 hrs, Volume= 0.002 af, Atten= 4%, Lag= 1.4 min
Primary = 0.02 cfs @ 12.12 hrs, Volume= 0.002 af
Routed to Pond 13P : DRY SWALE FILTER
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Pond 14P : BIORETENTION POOL

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.01' @ 12.12 hrs Surf.Area= 191 sf Storage= 2 cf

Plug-Flow detention time= 1.4 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 1.4 min (852.7 - 851.3)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

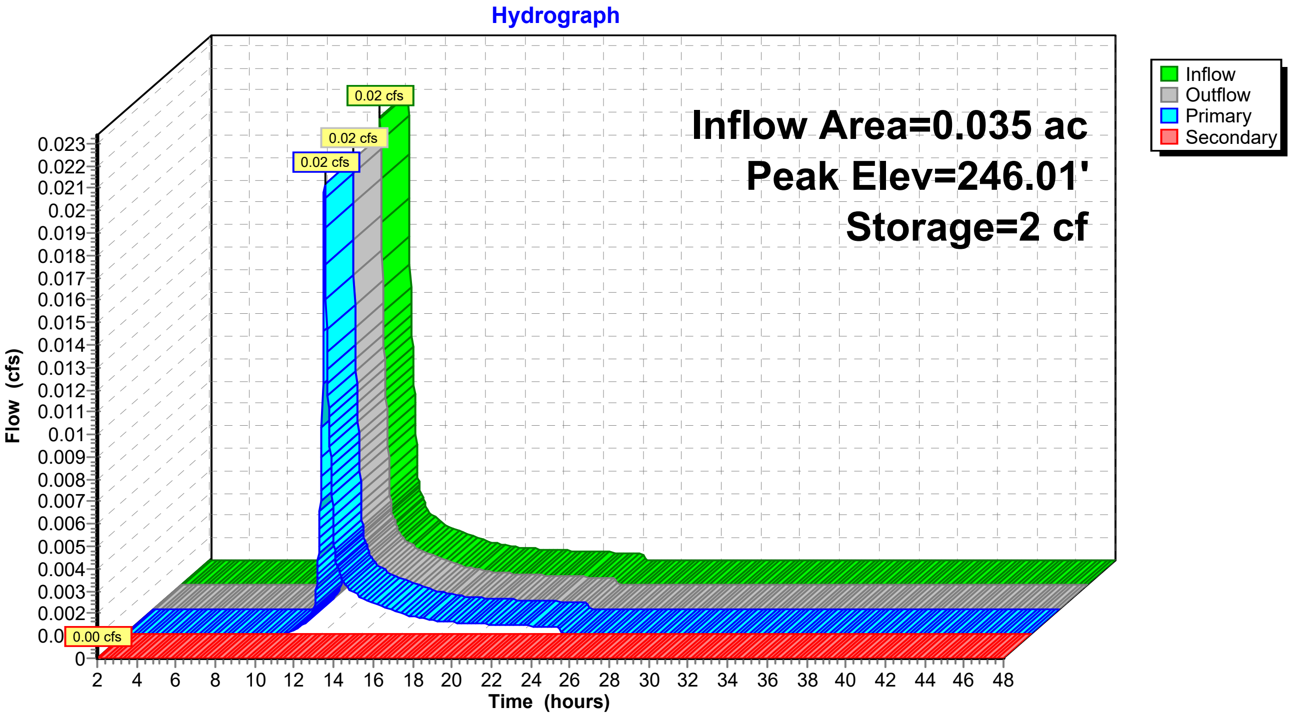
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.02 cfs @ 12.12 hrs HW=246.01' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=246.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 12P: BIORETENTION POOL



Summary for Pond 13P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 0.52" for WQv Event event
Inflow = 0.02 cfs @ 12.12 hrs, Volume= 0.002 af
Outflow = 0.02 cfs @ 12.17 hrs, Volume= 0.002 af, Atten= 15%, Lag= 3.5 min
Primary = 0.02 cfs @ 12.17 hrs, Volume= 0.002 af
Routed to Reach 15R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.03' @ 12.17 hrs Surf.Area= 391 sf Storage= 4 cf

Plug-Flow detention time= 4.3 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 4.3 min (857.0 - 852.7)

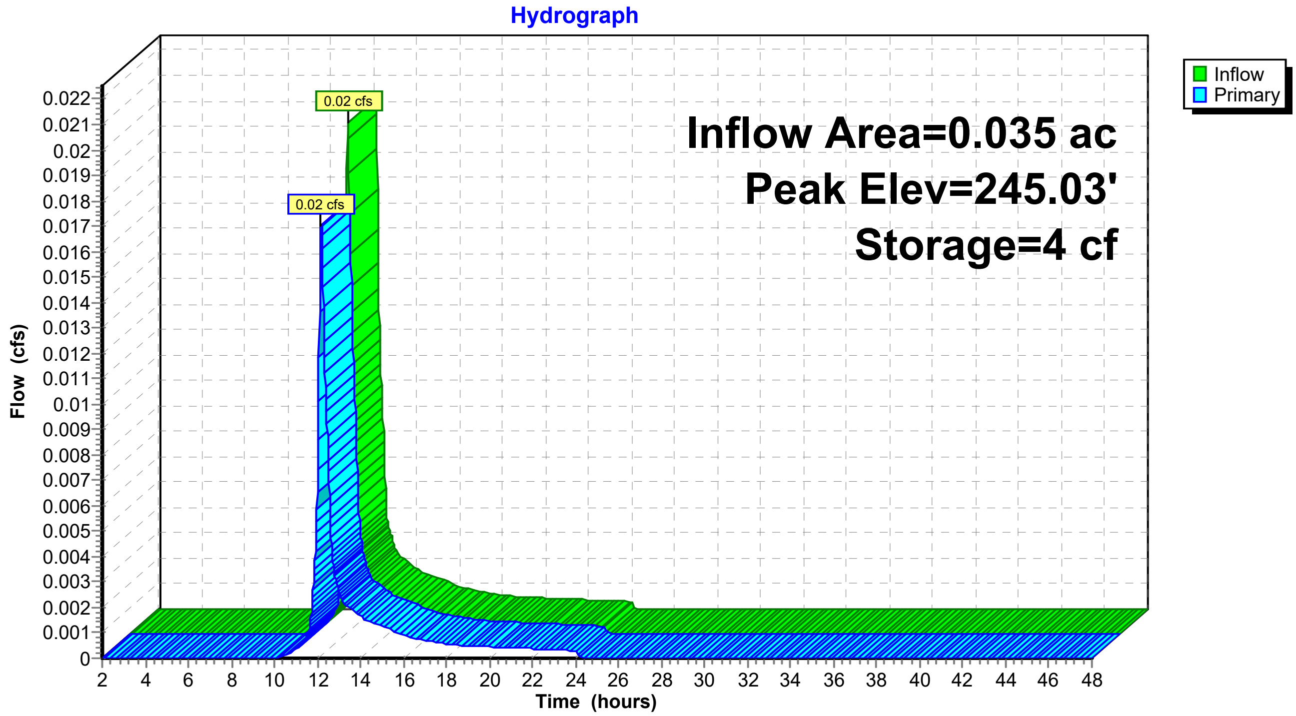
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 12.17 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 13P: DRY SWALE FILTER



Summary for Pond 14P: BIORETENTION POOL

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 0.52" for WQv Event event
Inflow = 0.02 cfs @ 12.09 hrs, Volume= 0.002 af
Outflow = 0.02 cfs @ 12.12 hrs, Volume= 0.002 af, Atten= 4%, Lag= 1.4 min
Primary = 0.02 cfs @ 12.12 hrs, Volume= 0.002 af
Routed to Pond 15P : DRY SWALE FILTER
Secondary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link AP-5 : Q

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 246.01' @ 12.12 hrs Surf.Area= 191 sf Storage= 2 cf

Plug-Flow detention time= 1.4 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 1.4 min (852.7 - 851.3)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	285 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

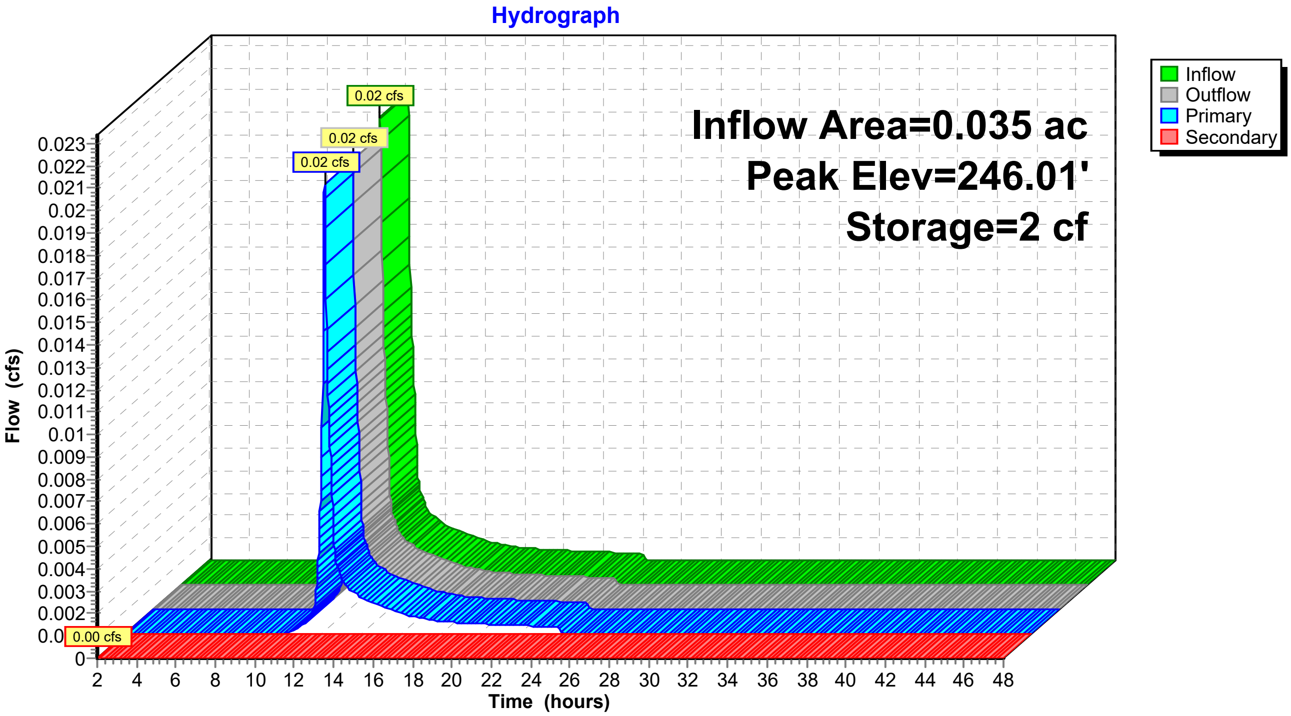
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
246.00	190	60.0	0	0	190
247.00	391	104.0	285	285	770

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**5.000 in/hr Exfiltration over Surface area**
#2	Secondary	246.50'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.02 cfs @ 12.12 hrs HW=246.01' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Secondary OutFlow Max=0.00 cfs @ 2.00 hrs HW=246.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 14P: BIORETENTION POOL



Summary for Pond 15P: DRY SWALE FILTER

Inflow Area = 0.035 ac, 52.71% Impervious, Inflow Depth = 0.52" for WQv Event event
Inflow = 0.02 cfs @ 12.12 hrs, Volume= 0.002 af
Outflow = 0.02 cfs @ 12.17 hrs, Volume= 0.002 af, Atten= 15%, Lag= 3.5 min
Primary = 0.02 cfs @ 12.17 hrs, Volume= 0.002 af
Routed to Reach 4R : UNDERDRAIN

Routing by Stor-Ind method, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs
Peak Elev= 245.03' @ 12.17 hrs Surf.Area= 391 sf Storage= 4 cf

Plug-Flow detention time= 4.3 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 4.3 min (857.0 - 852.7)

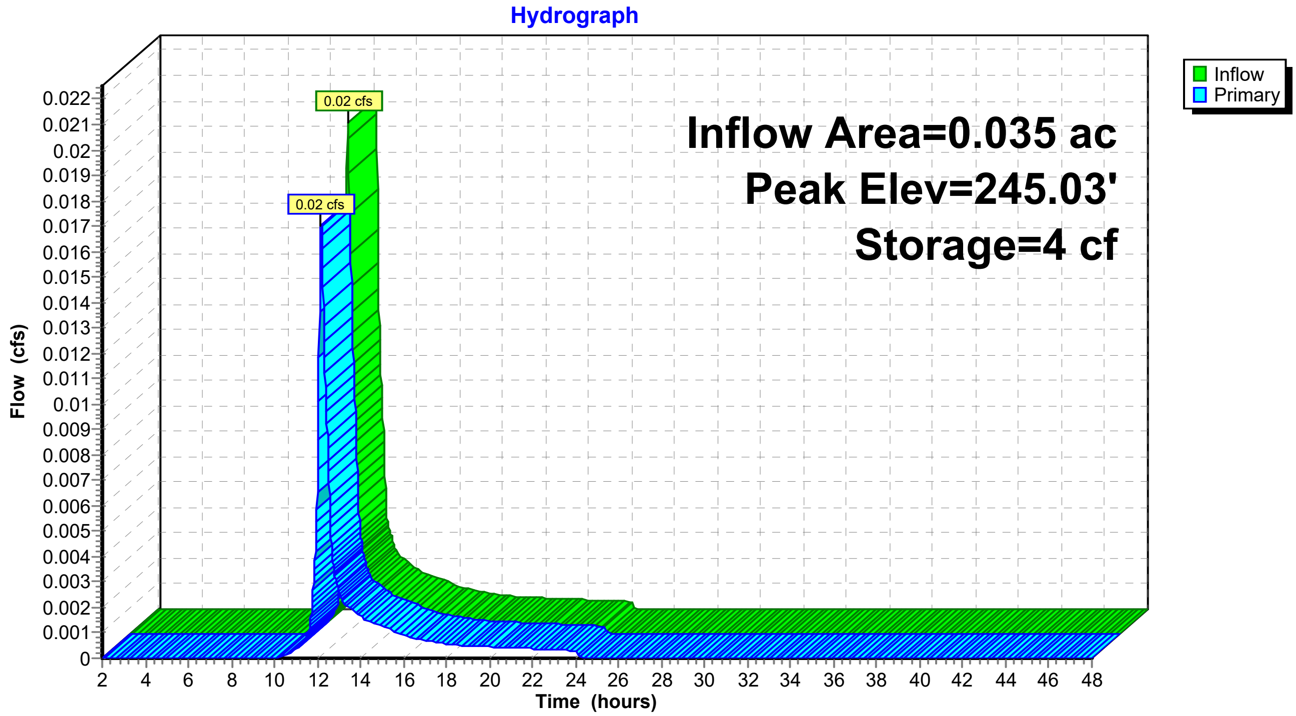
Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	469 cf	**Custom Stage Data (Irregular)** Listed below (Recalc) 1,173 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
245.00	391	104.0	0	0	391
248.00	391	104.0	1,173	1,173	703

Device	Routing	Invert	Outlet Devices
#1	Primary	244.50'	**6.0" Round Culvert** L= 40.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 244.50' / 242.50' S= 0.0500 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.20 sf
#2	Device 1	245.00'	**2.000 in/hr Exfiltration over Surface area**

Primary OutFlow Max=0.02 cfs @ 12.17 hrs HW=245.03' (Free Discharge)
└─**1=Culvert** (Passes 0.02 cfs of 0.50 cfs potential flow)
  └─**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond 15P: DRY SWALE FILTER

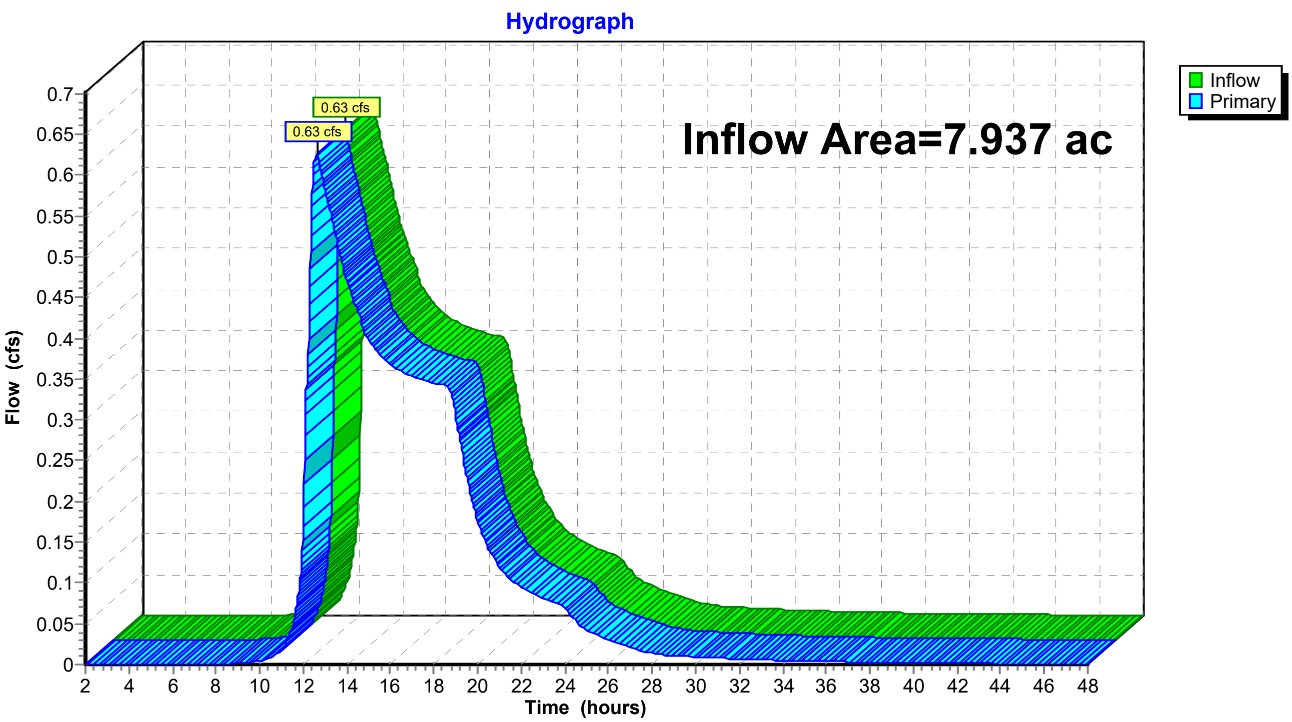


Summary for Link 1L: total 1

Inflow Area =	7.937 ac,	50.38% Impervious,	Inflow Depth > 0.48"	for WQv Event event
Inflow =	0.63 cfs @	12.62 hrs, Volume=	0.317 af	
Primary =	0.63 cfs @	12.62 hrs, Volume=	0.317 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link 1L: total 1

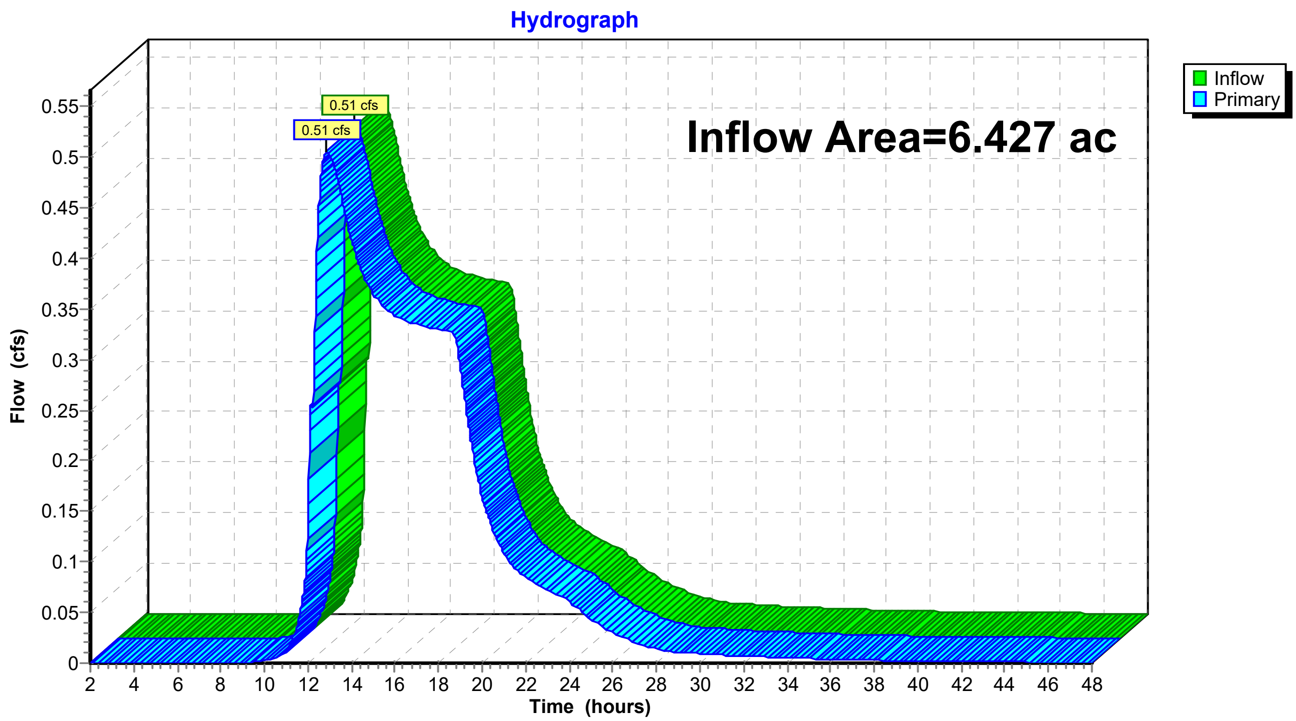


Summary for Link AP-1: Q

Inflow Area = 6.427 ac, 60.43% Impervious, Inflow Depth > 0.53" for WQv Event event
Inflow = 0.51 cfs @ 12.87 hrs, Volume= 0.285 af
Primary = 0.51 cfs @ 12.87 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

Link AP-1: Q



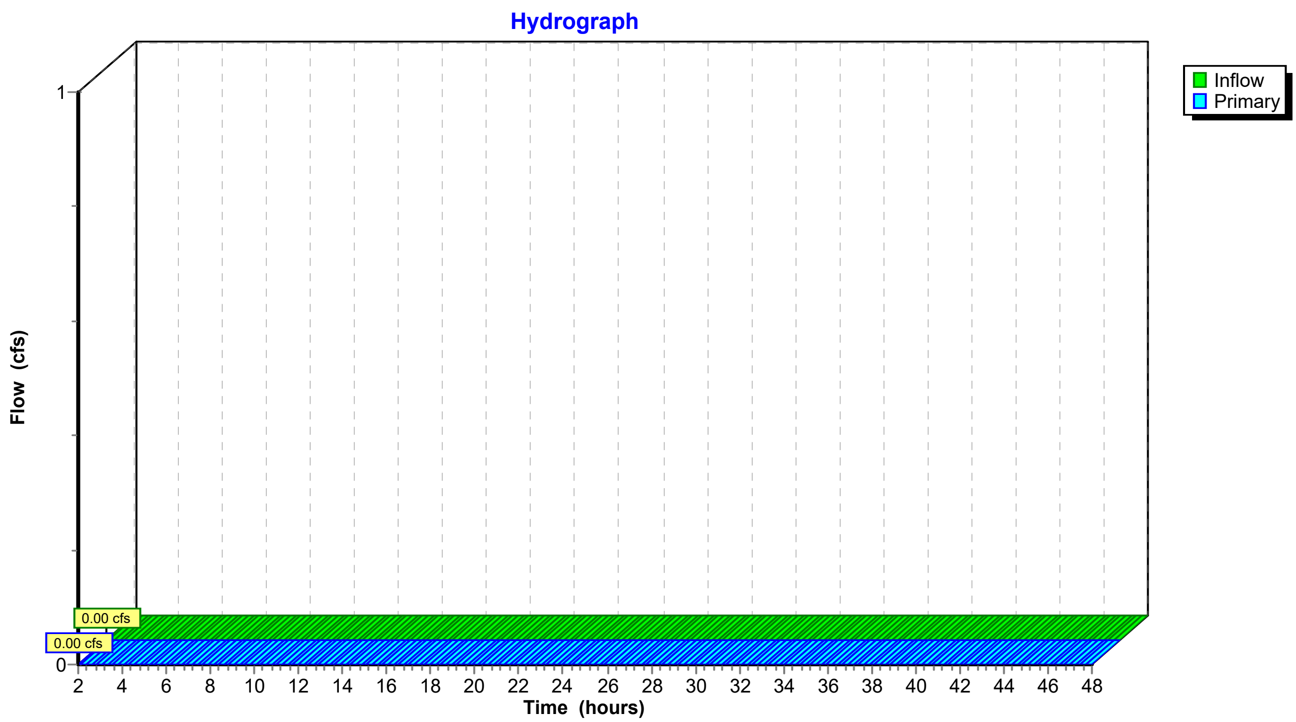
Summary for Link AP-2: Q

Inflow	=	0.00 cfs @	2.00 hrs,	Volume=	0.000 af
Primary	=	0.00 cfs @	2.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

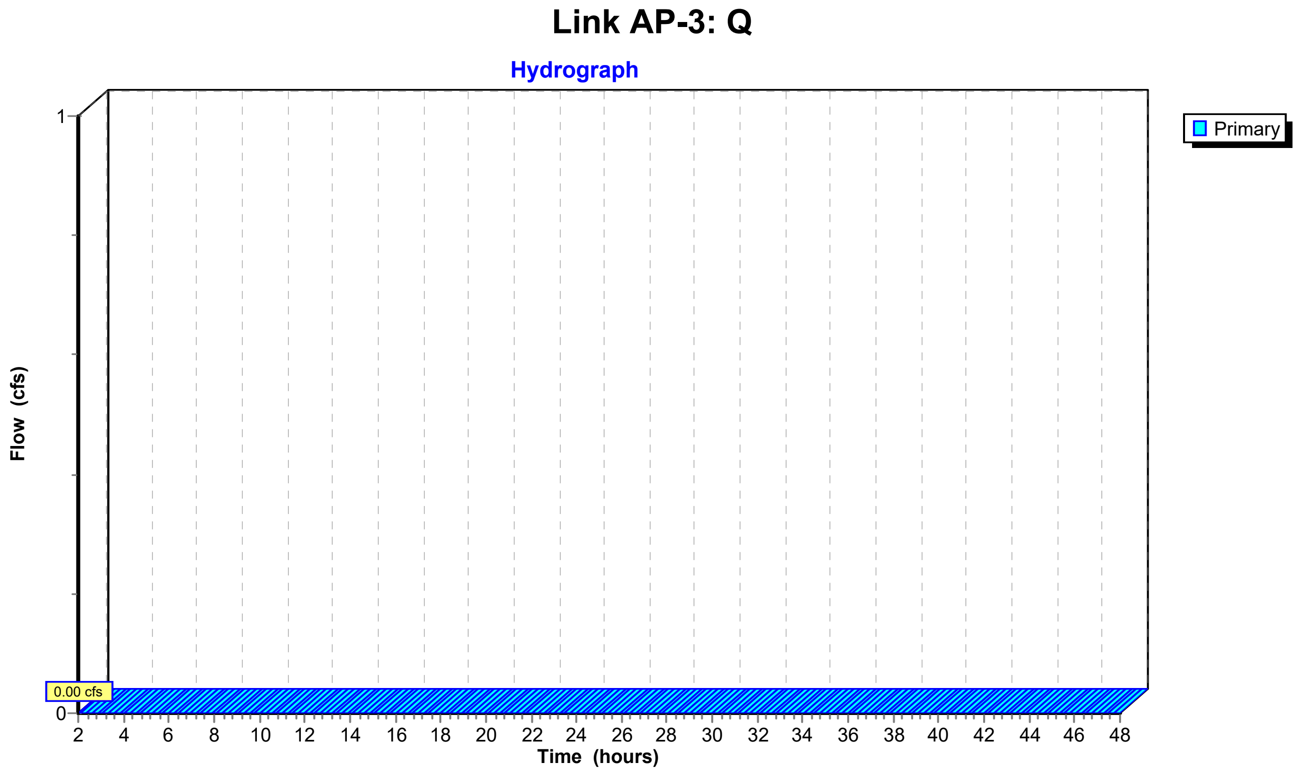
Link AP-2: Q



Summary for Link AP-3: Q

Primary = 0.00 cfs @ 2.00 hrs, Volume= 0.000 af
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs

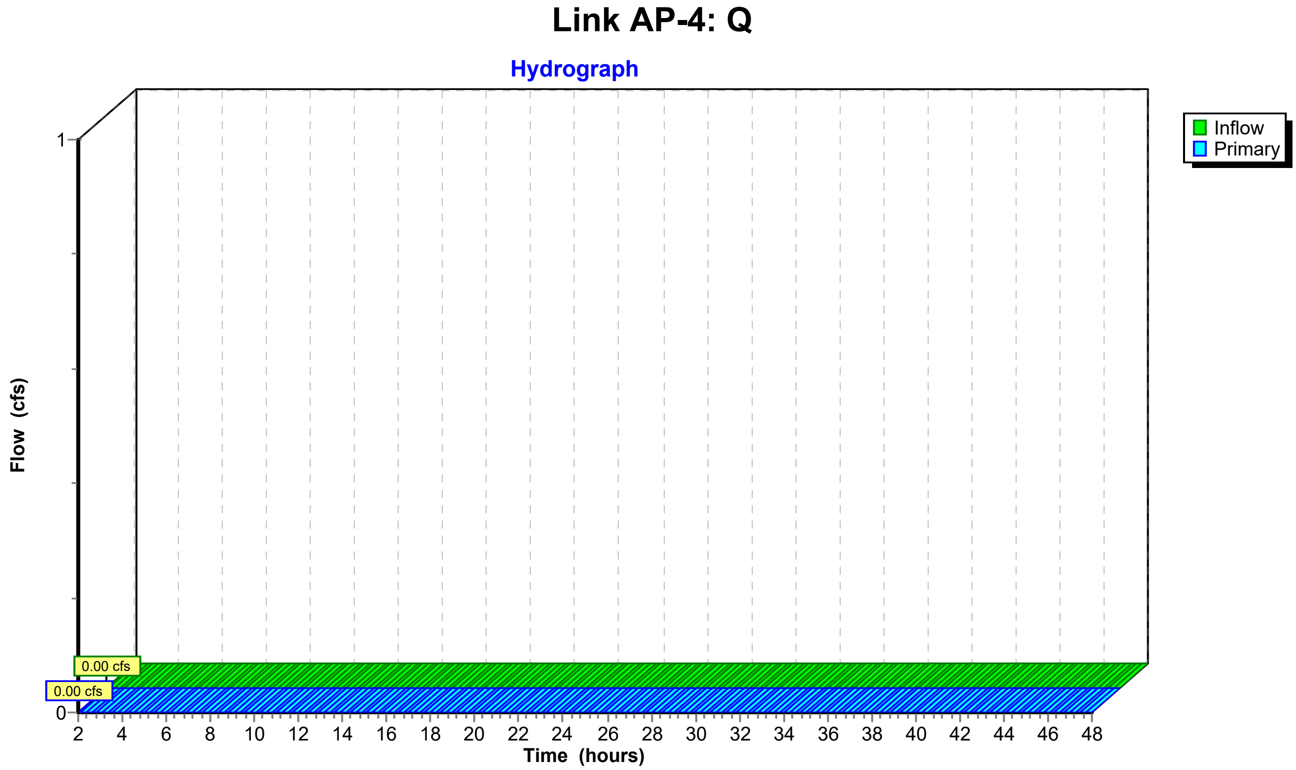


Summary for Link AP-4: Q

Inflow	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af
Primary	=	0.00 cfs @	2.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min

Routed to Link 1L : total 1

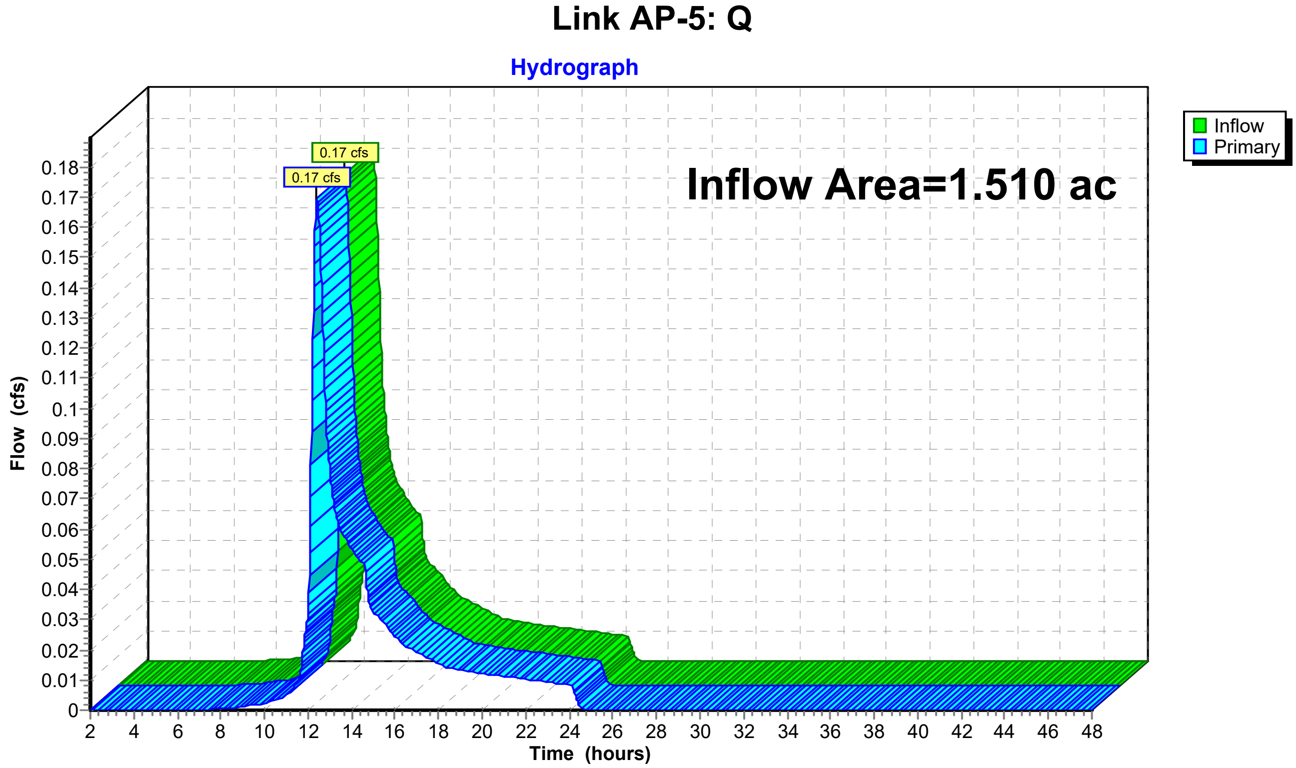
Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs



Summary for Link AP-5: Q

Inflow Area = 1.510 ac, 7.62% Impervious, Inflow Depth = 0.25" for WQv Event event
Inflow = 0.17 cfs @ 12.41 hrs, Volume= 0.032 af
Primary = 0.17 cfs @ 12.41 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min
Routed to Link 1L : total 1

Primary outflow = Inflow, Time Span= 2.00-48.00 hrs, dt= 0.02 hrs



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APPENDIX J: EXISTING & PROPOSED CONDITIONS DRAINAGE MAPS

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STATE OF NEW YORK · CHRISTOPHER J. LAPORTA · 102592 · LICENSED PROFESSIONAL ENGINEER

#	DATE	DESCRIPTION
1	3/22/2024	SED ADDENDUM #1

Drawn By:	MP
Checked By:	SK
Proj. #:	44-16-00-01-0-053-001
CSArch Proj. #:	108-2303
DD Submission:	1/29/2024

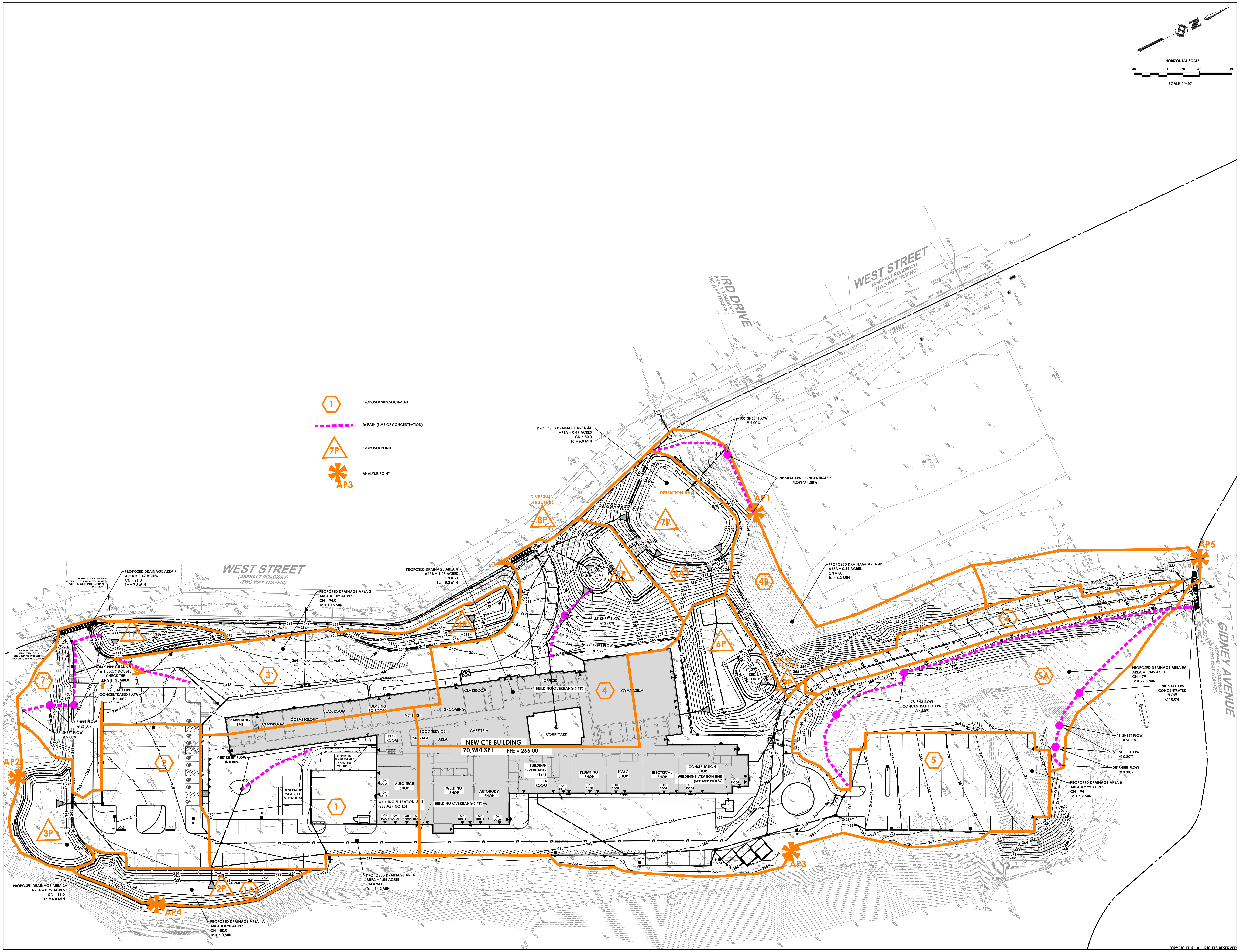
Sheet Title

EXISTING CONDITIONS DRAINAGE PLAN

Sheet No.

CTE ECD-1

DESIGN DEVELOPMENT



PASSERO engineering architecture
CSARCH
40 Beaver St. - Albany - New York 12207-1511
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Consultant

Project Title

NEWBURGH ENLARGED CITY SCHOOL DISTRICT
NEW CTE BUILDING
CTE NEWBURGH

#	DATE	DESCRIPTION
1	3/22/2024	SED ADDENDUM #1

Drawn By:	MP
Checked By:	SK
Proj. #:	44-16-00-01-0-053-001
CSArch Proj. #:	108-2303
DD Submission:	1/29/2024

Sheet Title

PROPOSED CONDITIONS DRAINAGE PLAN

Sheet No.

CTE PCD-1

DESIGN DEVELOPMENT

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APPENDIX K: WATER QUALITY CALCULATIONS

PASSERO

JOB	20223470.0003 CTE Building
SHEET NO.	1
OF	1
CALCULATED BY	PM
DATE	4/4/2024
CHECKED BY	
DATE	
SCALE	Water Quality Volume

Initial Water Quality Volume

WQv = [(P)(Rv)(A)]/12

Where:

Rv = 0.05 + 0.009(I)

I = impervious cover in percent

P = 90% rainfall (see Figure 4.1)

A = site area in acres

Location	Site Area (ac)	New Impervious Area (ac)	Replaced Impervious Area (ac)	% Impervious	Rv	Rainfall (P) (inches)	WQv (ac-ft)		cf
1	1.040	0.828		79.6%	0.77	1.35	0.090		3906.7
2	0.789	0.489		62.0%	0.61	1.35	0.054		2350
3	1.019	0.797		78.2%	0.75	1.35	0.086		3764.8
4	1.245	0.757		60.8%	0.60	1.35	0.084		3643.8
5	2.987	2.330		78.0%	0.75	1.35	0.253		11008
6	0.095	0.078		82.1%	0.79	1.35	0.008		367.29
7	0.471	0.167		35.5%	0.37	1.35	0.020		851.95
	7.646	5.446	0.000	71.2%	0.69	1.35	0.594		25893

RRV Provided= Subcatchments 1, 2, 3, 7 @100%, Subcatchments 4, 5 & 6 @40%	0.388
Remaining WQv treated in same practices as "standard practice"	0.207

PASSERO

JOB	20223470.0003 CTE Building
SHEET NO.	1 OF 4
CALCULATED BY	PM DATE 1/5/2024
CHECKED BY	xx DATE xx
SCALE	N.T.S.

Runoff Reduction Volume-For added impervious area

DA 7.646 acres **HSG** C **90% RAIN** 1.35 inch

1. **Planning (check all that apply)**

- [ ] Preserve undisturbed areas, natural buffer, and critical environmental areas
- [ ] Employ open space, conservation, clustering site design techniques
- [ ] Avoid developing in environmentally sensitive areas
- [ ] Minimize impervious surfaces, building footprints, parking, roads, walks and drives
- [ ] Minimize clearing and grading

PASSERO

2. **Water Quality Volume (before runoff reduction)** WQv=P*A*Rv/12 **WQv=** 0.594 af; 25892.772 cf

DA 7.646 acres **Impervious Area** 5.446 **Rv=** 0.691

3. **Minimum RRv Requirements** RRv=P*.95*S*AI/12

P= 1.35 inch **S=** 0.3 **AI=** 5.446 **RRv=** 0.175 af; 7606.12 cf

4. **Area Reduction Practices (check all that apply)**

Practice				
[ ] Conservation of natural areas	contributing AI=		Area=	ac
[ ] Riparian Buffers/filter strips	contributing AI=		Area=	ac
[ ] Tree Planting/Tree preservation	contributing AI=		Area=	ac
[ ] Total Area Reduction			0	ac
[ ] Total Impervious area within area reduction			0	ac

5. **Subtract total area reduction from DA**

Remaining drainage area: (#2-#4) 7.646 ac
Remaining impervious area: (#2 AI-#4 AI) 5.446 ac

6. **Recalculate WQv for site area remaining after area reductions:**

Remaining DA= 7.646
Remaining AI= 5.446
Rv= 0.691 Area reduced WQv= 0.594 af

7. **Runoff reduction volume (RRv) from #2: (#2 WQv-#6 WQv)=** **RRv=** 0.000 af

Rooftop Disconnect

8. **Incorporate rooftop area disconnection:**

Total disconnected rooftop area (now considered pervious for Rv calculation Area= 0.000 ac

9. **Recalculate WQv with Rv modified for impervious disconnect:**

DA from (#5) 7.646 **Remaining AI=** 5.446 **Rv=** 0.691 Rv reduced WQv= 0.594 af

10. **Runoff reduction volume: #6 (area reduced WQv) - #9 (Rv reduced WQv)=** RRv= 0.000 af
0 cf

Source Control WQv Treatment Practices (from attached worksheet)

11a. **Subtotal DA tributary to Source Control treatment practices=** 7.803 acres
11b. **Subtotal Source Control WQv Treatment Volume=** 0.388 af
11c. **Subtotal Runoff Reduction Volume (RRv)=** 0.388 af

TOTAL Runoff Reduction Volume (RRv)

12. **Total RRv provided (#7 + #10 + 11c) =** Total RRv= 0.388 af

13. **Is RRv (#12) $\geq$ original WQv (#2)** YES NO If yes, skip to #18

14. **Is RRv (#12) $\geq$ minimum WQv (#3)** YES NO If no, provide add'l RRV and recalculate

15. **Total drainage area treated with runoff reduction/source control practices=** 7.803 ac
(Area reduction from #4 + total DA tributary to source control #11a.)

16. **Is all of the watershed DA treated by either area reduction or source control practices?**
YES NO If yes, skip to #18

Standard WQv Treatment

17. **Provide treatment for any remaining untreated watershed DA with standard practices**

Remaining untreated DA=DA (#2)	7.646	ac	- treated DA (#15)	7.803	ac =	-0.157	ac
Remaining impervious=AI (#2)	5.446	ac	- treated AI (#11, #8, #4)	5.435	ac =	0.011	ac
Remaining DA =	-0.157	ac					
Remaining AI=	0.011	ac					
Rv=	0.051						
WQv=	0.044	af					

Standard WQv Treatment (Continued)

Ponds	WQv Provided	________	af	*Minimum Rv= 0.20
Wetlands	WQv Provided	________	af	
Infiltration	WQv Provided	________	af	
Filters	WQv Provided	________	af	
Open Channels	WQv Provided	________	af	

Peak Flow Attenuation

18. **Calculate peak runoff rates for pre-development site conditions**

DA= 0 ac RCN= 0 Tc (hours) 0.00

Q1=	0.00
Q10=	0.00
Q100=	0.00

19. **Calculate peak runoff rates for post-development site conditions with RRv (method used "HydroCAD")**

DA= 0 ac RCN= 0 Tc (hours) 0.000

Q1=	0.00
Q10=	0.00
Q100=	0.00

20. **Provide necessary stormwater volume detention for channel protection, overbank and extreme storm runoff to mitigate any increase in post-developed runoff from pre-developed conditions using:**

Ponds	CP vol	________	cf	OB vol	________	cf	ES vol	________	cf
Wetlands	CP vol	________	cf	OB vol	________	cf	ES vol	________	cf
Dry Detention	CP vol		cf	OB vol		cf	ES vol		cf
Underground storage	CP vol	________	cf	OB vol	________	cf	ES vol	________	cf
Blue roofs	CP vol	________	cf	OB vol	________	cf	ES vol	________	cf

11. SOURCE CONTROL WQv TREATMENT PRACTICES WORKSHEET

[x] Infiltration — **Allowable Reduction**

DA(ac)=	3.079	Rv=	0.725		100% of WQv=	0.251
AI (ac)=	2.31	WQv=	0.251			

[x] Bioretention — **Allowable Reduction**

DA(ac)=	4.724	Rv=	0.645	A/B soils	80% of WQv=	0.000
AI (ac)=	3.125	WQv=	0.343	C/D soils	40% of WQv=	0.137

[ ] Dry Swale — **Allowable Reduction**

DA(ac)=	0	Rv=	0.000	A/B soils	40% of WQv=	0.000
AI (ac)=	0	WQv=	0.000	C/D soils	20% of WQv=	0.000

[ ] Vegetated Swale — **Allowable Reduction**

DA(ac)=	0	Rv=	0.000	A/B soils	20% of WQv=	0.000
AI (ac)=	0	WQv=	0.000	C/D soils	10% of WQv=	0.000

[ ] Green Roof — **Allowable Reduction**

Roof=	0	Rv=	0.000		100% of WQv=	0.000
		WQv=	0.000			

[ ] Rain Garden — **Allowable Reduction**

Roof=	0	Rv=	0.000	A/B soils	100% of WQv=	0.000
		WQv=	0.000	C/D soils	40% of WQv=	0.000

[ ] Cisterns/Rain Barrels — **Allowable Reduction**

Roof=	0	Rv=	0.000	A/B soils	100% of WQv=	0.000
		WQv=	0.000	C/D soils	40% of WQv=	0.000

[ ] Stormwater Planters — **Allowable Reduction**

DA(ac)=	0	Rv=	0.000		100% of WQv=	0.000
AI (ac)=	0	WQv=	0.000			

[ ] Porous Pavement — **Allowable Reduction**

DA(ac)=	0	Rv=	0.000		100% of WQv=	0.000
AI (ac)=	0	WQv=	0.000			

11a.	**Subtotal DA tributary to Source Control WQv Treatment=**	7.803 ac		
11b.	**Subtotal Source Control WQv Treatment Volume=**	0.388 af		
11c.	**Subtotal of All Runoff Reduction Volume (RRv)=**		Subtotal RRv=	**0.388**

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APPENDIX L: STORM SEWER PIPE SIZING CALCULATIONS

Project:	Newburgh CTE
Project No:	20223470.0003
Date:	04/09/23
By:	MP
Sheet	1 of 3

STORM SEWER NETWORK CALCULATIONS

	Drainage Structure		Local				Upstream contribution			Total cA	Controlling Tc	I	Q (cfs)	Pipe			Length of pipe (ft.)	% slope	Diff. In INV	Capacity (cfs)	Ratio of liquid to dia of pipe	velocity (fps)	flow time (min)	Next Point	
	From	To	Tc	c	A	cA	From	Tc	cA					DIA (in)	MATL	n								To	Tc
CB	DS-01	DS-02	6.0 mins	0.7	0.06 ac	0.04				0.04	6.0	4.69	0.20	12	HDPE	0.012	22	0.30	0.00	2.12	0.21	1.69	0.2	DS-02	6.2
CB	DS-02	DS-03	6.0 mins	0.7	0.13 ac	0.09	DS-01	6.2	0.0	0.13	6.2	4.69	0.61	12	HDPE	0.012	39	0.30	0.00	2.12	0.36	2.30	0.3	DS-03	6.5

Project:	Newburgh CTE
Project No:	20223470.0003
Date:	04/09/23
By:	MP
Sheet	2 of 3

STORM SEWER NETWORK CALCULATIONS

	Drainage Structure		Local				Upstream contribution			Total cA	Controlling Tc	I	Q (cfs)	Pipe			Length of pipe (ft.)	% slope	Diff. In INV	Capacity (cfs)	Ratio of liquid to dia of pipe	velocity (fps)	flow time (min)	Next Point	
	From	To	Tc	c	A	cA	From	Tc	cA					DIA (in)	MATL	n								To	Tc
CB	DS-4	DS-5	6.0 mins	0.7	0.13 ac	0.09				0.09	6.0	4.69	0.44	12	HDPE	0.012	98	0.25	0.00	1.93	0.31	1.96	0.8	DS-5	6.8
CB	DS-5	DS-6	6.0 mins	0.7	0.03 ac	0.02	DS-4	6.8	0.1	0.11	6.8	4.69	0.53	12	HDPE	0.012	21	0.25	0.00	1.93	0.35	2.06	0.2	DS-6	7.0
CB	DS-6	DS-7	6.0 mins	0.7	0.31 ac	0.22	DS-5	7.0	0.1	0.33	7.0	4.69	1.54	12	HDPE	0.012	95	0.39	0.00	2.42	0.60	3.29	0.5	DS-7	7.5
CB	DS-8	DS-7	6.0 mins	0.7	0.16 ac	0.11	DS-6	7.5	0.3	0.44	7.5	4.69	2.06	12	HDPE	0.012	90	0.50	0.00	2.74	0.68	3.87	0.4	DS-7	7.9

Project:	Newburgh CTE
Project No:	20223470.0003
Date:	04/09/23
By:	MP
Sheet	2 of 3

STORM SEWER NETWORK CALCULATIONS

	Drainage Structure		Local				Upstream contribution			Total cA	Controlling Tc	I	Q (cfs)	Pipe			Length of pipe (ft.)	% slope	Diff. In INV	Capacity (cfs)	Ratio of liquid to dia of pipe	velocity (fps)	flow time (min)	Next Point	
	From	To	Tc	c	A	cA	From	Tc	cA					DIA (in)	MATL	n								To	Tc
CB	DS-9	DS-10	6.0 mins	0.7	0.60 ac	0.42				0.42	6.0	4.69	1.97	12	HDPE	0.012	80	0.50	0.00	2.74	0.65	3.84	0.3	DS-10	6.3
CB	DS-10	DS-11	6.0 mins	0.7	0.02 ac	0.02	DS-9	6.3	0.4	0.44	6.3	4.69	2.04	12	HDPE	0.012	108	0.50	0.00	2.74	0.67	3.87	0.5	DS-11	6.8
CB	DS-11	FES-11.1	6.0 mins	0.7	0.31 ac	0.22	DS-10	6.8	0.4	0.65	6.8	4.69	3.07	15	HDPE	0.012	5	0.50	0.00	4.96	0.58	4.30	0.0	FES-11.1	6.8

PA

Project: Newburgh CTE
Project No: 20223470.0003
Date: 04/09/23
By: MP
Sheet 2 of 3

STORM SEWER NETWORK CALCULATIONS

	Drainage Structure From	Drainage Structure To	Local Tc	Local c	Local A	Local cA	Upstream contribution From	Upstream contribution Tc	Upstream contribution cA	Total cA	Controlling Tc	I	Q (cfs)	Pipe DIA (in)	Pipe MATL	Pipe n	Length of pipe (ft.)	% slope	Diff. In INV	Capacity (cfs)	Ratio of liquid to dia of pipe	velocity (fps)	flow time (min)	Next Point To	Next Point Tc
CB	DS-12	DS-13	6.0 mins	0.7	0.12 ac	0.08				0.08	6.0	4.69	0.40	12	HDPE	0.012	98	1.00	0.00	3.87	0.23	3.27	0.5	DS-13	6.5
CB	DS-13	DS-14	6.0 mins	0.7	0.09 ac	0.06	DS-12	6.5	0.1	0.15	6.5	4.69	0.70	12	HDPE	0.012	21	1.00	0.00	3.87	0.28	3.69	0.1	DS-14	6.6
CB	DS-14	FES-14.1	6.0 mins	0.7		0.00	DS-13	6.6	0.1	0.15	6.6	4.69	0.70	15	HDPE	0.012	95	7.83	0.00	19.62	0.14	7.89	0.2	FES-14.1	6.8
CB	FES-14.1	DS-17	6.0 mins	0.4	0.39 ac	0.14	DS-14	6.8	0.1	0.29	6.8	4.69	1.34	15	HDPE	0.012	90	1.00	0.00	7.01	0.29	4.35	0.3	DS-17	7.1

Project:	Newburgh CTE
Project No:	20223470.0003
Date:	04/09/23
By:	MP
Sheet	2 of 3

STORM SEWER NETWORK CALCULATIONS

	Drainage Structure		Local				Upstream contribution			Tota l cA	Controlling Tc	I	Q (cfs)	Pipe			Length of pipe (ft.)	% slope	Diff. In INV	Capacity (cfs)	Ratio of liquid to dia of pipe	velocity (fps)	flow time (min)	Next Point	
	From	To	Tc	c	A	cA	From	Tc	cA					DIA (in)	MATL	n								To	Tc
CB	DS-34	DS-35	6.0 mins	0.7	0.06 ac	0.04				0.04	6.0	4.69	0.20	12	HDPE	0.012	64	0.50	0.00	2.74	0.18	2.01	0.5	DS-35	6.5
CB	DS-35	DS-36	6.0 mins	0.7	0.06 ac	0.04	DS-34	6.5	0.0	0.08	6.5	4.69	0.39	12	HDPE	0.012	43	0.50	0.00	2.74	0.26	2.48	0.3	DS-36	6.8
CB	DS-36	DS-37	6.0 mins	0.7	0.15 ac	0.11	DS-35	6.8	0.1	0.19	6.8	4.69	0.90	12	HDPE	0.012	143	0.50	0.00	2.74	0.38	3.08	0.8	DS-37	7.6
CB	DS-42	DS-37	6.0 mins	0.4	0.50 ac	0.17	DS-36	7.6	0.2	0.36	7.6	4.69	1.71	12	HDPE	0.012	103	0.79	0.00	3.44	0.50	4.38	0.4	DS-37	8.0

Project: Newburgh CTE
Project No: 20223470.0003
Date: 04/09/23
By: MP
Sheet 2 of 3

STORM SEWER NETWORK CALCULATIONS

	Drainage Structure		Local				Upstream contribution			Total cA	Controlling Tc	I	Q (cfs)	Pipe			Length of pipe (ft.)	% slope	Diff. In INV	Capacity (cfs)	Ratio of liquid to dia of pipe	velocity (fps)	flow time (min)	Next Point	
	From	To	Tc	c	A	cA	From	Tc	cA					DIA (in)	MATL	n								To	Tc
CB	DS-29	DS-27	6.0 mins	0.7	0.87 ac	0.61				0.61	6.0	4.69	2.85	12	HDPE	0.012	112	1.00	0.00	3.87	0.67	5.45	0.3	DS-27	6.3
CB	DS-28	DS-27	6.0 mins	0.7	0.02 ac	0.02	DS-29	6.3	0.6	0.62	6.3	4.69	2.93	12	HDPE	0.012	18	1.00	0.00	3.87	0.68	5.48	0.1	DS-27	6.4
CB	DS-27	DS-21	6.0 mins	0.7	0.19 ac	0.13	DS-28	6.4	0.6	0.76	6.4	4.69	3.55	15	HDPE	0.012	65	2.62	0.00	11.35	0.37	8.06	0.1	DS-21	6.5
CB	DS-24	DS-23	6.0 mins	0.4	0.11 ac	0.04	DS-27	6.5	0.8	0.80	6.5	4.69	3.74	12	HDPE	0.012	103	1.00	0.00	3.87	0.93	5.47	0.3	DS-23	6.8
CB	DS-23	DS-22	6.0 mins	0.4	0.46 ac	0.16	DS-24	6.8	0.8	0.96	6.8	4.69	4.49	12	HDPE	0.012	43	7.11	0.00	10.31	0.46	12.64	0.1	DS-22	6.9
CB	DS-26	DS-25	6.0 mins	0.7	0.02 ac	0.02				0.02	6.0	4.69	0.08	12	HDPE	0.012	64	1.52	0.00	4.77	0.12	2.70	0.4	DS-25	6.4
CB	DS-25	DS-38	6.0 mins	0.7	0.02 ac	0.02	DS-26	6.4	0.0	0.03	6.4	4.69	0.15	12	HDPE	0.012	19	2.28	0.00	5.83	0.13	3.49	0.1	DS-38	6.5
CB	DS-38	DS-22	6.0 mins	0.7	0.04 ac	0.03	DS-25	6.5	0.0	0.06	6.5	4.69	0.29	12	HDPE	0.012	24	1.68	0.00	5.01	0.16	3.49	0.1	DS-22	6.6
CB	DS-22	DS-21	6.0 mins	0.4	0.25 ac	0.09	DS-38	6.6	0.1	0.15	6.6	4.69	0.70	15	HDPE	0.012	88	1.00	0.00	7.01	0.21	3.61	0.4	DS-21	7.0
CB	DS-21	DS-20	6.0 mins	0.4	0.70 ac	0.24	DS-22	7.0	0.1	0.39	7.0	4.69	1.84	15	HDPE	0.012	124	1.00	0.00	7.01	0.34	4.73	0.4	DS-20	7.4
CB	DS-20	DS-41	6.0 mins	0.4	0.41 ac	0.14	DS-21	7.4	0.4	0.54	7.4	4.69	2.51	15	HDPE	0.012	57	2.66	0.00	11.44	0.31	7.35	0.1	DS-41	7.6
CB	DS-41	FES-41.1	6.0 mins	0.4	0.02 ac	0.01	DS-20	7.6	0.5	0.54	7.6	4.69	2.55	15	HDPE	0.012	176	7.41	0.00	19.09	0.25	10.88	0.3	FES-41.1	7.8

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APPENDIX M: CONSTRUCTION SITE INPECTION & MAINTENANCE LOG SHEETS

STATE POLLUTANT DISCHARGE ELIMINATION SYSTEM FOR CONSTRUCTION ACTIVITIES

Standardized Qualified Inspector Form

Project Name and Location of Project: ______________________ ______________________ ______________________ Municipality: ______________________ County: ______________________ Qualified Inspector: ______________________ Qualified Inspector Title: ______________________	Date: Permit #: **NYR10** Entry Time:	Weather: Exit Time:

5 Acre Waiver: □ Yes □ No

Name of SPDES Permittee: ______________________

Phone: ______________________ Fax: ______________________

Name of Representative on Site: ______________________

Qualified Inspector's Credentials & Certification

Qualified Inspector (QI) means a person that is knowledgeable in the principles and practices of erosion and sediment control (ESC). A person is considered qualified under the following conditions:

1. A licensed Professional Engineer; licensed Landscape Architect with documented training and education in the principles and practices of ESC;
2. An individual certified in ESC by CPESC, Incorporated or any other agency endorsed by the NYS Department of Environmental Conservation Office of Water Resources;
3. An individual working under the direct supervision of a qualified licensed Professional Engineer or qualified licensed Landscape Architect with documented training and education in the principles and practices of ESC **and has** completed the four (4) hour training program in the principles and practices of erosion and sediment control from either a Soil and Water Conservation District, CPESC or any other agency endorsed by the NYS Department of Environmental Conservation Office of Water Resources. This initial training must be completed no later than May 1, 2010. After receiving the initial training, an individual working under the direct supervision of a qualified licensed Professional Engineer or qualified licensed Landscape Architect must complete four (4) hours of training every three (3) years.
4. Any other individual endorsed by the NYS Department of Environmental Conservation by written documentation.
5. Inspections of any post-construction stormwater management practices that include structural components, such as a dam for an impoundment, shall be performed by a licensed Professional Engineer.1

Part I. CONSTRUCTION DURATION INSPECTIONS **Page 2 of _______**

a. **SITE PLAN/SKETCH OF AREAS DISTURBED AT TIME OF INSPECTION AND AREAS THAT HAVE BEEN STABILIZED (TEMPORARY OR FINAL) SINCE LAST INSPECTION**:

Part I. CONSTRUCTION DURATION INSPECTIONS **Page 3 of ______**

b. Other Permit Required Reporting

Maintaining Water Quality - *Attach Color Photographs of the site documenting discharge points and site conditions.*
Describe the condition of runoff at all points of discharge.
Is there an increase in turbidity causing a substantial visible contrast to natural conditions? ____________
Is there residue from oil and floating substances, visible oil film, or globules or grease? _______________
Is there evidence of silt deposition from project in a stream, wetland, or other water body? ____________
If yes, where? __________________________________remedial measure needed? __________________
Provide a description of the conditions of all natural water bodies within or immediately adjacent to the project. ____

Area of Disturbance
Total area of disturbance (as shown on sketch plan and not including areas that have temporary or permanent stabilization measures applied) ____
Are all disturbances within the limits of the SWPPP? ____

Weather Conditions
A description of the weather and soil conditions (e.g. dry, wet, saturated) at the time of the inspection;
____
____

General Housekeeping
Are facilities and equipment necessary for implementation of erosion and sediment control in working order and/or properly maintained?____
Is construction impacting the adjacent property? ____
Is dust adequately controlled?____
Describe corrective action(s): ____
Date correction needed: ____

c. Runoff Controls *Direct runoff away from exposed soil surfaces and control water that falls onto the site*

Runoff conveyance systems ☐ N A
Are all runoff conveyance systems called for in the SWPPP installed, stabilized and working? _________
If not, what specific areas need detailing?____
With minimum side slopes 2H:1V or flatter? _______ Stabilized by geotextile fabric, seed, or mulch with no erosion occurring? _______Sediment-laden runoff directed to sediment trapping structure? ____________
Describe corrective action(s): ____
Date correction needed: ____

Runoff Control Structures ☐ N A
Have all required runoff control structures (rock outlets and aprons) been installed and constructed per plan and according to the Blue Book?____________ Installed concurrently with pipe installation? ____________
Describe corrective action(s): ____
Date correction needed: ____

Temporary Stream or Channel Crossing ☐ N A
Have construction crossings at concentrated flow areas been culverted?_____________________________
Describe corrective action(s): ____
Date correction needed: ____

Stone Check Dam ☐ N A
Installed per standards? __________ channel stable (flow is not eroding soil underneath or around the structure). ________does sediment need to be removed? ____
Describe corrective action(s): ____
Date correction needed: ____

Excavation Dewatering ☐ N A
1. Flowing water ☐ N A – Upstream berm (sandbags, inflatable dams, etc. with one-foot minimum freeboard) and downstream berms are installed per plan? _______and functioning? (clean water from upstream pool is being pumped to the downstream pool)?
____
2. Sediment laden water from work area ☐ N A - Is being discharged to a silt-trapping device? ___________
3. Groundwater from excavations ☐ N A - is being managed properly (sumps and sediment control)? ______
Describe corrective action(s): ____
Date correction needed: ____

d. Soil Stabilization *Basic erosion control is achieved by covering all bare ground areas.*

Topsoil and Spoil Stockpiles ☐ N A
Stabilized - sediment controls at downhill slope? ____
Describe corrective action(s): ____
Date correction needed: ____

Revegetation/Stabilization ☐ N A
Has temporary or permanent seeding *and* mulch (as shown on site sketch plan) been applied to areas that have been inactive for 14 days or less (or, inactive for 7 days if over 5 acres disturbed)?______________________
Has soil preparation been applied as specified in the SWPPP and in accordance with the Blue Book (Assure that all the necessary soil testing/fertilizer/lime, topsoil, decompaction has been applied)?
____
Have rolled erosion control products specified for steep slopes or channels been installed? _______________
Describe corrective action(s): ____
Date correction needed: ____

e. Sediment Controls

Stabilized Construction Entrance ☐ N A
Stone is clean and all access areas covered (entrances, construction routes, materials storage areas, equipment parking)?_________________ Tracking onto public streets is minimized and cleaned daily? _____________
Describe:____
Date correction needed: ____

Silt Fence ☐ N A

Installed on contour? not across conveyance channels?__________ At least 10 feet from toe of slope?_____________At appropriate spacing intervals based on slope?________Wrapped ends for continuous support?___________Fabric is tight, without rips or frayed areas?__________Posts are stable?____________ buried 6 inches minimum?_________Any "bulges"?____________________________
Describe:____
____
Date correction needed: ____

Temporary Sediment Trap ☐ N A

Is outlet structure constructed properly?__________geotextile fabric has been placed beneath rock fill?_____________Maintenance – depth of sediment in basin? ____________ 50% capacity? ____________
Describe:____
____
Date correction needed: ____

Temporary Sediment Basin ☐ N A

Is basin and outlet structure constructed per the approved plan? _________________________________
Are basin side slopes stabilized with seed/mulch?
____
Maintenance – depth of sediment in basin? ____________ 50% capacity?
____
Describe:____
____
Date correction needed: ____

Drop Inlet Protection ☐ N A

Type(s) of inlet control? ____
Installed per Blue Book specifications: drainage area (typically 1 acre)? ______________________________
Appropriate for location? ____
Describe:____
____
Date correction needed: ____

f. Digital Color Photographs of Deficient BMPs

The *qualified inspector* shall attach paper color copies of the digital photographs to this inspection report of deficient BMPs with date stamp, that clearly show the condition of all practices that have been identified as needing corrective actions.

g. Digital Color Photographs of BMPs that have been Corrected

The *qualified inspector* shall attach paper color copies of the digital photographs to this inspection report of corrected BMPs with date stamp, that clearly show the condition of the practice(s) after the corrective actions has been completed.

h. Post-Construction Stormwater Management

Report of any corrective action(s) that must be taken to install, correct, repair, replace or maintain any deficiencies identified with the construction of the post-construction stormwater management practice(s).

Report the current phase of construction of all post-construction stormwater management practice(s) and whether the installation appears to be geometrically consistent with the approved hydraulic design (e.g. the pond, the outlet structure, orifice, pipe sizing and slope is geometrically consistent with the SWPPP):___________________________________

____
____
____

i. Revisions to SWPPP

When the owner or operator becomes aware that they failed to submit any relevant facts, or submitted incorrect information in the NOI or in any other report, or have made substantive revisions to the SWPPP (e.g. the scope of the project changes significantly, the type of post-construction stormwater management practice(s) changes, there is a reduction in the sizing of the post-construction stormwater management practice, or there is an increase in the disturbance area or impervious area) which were not reflected in the original NOI submitted to the Department and/or the MS4, they shall promptly submit such facts or information. Failure of the owner or operator to correct or supplement any relevant facts within five (5) business days of becoming aware of the deficiency shall constitute a permit violation (GP-0-10-001 PartVII.G)

____
____
____
____

j. Inspection Notes and Signature

Inspection Notes:

____
____
____
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____

PART I. j. Signature

GP-0-10-001 Part VII.Q

Articles 175 and 210 of the New York State Penal Law provide for Criminal penalty of a fine and/or imprisonment for falsifying forms and reports required by this permit.

____ _________________________________

Qualified Inspector (print name) **Date of Inspection**

____

Signature

The above signed acknowledges that, to the best of his/her knowledge, all information provided on the forms is accurate and complete.

Title: __________________________________ Address: _______________________________

Phone: _______________________ Email: ____

CPESC#: ___________________________________

Stormwater Training Number for *Trained Individuals*: ___________________________________

P.E. or L.A. Supervisor Name for *Trained Individuals*:______________________________________

Compliance certification:

Received and reviewed by_________________________________Title:__________________________

The above signed acknowledges receipt of this inspection report

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APPENDIX N: ELECTRONIC NOTICE OF INTENT

NOI for coverage under Stormwater General Permit for Construction Activity

version 1.37

(Submission #: HQ2-SFFG-2Y4KZ, version 1)

Details

Originally Started By	Patrick Mitchell
Alternate Identifier	Newburgh ECSD 2019 Capital Improvements Project CTE Building
Submission ID	HQ2-SFFG-2Y4KZ
Submission Reason	New
Status	Draft

Form Input

Owner/Operator Information

Owner/Operator Name (Company/Private Owner/Municipality/Agency/Institution, etc.)
Newburgh Enlarged School District

Owner/Operator Contact Person Last Name (NOT CONSULTANT)
Campbell

Owner/Operator Contact Person First Name
Jackielyn

Owner/Operator Mailing Address
124 Grand Street

City
Newburgh

State
NY

Zip
12550

Phone
845-563-3500

Email
jmanningcampbell@necsd.com

Federal Tax ID
N/A

> If the owner/operator is an organization, provide the Federal Tax ID number, or Employer Identification Number (EIN), in the format xx-xxxxxxx. If the owner/operator is an individual and not an organization, enter "Not Applicable" or "N/A" and do not provide the individual's social security number.

Project Location

Project/Site Name
Newburgh ECSD 2019 Capital Improvements Project CTE Building

Street Address (Not P.O. Box)
220 West Street

Side of Street
East

City/Town/Village (THAT ISSUES BUILDING PERMIT)
Newburgh

State
NY

Zip
12550

DEC Region
3

> The DEC Region must be provided. Please use the NYSDEC Stormwater Interactive Map (https://gisservices.dec.ny.gov/gis/stormwater/) to confirm which DEC Region this site is located in. To view the DEC Regions, click on "Other Useful Reference Layers" on the left side of the map, then click on "DEC Administrative Boundary." Zoom out as needed to see the Region boundaries.
> For projects that span multiple Regions, please select a primary Region and then provide the additional Regions as a note in Question 39.

County
ORANGE

Name of Nearest Cross Street
Gidney Avenue

Distance to Nearest Cross Street (Feet)
0

Project In Relation to Cross Street
South

Tax Map Numbers Section-Block-Parcel
331100-6-5-18

Tax Map Numbers
N/A

> If the project does not have tax map numbers (e.g. linear projects), enter "Not Applicable" or "N/A".

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
41.51062112719063,-74.02788286295166

Project Details

2. What is the nature of this project?
Redevelopment with increase in impervious area

> For the purposes of this eNOI, "New Construction" refers to any project that does not involve the disturbance of existing impervious area (i.e. 0 acres). If existing impervious area will be disturbed on the project site, it is considered redevelopment with either increase in impervious area or no increase in impervious area.

3. Select the predominant land use for both pre and post development conditions.

Pre-Development Existing Landuse
Institutional/School

Post-Development Future Land Use
Institutional/School

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)
65.0

Total Area to be Disturbed (acres)
9.8

Existing Impervious Area to be Disturbed (acres)
0.2

Future Impervious Area Within Disturbed Area (acres)
5.7

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 (%)
0

C (%)
100

D (%)
0

7. Is this a phased project?
No

8. Enter the planned start and end dates of the disturbance activities.

Start Date
06/30/2024

End Date
09/01/2025

9. Identify the nearest surface waterbody(ies) to which construction site runoff will discharge.
Hudson River

> Drainage ditches and storm sewer systems are not considered surface waterbodies. Please identify the surface waterbody that they discharge to. If the nearest surface waterbody is unnamed, provide a description of the waterbody, such as, “Unnamed tributary to Niagara River.”

9a. Type of waterbody identified in question 9?
River Off Site

Other Waterbody Type Off Site Description
NONE PROVIDED

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?
No

12. Is the project located in one of the watershed areas associated with AA and AA-S classified waters?
No

> Please use the DEC Stormwater Interactive Map (https://gisservices.dec.ny.gov/gis/stormwater/) to confirm if this site is located in one of the watersheds of an AA or AA-S classified water. To view the watershed areas, click on “Permit Related Layers” on the left side of the map, then click on “Class AA AAS Watersheds.”

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 D (provided the map unit name is inclusive of slopes greater than 25%), 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?
City of Newburgh

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?
No

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)?
Yes

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?
Yes

24. The Stormwater Pollution Prevention Plan (SWPPP) was prepared by:
Professional Engineer (P.E.)

SWPPP Preparer
Passero Associates

Contact Name (Last, First)
LaPorta, Chris

Mailing Address
6 Front Street

City
Newburgh

State
NY

Zip
12550

Phone
845-328-1808

Email
claporta@passero.com

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

> swppp preparer certification form-signed.pdf - 04/20/2023 02:44 PM
> **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
Silt Fence
Stabilized Construction Entrance
Construction Road Stabilization
Dust Control
Check Dams
Sediment Basin
Storm Drain Inlet Protection

Biotechnical
None

Vegetative Measures
Mulching
Protecting Vegetation
Seeding
Topsoiling

Permanent Structural
Diversion
Land Grading
Rock Outlet Protection

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.
Preservation of Undisturbed Area
Preservation of Buffers
Reduction of Clearing and Grading
Locating Development in Less Sensitive Areas
Driveway Reduction
Building Footprint Reduction

27a. Indicate which of the following soil restoration criteria was used to address the requirements in Section 5.1.6("Soil Restoration") of the Design Manual (2010 version).
All disturbed areas will be restored in accordance with the Soil Restoration requirements in Table 5.3 of the Design Manual (see page 5-22).

28. Provide the total Water Quality Volume (WQv) required for this project (based on final site plan/layout). (Acre-feet)
0.594

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)
0.388

31. Is the Total RRv provided (#30) greater than or equal to the total WQv required (#28)?
No

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)
.175

32a. Is the Total RRv provided (#30) greater than or equal to the Minimum RRv Required (#32)?
Yes

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)
.207

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).
.595

35. Is the sum of the RRv provided (#30) and the WQv provided (#33a) greater than or equal to the total WQv required (#28)?
Yes

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)
.901

CPv Provided (acre-feet)
1.13

36a. The need to provide channel protection has been waived because:
Reduction of the total CPv is achieved on site through runoff reduction techniques or infiltration systems.

37. Provide the Overbank Flood (Qp) and Extreme Flood (Qf) control criteria or select waiver (#37a), if applicable.

Overbank Flood Control Criteria (Qp)

Pre-Development (CFS)
18.15

Post-Development (CFS)
13.11

Total Extreme Flood Control Criteria (Qf)

Pre-Development (CFS)
41.33

Post-Development (CFS)
25.6

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?
Yes

If Yes, Identify the entity responsible for the long term Operation and Maintenance
Owner

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.
Total treatment using RRV techniques could not be met due to the poor soils onsite at the low points.

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)
0

Total Contributing Impervious Acres for Conservation of Natural Area (RR-1)
0

Total Contributing Acres for Sheetflow to Riparian Buffers/Filter Strips (RR-2)
0

Total Contributing Impervious Acres for Sheetflow to Riparian Buffers/Filter Strips (RR-2)
0

Total Contributing Acres for Tree Planting/Tree Pit (RR-3)
0

Total Contributing Impervious Acres for Tree Planting/Tree Pit (RR-3)
0

Total Contributing Acres for Disconnection of Rooftop Runoff (RR-4)
0

RR Techniques (Volume Reduction)

Total Contributing Impervious Acres for Disconnection of Rooftop Runoff (RR-4)
0

Total Contributing Impervious Acres for Vegetated Swale (RR-5)
.08

Total Contributing Impervious Acres for Rain Garden (RR-6)
0

Total Contributing Impervious Acres for Stormwater Planter (RR-7)
0

Total Contributing Impervious Acres for Rain Barrel/Cistern (RR-8)
0

Total Contributing Impervious Acres for Porous Pavement (RR-9)
0

Total Contributing Impervious Acres for Green Roof (RR-10)
0

Standard SMPs with RRv Capacity

Total Contributing Impervious Acres for Infiltration Trench (I-1)
0

Total Contributing Impervious Acres for Infiltration Basin (I-2)
2.281

Total Contributing Impervious Acres for Dry Well (I-3)
0

Total Contributing Impervious Acres for Underground Infiltration System (I-4)
0

Total Contributing Impervious Acres for Bioretention (F-5)
3.087

Total Contributing Impervious Acres for Dry Swale (O-1)
.078

Standard SMPs

Total Contributing Impervious Acres for Micropool Extended Detention (P-1)
0

Total Contributing Impervious Acres for Wet Pond (P-2)
0

Total Contributing Impervious Acres for Wet Extended Detention (P-3)
0

Total Contributing Impervious Acres for Multiple Pond System (P-4)
0

Total Contributing Impervious Acres for Pocket Pond (P-5)
0

Total Contributing Impervious Acres for Surface Sand Filter (F-1)
0

Total Contributing Impervious Acres for Underground Sand Filter (F-2)
0

Total Contributing Impervious Acres for Perimeter Sand Filter (F-3)
0

Total Contributing Impervious Acres for Organic Filter (F-4)
0

Total Contributing Impervious Acres for Shallow Wetland (W-1)
0

Total Contributing Impervious Acres for Extended Detention Wetland (W-2)
0

Total Contributing Impervious Acres for Pond/Wetland System (W-3)
0

Total Contributing Impervious Acres for Pocket Wetland (W-4)
0

Total Contributing Impervious Acres for Wet Swale (O-2)
0

Alternative SMPs (DO NOT INCLUDE PRACTICES BEING USED FOR PRETREATMENT ONLY)

Total Contributing Impervious Area for Hydrodynamic
0

Total Contributing Impervious Area for Wet Vault
0

Total Contributing Impervious Area for Media Filter
0

"Other" Alternative SMP?
0

Total Contributing Impervious Area for "Other"
0

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.
HP9-VW17-Y9WNB

MS4 SWPPP Acceptance

43. Is this project subject to the requirements of a regulated, traditional land use control MS4?
No

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
Owner Certification-signed.pdf - 04/20/2023 12:35 PM
Comment
NONE PROVIDED

Attachments

Date	Attachment Name	Context	User
4/20/2023 2:44 PM	swppp preparer certification form-signed.pdf	Attachment	Patrick Mitchell

Date	Attachment Name	Context	User
4/20/2023 12:35 PM	Owner Certification-signed.pdf	Attachment	Patrick Mitchell

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APPENDIX O: NOTICE OF TERMINATION

New York State Department of Environmental Conservation
Division of Water
625 Broadway, 4th Floor
Albany, New York 12233-3505
(NOTE: Submit completed form to address above)

NOTICE OF TERMINATION for Storm Water Discharges Authorized under the SPDES General Permit for Construction Activity

Please indicate your permit identification number: NYR ___ ___ ___ ___ ___ ___

I. Owner or Operator Information

1. Owner/Operator Name:

2. Street Address:

3. City/State/Zip:

4. Contact Person: | 4a.Telephone:

4b. Contact Person E-Mail:

II. Project Site Information

5. Project/Site Name:

6. Street Address:

7. City/Zip:

8. County:

III. Reason for Termination

9a. □ All disturbed areas have achieved final stabilization in accordance with the general permit and SWPPP. ***Date final stabilization completed** (month/year): ________________________________

9b. □ Permit coverage has been transferred to new owner/operator. Indicate new owner/operator's permit identification number: NYR ____ ____ ____ ____ ____ ____
(Note: Permit coverage can not be terminated by owner identified in I.1. above until new owner/operator obtains coverage under the general permit)

9c. □ Other (Explain on Page 2)

IV. Final Site Information:

10a. Did this construction activity require the development of a SWPPP that includes post-construction stormwater management practices? □ yes □ no (If no, go to question 10f.)

10b. Have all post-construction stormwater management practices included in the final SWPPP been constructed? □ yes □ no (If no, explain on Page 2)

10c. Identify the entity responsible for long-term operation and maintenance of practice(s)?

____

NOTICE OF TERMINATION for Storm Water Discharges Authorized under the SPDES General Permit for Construction Activity - continued

10d. Has the entity responsible for long-term operation and maintenance been given a copy of the operation and maintenance plan required by the general permit? □ yes □ no

10e. Indicate the method used to ensure long-term operation and maintenance of the post-construction stormwater management practice(s):

□ Post-construction stormwater management practice(s) and any right-of-way(s) needed to maintain practice(s) have been deeded to the municipality.

□ Executed maintenance agreement is in place with the municipality that will maintain the post-construction stormwater management practice(s).

□ For post-construction stormwater management practices that are privately owned, a mechanism is in place that requires operation and maintenance of the practice(s) in accordance with the operation and maintenance plan, such as a deed covenant in the owner or operator's deed of record.

□ For post-construction stormwater management practices that are owned by a public or private institution (e.g. school, university or hospital), government agency or authority, or public utility; policy and procedures are in place that ensures operation and maintenance of the practice(s) in accordance with the operation and maintenance plan.

10f. Provide the total area of impervious surface (i.e. roof, pavement, concrete, gravel, etc.) constructed within the disturbance area? ______________________________ (acres)

11. Is this project subject to the requirements of a regulated, traditional land use control MS4? □ yes □ no

(If Yes, complete section VI - "MS4 Acceptance" statement

V. Additional Information/Explanation:

(Use this section to answer questions 9c. and 10b., if applicable)

VI. MS4 Acceptance - MS4 Official (principal executive officer or ranking elected official) or Duly Authorized Representative (Note: Not required when 9b. is checked -transfer of coverage)

I have determined that it is acceptable for the owner or operator of the construction project identified in question 5 to submit the Notice of Termination at this time.

Printed Name:	
Title/Position:	
Signature:	Date:

NOTICE OF TERMINATION for Storm Water Discharges Authorized under the SPDES General Permit for Construction Activity - continued

VII. Qualified Inspector Certification - Final Stabilization:

I hereby certify that all disturbed areas have achieved final stabilization as defined in the current version of the general permit, and that all temporary, structural erosion and sediment control measures have been removed. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:	
Title/Position:	
Signature:	Date:

VIII. Qualified Inspector Certification - Post-construction Stormwater Management Practice(s):

I hereby certify that all post-construction stormwater management practices have been constructed in conformance with the SWPPP. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:	
Title/Position:	
Signature:	Date:

IX. Owner or Operator Certification

I hereby certify that this document was prepared by me or under my direction or supervision. My determination, based upon my inquiry of the person(s) who managed the construction activity, or those persons directly responsible for gathering the information, is that the information provided in this document is true, accurate and complete. Furthermore, I understand that certifying false, incorrect or inaccurate information is a violation of the referenced permit and the laws of the State of New York and could subject me to criminal, civil and/or administrative proceedings.

Printed Name:	
Title/Position:	
Signature:	Date:

(NYS DEC Notice of Termination - January 2015)

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APPENDIX P: NYSDEC SPDES GENERAL PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITY (PERMIT NO. GP-0-20-001)

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SPDES GENERAL PERMIT
FOR STORMWATER DISCHARGES

From

CONSTRUCTION ACTIVITY

Permit No. GP- 0-20-001

Issued Pursuant to Article 17, Titles 7, 8 and Article 70

of the Environmental Conservation Law

Effective Date: January 29, 2020 Expiration Date: January 28, 2025

John J. Ferguson

Chief Permit Administrator

1-23-20

Authorized Signature Date

Address: NYS DEC
Division of Environmental Permits
625 Broadway, 4th Floor
Albany, N.Y. 12233-1750

PREFACE

Pursuant to Section 402 of the Clean Water Act ("CWA"), stormwater *discharges* from certain *construction activities* are unlawful unless they are authorized by a *National Pollutant Discharge Elimination System ("NPDES")* permit or by a state permit program. New York administers the approved State Pollutant Discharge Elimination System (SPDES) program with permits issued in accordance with the New York State Environmental Conservation Law (ECL) Article 17, Titles 7, 8 and Article 70.

An *owner or operator* of a *construction activity* that is eligible for coverage under this permit must obtain coverage prior to the *commencement of construction activity*. Activities that fit the definition of "*construction activity*", as defined under 40 CFR 122.26(b)(14)(x), (15)(i), and (15)(ii), constitute construction of a *point source* and therefore, pursuant to ECL section 17-0505 and 17-0701, the *owner or operator* must have coverage under a SPDES permit prior to *commencing construction activity*. The *owner or operator* cannot wait until there is an actual *discharge* from the *construction site* to obtain permit coverage.

***Note: The italicized words/phrases within this permit are defined in Appendix A.**

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
SPDES GENERAL PERMIT FOR STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITIES

Table of Contents

Part 1. PERMIT COVERAGE AND LIMITATIONS

A. Permit Application

This permit authorizes stormwater *discharges* to *surface waters of the State* from the following *construction activities* identified within 40 CFR Parts 122.26(b)(14)(x), 122.26(b)(15)(i) and 122.26(b)(15)(ii), provided all of the eligibility provisions of this permit are met:

1. *Construction activities* involving soil disturbances of one (1) or more acres; including disturbances of less than one acre that are part of a *larger common plan of development or sale* that will ultimately disturb one or more acres of land; excluding *routine maintenance activity* that is performed to maintain the original line and grade, hydraulic capacity or original purpose of a facility;

2. *Construction activities* involving soil disturbances of less than one (1) acre where the Department has determined that a *SPDES* permit is required for stormwater *discharges* based on the potential for contribution to a violation of a *water quality standard* or for significant contribution of *pollutants* to *surface waters of the State.*

3. *Construction activities* located in the watershed(s) identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.

B. Effluent Limitations Applicable to Discharges from Construction Activities

*Discharge*s authorized by this permit must achieve, at a minimum, the effluent limitations in Part I.B.1. (a) – (f) of this permit. These limitations represent the degree of effluent reduction attainable by the application of best practicable technology currently available.

1. Erosion and Sediment Control Requirements - The *owner or operator* must select, design, install, implement and maintain control measures to *minimize* the *discharge* of *pollutants* and prevent a violation of the *water quality standards*. The selection, design, installation, implementation, and maintenance of these control measures must meet the non-numeric effluent limitations in Part I.B.1.(a) – (f) of this permit and be in accordance with the New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016, using sound engineering judgment. Where control measures are not designed in conformance with the design criteria included in the technical standard, the *owner or operator* must include in the *Stormwater Pollution Prevention Plan* ("SWPPP") the reason(s) for the

deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

a. **Erosion and Sediment Controls.** Design, install and maintain effective erosion and sediment controls to *minimize* the *discharge* of *pollutants* and prevent a violation of the *water quality standards*. At a minimum, such controls must be designed, installed and maintained to:

(i) *Minimize* soil erosion through application of runoff control and soil stabilization control measure to *minimize pollutant discharges*;

(ii) Control stormwater *discharge*s, including both peak flowrates and total stormwater volume, to *minimize* channel and *streambank* erosion and scour in the immediate vicinity of the *discharge* points;

(iii) *Minimize* the amount of soil exposed during *construction activity*;

(iv) *Minimize* the disturbance of *steep slopes*;

(v) *Minimize* sediment *discharge*s from the site;

(vi) Provide and maintain *natural buffer*s around surface waters, direct stormwater to vegetated areas and maximize stormwater infiltration to reduce *pollutant discharge*s, unless *infeasible*;

(vii) *Minimize* soil compaction. Minimizing soil compaction is not required where the intended function of a specific area of the site dictates that it be compacted;

(viii) Unless *infeasible*, preserve a sufficient amount of topsoil to complete soil restoration and establish a uniform, dense vegetative cover; and

(ix) *Minimize* dust. On areas of exposed soil, *minimize* dust through the appropriate application of water or other dust suppression techniques to control the generation of pollutants that could be discharged from the site.

b. **Soil Stabilization**. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within fourteen (14) days from the date the current soil disturbance activity ceased. For construction sites that *directly discharge* to one of the 303(d) segments listed in Appendix E or is located in one of the watersheds listed in Appendix C, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. See Appendix A for definition of *Temporarily Ceased*.

c. **Dewatering**. *Discharge*s from *dewatering* activities, including *discharge*s from *dewatering* of trenches and excavations, must be managed by appropriate control measures.

d. **Pollution Prevention Measures**. Design, install, implement, and maintain effective pollution prevention measures to *minimize* the *discharge* of *pollutants* and prevent a violation of the *water quality standards*. At a minimum, such measures must be designed, installed, implemented and maintained to:

(i) *Minimize* the *discharge* of *pollutants* from equipment and vehicle washing, wheel wash water, and other wash waters. This applies to washing operations that use clean water only. Soaps, detergents and solvents cannot be used;

(ii) *Minimize* the exposure of building materials, building products, construction wastes, trash, landscape materials, fertilizers, pesticides, herbicides, detergents, sanitary waste, hazardous and toxic waste, and other materials present on the site to precipitation and to stormwater. Minimization of exposure is not required in cases where the exposure to precipitation and to stormwater will not result in a *discharge* of *pollutants*, or where exposure of a specific material or product poses little risk of stormwater contamination (such as final products and materials intended for outdoor use) ; and

(iii) Prevent the *discharge* of *pollutants* from spills and leaks and implement chemical spill and leak prevention and response procedures.

e. **Prohibited *Discharge*s.** The following *discharge*s are prohibited:

(i) Wastewater from washout of concrete;

(ii) Wastewater from washout and cleanout of stucco, paint, form release oils, curing compounds and other construction materials;

(iii) Fuels, oils, or other *pollutants* used in vehicle and equipment operation and maintenance;

(iv) Soaps or solvents used in vehicle and equipment washing; and

(v) Toxic or hazardous substances from a spill or other release.

f. Surface Outlets. When discharging from basins and impoundments, the outlets shall be designed, constructed and maintained in such a manner that sediment does not leave the basin or impoundment and that erosion at or below the outlet does not occur.

C. Post-construction Stormwater Management Practice Requirements

1. The *owner or operator* of a *construction activity* that requires post-construction stormwater management practices pursuant to Part III.C. of this permit must select, design, install, and maintain the practices to meet the *performance criteria* in the New York State Stormwater Management Design Manual (“Design Manual”), dated January 2015, using sound engineering judgment. Where post-construction stormwater management practices (“SMPs”) are not designed in conformance with the *performance criteria* in the Design Manual, the *owner or operator* must include in the SWPPP the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

2. The *owner or operator* of a *construction activity* that requires post-construction stormwater management practices pursuant to Part III.C. of this permit must design the practices to meet the applicable *sizing criteria* in Part I.C.2.a., b., c. or d. of this permit.

a. Sizing Criteria for New Development

(i) Runoff Reduction Volume (“RRv”): Reduce the total Water Quality Volume (“WQv”) by application of RR techniques and standard SMPs with RRv capacity. The total WQv shall be calculated in accordance with the criteria in Section 4.2 of the Design Manual.

(ii) Minimum RRv and Treatment of Remaining Total WQv: Construction activities that cannot meet the criteria in Part I.C.2.a.(i) of this permit due to site limitations shall direct runoff from all newly constructed impervious areas to a RR technique or standard SMP with RRv capacity unless infeasible. The specific site limitations that prevent the reduction of 100% of the WQv shall be documented in the SWPPP.

For each impervious area that is not directed to a RR technique or standard SMP with RRv capacity, the SWPPP must include documentation which demonstrates that all options were considered and for each option explains why it is considered infeasible.

In no case shall the runoff reduction achieved from the newly constructed impervious areas be less than the Minimum RRv as calculated using the criteria in Section 4.3 of the Design Manual. The remaining portion of the total WQv that cannot be reduced shall be treated by application of standard SMPs.

(iii) Channel Protection Volume (“Cpv”): Provide 24 hour extended detention of the post-developed 1-year, 24-hour storm event; remaining after runoff reduction. The Cpv requirement does not apply when:
(1) Reduction of the entire Cpv is achieved by application of runoff reduction techniques or infiltration systems, or
(2) The site discharges directly to tidal waters, or fifth order or larger streams.

(iv) *Overbank* Flood Control Criteria (“Qp”): Requires storage to attenuate the post-development 10-year, 24-hour peak discharge rate (Qp) to predevelopment rates. The Qp requirement does not apply when:
(1) the site discharges directly to tidal waters or fifth order or larger streams, or
(2) A downstream analysis reveals that *overbank* control is not required.

(v) Extreme Flood Control Criteria (“Qf”): Requires storage to attenuate the post-development 100-year, 24-hour peak discharge rate (Qf) to predevelopment rates. The Qf requirement does not apply when:
(1) the site discharges directly to tidal waters or fifth order or larger streams, or
(2) A downstream analysis reveals that *overbank* control is not required.

b. *Sizing Criteria* for *New Development* in Enhanced Phosphorus Removal Watershed

(i) Runoff Reduction Volume (RRv): Reduce the total Water Quality Volume (WQv) by application of RR techniques and standard SMPs with RRv capacity. The total WQv is the runoff volume from the 1-year, 24 hour design storm over the post-developed watershed and shall be calculated in accordance with the criteria in Section 10.3 of the Design Manual.

(ii) Minimum RRv and Treatment of Remaining Total WQv: *Construction activities* that cannot meet the criteria in Part I.C.2.b.(i) of this permit due to *site limitations* shall direct runoff from all newly constructed *impervious areas* to a RR technique or standard SMP with RRv capacity unless *infeasible*. The specific *site limitations* that prevent the reduction of 100% of the WQv shall be documented in the SWPPP. For each *impervious area* that is not directed to a RR technique or standard SMP with RRv capacity, the SWPPP must include documentation which demonstrates that all options were considered and for each option explains why it is considered *infeasible.*

In no case shall the runoff reduction achieved from the newly constructed *impervious areas* be less than the Minimum RRv as calculated using the criteria in Section 10.3 of the Design Manual. The remaining portion of the total WQv that cannot be reduced shall be treated by application of standard SMPs.

(iii) Channel Protection Volume (Cpv): Provide 24 hour extended detention of the post-developed 1-year, 24-hour storm event; remaining after runoff reduction. The Cpv requirement does not apply when:
(1) Reduction of the entire Cpv is achieved by application of runoff reduction techniques or infiltration systems, or
(2) The site *discharge*s directly to tidal waters, or fifth order or larger streams.

(iv) *Overbank* Flood Control Criteria (Qp): Requires storage to attenuate the post-development 10-year, 24-hour peak *discharge* rate (Qp) to predevelopment rates. The Qp requirement does not apply when:
(1) the site *discharge*s directly to tidal waters or fifth order or larger streams, or
(2) A downstream analysis reveals that *overbank* control is not required.

(v) Extreme Flood Control Criteria (Qf): Requires storage to attenuate the post-development 100-year, 24-hour peak *discharge* rate (Qf) to predevelopment rates. The Qf requirement does not apply when:
(1) the site *discharge*s directly to tidal waters or fifth order or larger streams, or
(2) A downstream analysis reveals that *overbank* control is not required.

c. Sizing Criteria for Redevelopment Activity

(i) Water Quality Volume (WQv): The WQv treatment objective for *redevelopment activity* shall be addressed by one of the following options. *Redevelopment activities* located in an Enhanced Phosphorus Removal Watershed (see Part III.B.3. and Appendix C of this permit) shall calculate the WQv in accordance with Section 10.3 of the Design Manual. All other *redevelopment activities* shall calculate the WQv in accordance with Section 4.2 of the Design Manual.

(1) Reduce the existing *impervious cover* by a minimum of 25% of the total disturbed, *impervious area*. The Soil Restoration criteria in Section 5.1.6 of the Design Manual must be applied to all newly created pervious areas, or

(2) Capture and treat a minimum of 25% of the WQv from the disturbed, *impervious area* by the application of standard SMPs; or reduce 25% of the WQv from the disturbed, *impervious area* by the application of RR techniques or standard SMPs with RRv capacity., or

(3) Capture and treat a minimum of 75% of the WQv from the disturbed, *impervious area* as well as any additional runoff from tributary areas by application of the alternative practices discussed in Sections 9.3 and 9.4 of the Design Manual., or

(4) Application of a combination of 1, 2 and 3 above that provide a weighted average of at least two of the above methods. Application of this method shall be in accordance with the criteria in Section 9.2.1(B) (IV) of the Design Manual.

If there is an existing post-construction stormwater management practice located on the site that captures and treats runoff from the *impervious area* that is being disturbed, the WQv treatment option selected must, at a minimum, provide treatment equal to the treatment that was being provided by the existing practice(s) if that treatment is greater than the treatment required by options 1 – 4 above.

(ii) Channel Protection Volume (Cpv): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site.

(iii) *Overbank* Flood Control Criteria (Qp): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site.

(iv) Extreme Flood Control Criteria (Qf): Not required if there are no changes to hydrology that increase the *discharge* rate from the project site

d. Sizing Criteria for Combination of Redevelopment Activity and New Development

Construction projects that include both New Development and Redevelopment Activity shall provide post-construction stormwater management controls that meet the sizing criteria calculated as an aggregate of the Sizing Criteria in Part I.C.2.a. or b. of this permit for the New Development portion of the project and Part I.C.2.c of this permit for Redevelopment Activity portion of the project.

D. Maintaining Water Quality

The Department expects that compliance with the conditions of this permit will control *discharge*s necessary to meet applicable *water quality standards*. It shall be a violation of the *ECL* for any discharge to either cause or contribute to a violation of *water quality standards* as contained in Parts 700 through 705 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York, such as:

1. There shall be no increase in turbidity that will cause a substantial visible contrast to natural conditions;

2. There shall be no increase in suspended, colloidal or settleable solids that will cause deposition or impair the waters for their best usages; and

3. There shall be no residue from oil and floating substances, nor visible oil film, nor globules of grease.

If there is evidence indicating that the stormwater *discharge*s authorized by this permit are causing, have the reasonable potential to cause, or are contributing to a violation of the *water quality standards*; the *owner or operator* must take appropriate corrective action in accordance with Part IV.C.5. of this general permit and document in accordance with Part IV.C.4. of this general permit. To address the *water quality standard* violation the *owner or operator* may need to provide additional information, include and implement appropriate controls in the SWPPP to correct the problem, or obtain an individual SPDES permit.

If there is evidence indicating that despite compliance with the terms and conditions of this general permit it is demonstrated that the stormwater *discharge*s authorized by this permit are causing or contributing to a violation of *water quality standards*, or if the Department determines that a modification of the permit is necessary to prevent a violation of *water quality standards*, the authorized *discharge*s will no longer be eligible for coverage under this permit. The Department may require the *owner or operator* to obtain an individual SPDES permit to continue discharging.

E. Eligibility Under This General Permit

1. This permit may authorize all *discharges* of stormwater from *construction activity* to *surface waters of the State* and *groundwaters* except for ineligible *discharges* identified under subparagraph F. of this Part.

2. Except for non-stormwater *discharges* explicitly listed in the next paragraph, this permit only authorizes stormwater *discharge*s; including stormwater runoff, snowmelt runoff, and surface runoff and drainage, from *construction activities*.

3. Notwithstanding paragraphs E.1 and E.2 above, the following non-stormwater discharges are authorized by this permit: those listed in 6 NYCRR 750-1.2(a)(29)(vi), with the following exception: "Discharges from firefighting activities are authorized only when the firefighting activities are emergencies/unplanned"; waters to which other components have not been added that are used to control dust in accordance with the SWPPP; and uncontaminated *discharge*s from *construction site* de-watering operations. All non-stormwater discharges must be identified in the SWPPP. Under all circumstances, the *owner or operator* must still comply with *water quality standards* in Part I.D of this permit.

4. The *owner or operator* must maintain permit eligibility to *discharge* under this permit. Any *discharges* that are not compliant with the eligibility conditions of this permit are not authorized by the permit and the *owner or operator* must either apply for a separate permit to cover those ineligible *discharges* or take steps necessary to make the *discharge* eligible for coverage.

F. Activities Which Are Ineligible for Coverage Under This General Permit

All of the following are **<u>not</u>** authorized by this permit:

1. *Discharge*s after *construction activities* have been completed and the site has undergone *final stabilization*;

2. *Discharge*s that are mixed with sources of non-stormwater other than those expressly authorized under subsection E.3. of this Part and identified in the SWPPP required by this permit;

3. *Discharges* that are required to obtain an individual SPDES permit or another SPDES general permit pursuant to Part VII.K. of this permit;

4. *Construction activities* or *discharges* from *construction activities* that may adversely affect an *endangered or threatened species* unless the *owner or*

operator has obtained a permit issued pursuant to 6 NYCRR Part 182 for the project or the Department has issued a letter of non-jurisdiction for the project. All documentation necessary to demonstrate eligibility shall be maintained on site in accordance with Part II.D.2 of this permit;

5. *Discharges* which either cause or contribute to a violation of *water quality standards* adopted pursuant to the *ECL* and its accompanying regulations;

6. *Construction activities* for residential, commercial and institutional projects:

    a. Where the *discharge*s from the *construction activities* are tributary to waters of the state classified as AA or AA-s; and

    b. Which are undertaken on land with no existing *impervious cover*; and

    c. Which disturb one (1) or more acres of land designated on the current United States Department of Agriculture ("USDA") Soil Survey as Soil Slope Phase "D", (provided the map unit name is inclusive of slopes greater than 25%), or Soil Slope Phase "E" or "F" (regardless of the map unit name), or a combination of the three designations.

7. *Construction activities* for linear transportation projects and linear utility projects:

    a. Where the *discharge*s from the *construction activities* are tributary to waters of the state classified as AA or AA-s; and

    b. Which are undertaken on land with no existing *impervious cover*; and

    c. Which disturb two (2) or more acres of land designated on the current USDA Soil Survey as Soil Slope Phase "D" (provided the map unit name is inclusive of slopes greater than 25%), or Soil Slope Phase "E" or "F" (regardless of the map unit name), or a combination of the three designations.

8. *Construction activities* that have the potential to affect an *historic property*, unless there is documentation that such impacts have been resolved. The following documentation necessary to demonstrate eligibility with this requirement shall be maintained on site in accordance with Part II.D.2 of this permit and made available to the Department in accordance with Part VII.F of this permit:

   a. Documentation that the *construction activity* is not within an archeologically sensitive area indicated on the sensitivity map, and that the *construction activity* is not located on or immediately adjacent to a property listed or determined to be eligible for listing on the National or State Registers of Historic Places, and that there is no new permanent building on the *construction site* within the following distances from a building, structure, or object that is more than 50 years old, or if there is such a new permanent building on the *construction site* within those parameters that NYS Office of Parks, Recreation and Historic Preservation (OPRHP), a Historic Preservation Commission of a Certified Local Government, or a qualified preservation professional has determined that the building, structure, or object more than 50 years old is not historically/archeologically significant.

      - 1-5 acres of disturbance - 20 feet
      - 5-20 acres of disturbance - 50 feet
      - 20+ acres of disturbance - 100 feet, or

   b. DEC consultation form sent to OPRHP, and copied to the NYS DEC Agency Historic Preservation Officer (APO), and
      (i) the State Environmental Quality Review (SEQR) Environmental Assessment Form (EAF) with a negative declaration or the Findings Statement, with documentation of OPRHP's agreement with the resolution; or
      (ii) documentation from OPRHP that the *construction activity* will result in No Impact; or
      (iii) documentation from OPRHP providing a determination of No Adverse Impact; or
      (iv) a Letter of Resolution signed by the owner/operator, OPRHP and the DEC APO which allows for this *construction activity* to be eligible for coverage under the general permit in terms of the State Historic Preservation Act (SHPA); or

   c. Documentation of satisfactory compliance with Section 106 of the National Historic Preservation Act for a coterminous project area:

(i) No Affect
(ii) No Adverse Affect
(iii) Executed Memorandum of Agreement, or

d. Documentation that:

(i) SHPA Section 14.09 has been completed by NYS DEC or another state agency.

9. *Discharge*s from *construction activities* that are subject to an existing SPDES individual or general permit where a SPDES permit for *construction activity* has been terminated or denied; or where the *owner or operator* has failed to renew an expired individual permit.

Part II. PERMIT COVERAGE

A. How to Obtain Coverage

1. An *owner or operator* of a *construction activity* that is not subject to the requirements of a regulated, traditional land use control MS4 must first prepare a SWPPP in accordance with all applicable requirements of this permit and then submit a completed Notice of Intent (NOI) to the Department to be authorized to discharge under this permit.

2. An *owner or operator* of a *construction activity* that is subject to the requirements of a *regulated, traditional land use control MS4* must first prepare a SWPPP in accordance with all applicable requirements of this permit and then have the SWPPP reviewed and accepted by the *regulated, traditional land use control MS4* prior to submitting the NOI to the Department. The *owner or operator* shall have the “MS4 SWPPP Acceptance” form signed in accordance with Part VII.H., and then submit that form along with a completed NOI to the Department.

3. The requirement for an *owner or operator* to have its SWPPP reviewed and accepted by the *regulated, traditional land use control MS4* prior to submitting the NOI to the Department does not apply to an *owner or operator* that is obtaining permit coverage in accordance with the requirements in Part II.F. (Change of *Owner or Operator*) or where the *owner or operator* of the *construction activity* is the *regulated, traditional land use control MS4* . This exemption does not apply to *construction activities* subject to the New York City Administrative Code.

B. Notice of Intent (NOI) Submittal

1. Prior to December 21, 2020, an owner or operator shall use either the electronic (eNOI) or paper version of the NOI that the Department prepared. Both versions of the NOI are located on the Department's website (http://www.dec.ny.gov/). The paper version of the NOI shall be signed in accordance with Part VII.H. of this permit and submitted to the following address:

   NOTICE OF INTENT
   NYS DEC, Bureau of Water Permits
   625 Broadway, 4th Floor
   Albany, New York 12233-3505

2. Beginning December 21, 2020 and in accordance with EPA's 2015 NPDES Electronic Reporting Rule (40 CFR Part 127), the *owner or operator* must submit the NOI electronically using the *Department's* online NOI.

3. The *owner or operator* shall have the SWPPP preparer sign the "SWPPP Preparer Certification" statement on the NOI prior to submitting the form to the Department.

4. As of the date the NOI is submitted to the Department, the *owner or operator* shall make the NOI and SWPPP available for review and copying in accordance with the requirements in Part VII.F. of this permit.

C. Permit Authorization

1. An *owner or operator* shall not *commence construction activity* until their authorization to *discharge* under this permit goes into effect.

2. Authorization to *discharge* under this permit will be effective when the *owner or operator* has satisfied all of the following criteria:

   a. project review pursuant to the State Environmental Quality Review Act ("SEQRA") have been satisfied, when SEQRA is applicable. See the Department's website (http://www.dec.ny.gov/) for more information,

   b. where required, all necessary Department permits subject to the *Uniform Procedures Act ("UPA")* (see 6 NYCRR Part 621), or the equivalent from another New York State agency, have been obtained, unless otherwise notified by the Department pursuant to 6 NYCRR 621.3(a)(4). *Owners or operators* of *construction activities* that are required to obtain *UPA* permits must submit a preliminary SWPPP to the appropriate DEC Permit Administrator at the Regional Office listed in Appendix F at the time all other necessary *UPA* permit applications are submitted. The preliminary SWPPP must include sufficient information to demonstrate that the *construction activity* qualifies for authorization under this permit,

c. the final SWPPP has been prepared, and

d. a complete NOI has been submitted to the Department in accordance with the requirements of this permit.

3. An *owner or operator* that has satisfied the requirements of Part II.C.2 above will be authorized to *discharge* stormwater from their *construction activity* in accordance with the following schedule:

   a. For *construction activities* that are <u>not</u> subject to the requirements of a *regulated, traditional land use control MS4*:

      (i) Five (5) business days from the date the Department receives a complete electronic version of the NOI (eNOI) for *construction activities* with a SWPPP that has been prepared in conformance with the design criteria in the technical standard referenced in Part III.B.1 and the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C.; or

      (ii) Sixty (60) business days from the date the Department receives a complete NOI (electronic or paper version) for *construction activities* with a SWPPP that has <u>not</u> been prepared in conformance with the design criteria in technical standard referenced in Part III.B.1. or, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C., the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, or;

      (iii) Ten (10) business days from the date the Department receives a complete paper version of the NOI for *construction activities* with a SWPPP that has been prepared in conformance with the design criteria in the technical standard referenced in Part III.B.1 and the *performance criteria* in the technical standard referenced in Parts III.B., 2 or 3, for *construction activities* that require post-construction stormwater management practices pursuant to Part III.C.

b. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4*:

(i) Five (5) business days from the date the Department receives both a complete electronic version of the NOI (eNOI) and signed "*MS4* SWPPP Acceptance" form, or

(ii) Ten (10) business days from the date the Department receives both a complete paper version of the NOI and signed "MS4 SWPPP Acceptance" form.

4. Coverage under this permit authorizes stormwater *discharges* from only those areas of disturbance that are identified in the NOI. If an *owner or operator* wishes to have stormwater *discharges* from future or additional areas of disturbance authorized, they must submit a new NOI that addresses that phase of the development, unless otherwise notified by the Department. The *owner or operator* shall not *commence construction activity* on the future or additional areas until their authorization to *discharge* under this permit goes into effect in accordance with Part II.C. of this permit.

D. General Requirements For Owners or Operators With Permit Coverage

1. The *owner or operator* shall ensure that the provisions of the SWPPP are implemented from the *commencement of construction activity* until all areas of disturbance have achieved *final stabilization* and the Notice of Termination ("NOT") has been submitted to the Department in accordance with Part V. of this permit. This includes any changes made to the SWPPP pursuant to Part III.A.4. of this permit.

2. The *owner or operator* shall maintain a copy of the General Permit (GP-0-20-001), NOI, *NOI Acknowledgment Letter*, SWPPP, MS4 SWPPP Acceptance form, inspection reports, responsible contractor's or subcontractor's certification statement (see Part III.A.6.), and all documentation necessary to demonstrate eligibility with this permit at the *construction site* until all disturbed areas have achieved *final stabilization* and the NOT has been submitted to the Department. The documents must be maintained in a secure location, such as a job trailer, on-site construction office, or mailbox with lock. The secure location must be accessible during normal business hours to an individual performing a compliance inspection.

3. The *owner or operator* of a *construction activity* shall not disturb greater than five (5) acres of soil at any one time without prior written authorization from the Department or, in areas under the jurisdiction of a *regulated, traditional land* *use control MS4,* the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*). At a minimum, the *owner or operator* must comply with the following requirements in order to be authorized to disturb greater than five (5) acres of soil at any one time:

a. The *owner or operator* shall have a *qualified inspector* conduct **at least** two (2) site inspections in accordance with Part IV.C. of this permit every seven (7) calendar days, for as long as greater than five (5) acres of soil remain disturbed. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.

b. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures must be initiated by the end of the next business day and completed within seven (7) days from the date the current soil disturbance activity ceased. The soil stabilization measures selected shall be in conformance with the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016.

c. The *owner or operator* shall prepare a phasing plan that defines maximum disturbed area per phase and shows required cuts and fills.

d. The *owner or operator* shall install any additional site-specific practices needed to protect water quality.

e. The *owner or operator* shall include the requirements above in their SWPPP.

4. In accordance with statute, regulations, and the terms and conditions of this permit, the Department may suspend or revoke an *owner's or operator's* coverage under this permit at any time if the Department determines that the SWPPP does not meet the permit requirements or consistent with Part VII.K..

5. Upon a finding of significant non-compliance with the practices described in the SWPPP or violation of this permit, the Department may order an immediate stop to all activity at the site until the non-compliance is remedied. The stop work order shall be in writing, describe the non-compliance in detail, and be sent to the *owner or operator*.

6. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4*, the *owner or operator* shall notify the

regulated, traditional land use control MS4 in writing of any planned amendments or modifications to the post-construction stormwater management practice component of the SWPPP required by Part III.A. 4. and 5. of this permit. Unless otherwise notified by the *regulated, traditional land use control MS4*, the *owner or operator* shall have the SWPPP amendments or modifications reviewed and accepted by the *regulated, traditional land use control MS4* prior to commencing construction of the post-construction stormwater management practice.

E. Permit Coverage for Discharges Authorized Under GP-0-15-002

1. Upon renewal of SPDES General Permit for Stormwater Discharges from *Construction Activity* (Permit No. GP-0-15-002), an *owner or operator* of *a construction activity* with coverage under GP-0-15-002, as of the effective date of GP- 0-20-001, shall be authorized to *discharge* in accordance with GP- 0-20-001, unless otherwise notified by the Department.

   An *owner or operator* may continue to implement the technical/design components of the post-construction stormwater management controls provided that such design was done in conformance with the technical standards in place at the time of initial project authorization. However, they must comply with the other, non-design provisions of GP-0-20-001.

F. Change of Owner or Operator

1. When property ownership changes or when there is a change in operational control over the construction plans and specifications, the original *owner or operator* must notify the new *owner or operator*, in writing, of the requirement to obtain permit coverage by submitting a NOI with the Department. For *construction activities* subject to the requirements of a *regulated, traditional land use control MS4,* the original *owner or operator* must also notify the MS4, in writing, of the change in ownership at least 30 calendar days prior to the change in ownership.

2. Once the new *owner or operator* obtains permit coverage, the original *owner or operator* shall then submit a completed NOT with the name and permit identification number of the new *owner or operator* to the Department at the address in Part II.B.1. of this permit. If the original *owner or operator* maintains ownership of a portion of the *construction activity* and will disturb soil, they must maintain their coverage under the permit.

3. Permit coverage for the new *owner or operator* will be effective as of the date the Department receives a complete NOI, provided the original *owner or*

operator was not subject to a sixty (60) business day authorization period that has not expired as of the date the Department receives the NOI from the new *owner or operator*.

Part III. STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

A. General SWPPP Requirements

1. A SWPPP shall be prepared and implemented by the *owner or operator* of each *construction activity* covered by this permit. The SWPPP must document the selection, design, installation, implementation and maintenance of the control measures and practices that will be used to meet the effluent limitations in Part I.B. of this permit and where applicable, the post-construction stormwater management practice requirements in Part I.C. of this permit. The SWPPP shall be prepared prior to the submittal of the NOI. The NOI shall be submitted to the Department prior to the *commencement of construction activity*. A copy of the completed, final NOI shall be included in the SWPPP.

2. The SWPPP shall describe the erosion and sediment control practices and where required, post-construction stormwater management practices that will be used and/or constructed to reduce the *pollutants* in stormwater *discharges* and to assure compliance with the terms and conditions of this permit. In addition, the SWPPP shall identify potential sources of pollution which may reasonably be expected to affect the quality of stormwater *discharges*.

3. All SWPPPs that require the post-construction stormwater management practice component shall be prepared by a *qualified professional* that is knowledgeable in the principles and practices of stormwater management and treatment.

4. The *owner or operator* must keep the SWPPP current so that it at all times accurately documents the erosion and sediment controls practices that are being used or will be used during construction, and all post-construction stormwater management practices that will be constructed on the site. At a minimum, the *owner or operator* shall amend the SWPPP, including construction drawings:

    a. whenever the current provisions prove to be ineffective in minimizing *pollutants* in stormwater *discharges* from the site;

b. whenever there is a change in design, construction, or operation at the *construction site* that has or could have an effect on the *discharge* of *pollutants*;

c. to address issues or deficiencies identified during an inspection by the *qualified inspector,* the Department or other regulatory authority; and

d. to document the final construction conditions.

5. The Department may notify the *owner or operator* at any time that the SWPPP does not meet one or more of the minimum requirements of this permit. The notification shall be in writing and identify the provisions of the SWPPP that require modification. Within fourteen (14) calendar days of such notification, or as otherwise indicated by the Department, the *owner or operator* shall make the required changes to the SWPPP and submit written notification to the Department that the changes have been made. If the *owner or operator* does not respond to the Department's comments in the specified time frame, the Department may suspend the *owner's or operator's* coverage under this permit or require the *owner or operator* to obtain coverage under an individual SPDES permit in accordance with Part II.D.4. of this permit.

6. Prior to the *commencement of construction activity*, the *owner or operator* must identify the contractor(s) and subcontractor(s) that will be responsible for installing, constructing, repairing, replacing, inspecting and maintaining the erosion and sediment control practices included in the SWPPP; and the contractor(s) and subcontractor(s) that will be responsible for constructing the post-construction stormwater management practices included in the SWPPP. The *owner or operator* shall have each of the contractors and subcontractors identify at least one person from their company that will be responsible for implementation of the SWPPP. This person shall be known as the *trained contractor.* The *owner or operator* shall ensure that at least one *trained contractor* is on site on a daily basis when soil disturbance activities are being performed.

   The *owner or operator* shall have each of the contractors and subcontractors identified above sign a copy of the following certification statement below before they commence any *construction activity*:

   > "I hereby certify under penalty of law that I understand and agree to comply with the terms and conditions of the SWPPP and agree to implement any corrective actions identified by the *qualified inspector* during a site inspection. I also understand that the *owner or operator* must comply with

the terms and conditions of the most current version of the New York State Pollutant Discharge Elimination System ("SPDES") general permit for stormwater *discharge*s from *construction activities* and that it is unlawful for any person to cause or contribute to a violation of *water quality standards*. Furthermore, I am aware that there are significant penalties for submitting false information, that I do not believe to be true, including the possibility of fine and imprisonment for knowing violations"

In addition to providing the certification statement above, the certification page must also identify the specific elements of the SWPPP that each contractor and subcontractor will be responsible for and include the name and title of the person providing the signature; the name and title of the *trained contractor* responsible for SWPPP implementation; the name, address and telephone number of the contracting firm; the address (or other identifying description) of the site; and the date the certification statement is signed. The *owner or operator* shall attach the certification statement(s) to the copy of the SWPPP that is maintained at the *construction site*. If new or additional contractors are hired to implement measures identified in the SWPPP after construction has commenced, they must also sign the certification statement and provide the information listed above.

7. For projects where the Department requests a copy of the SWPPP or inspection reports, the *owner or operator* shall submit the documents in both electronic (PDF only) and paper format within five (5) business days, unless otherwise notified by the Department.

B. Required SWPPP Contents

1. Erosion and sediment control component - All SWPPPs prepared pursuant to this permit shall include erosion and sediment control practices designed in conformance with the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016. Where erosion and sediment control practices are not designed in conformance with the design criteria included in the technical standard, the *owner or operator* must demonstrate *equivalence* to the technical standard. At a minimum, the erosion and sediment control component of the SWPPP shall include the following:

   a. Background information about the scope of the project, including the location, type and size of project

b. A site map/construction drawing(s) for the project, including a general location map. At a minimum, the site map shall show the total site area; all improvements; areas of disturbance; areas that will not be disturbed; existing vegetation; on-site and adjacent off-site surface water(s); floodplain/floodway boundaries; wetlands and drainage patterns that could be affected by the *construction activity*; existing and final contours ; locations of different soil types with boundaries; material, waste, borrow or equipment storage areas located on adjacent properties; and location(s) of the stormwater *discharge*(s);

c. A description of the soil(s) present at the site, including an identification of the Hydrologic Soil Group (HSG);

d. A construction phasing plan and sequence of operations describing the intended order of *construction activities*, including clearing and grubbing, excavation and grading, utility and infrastructure installation and any other activity at the site that results in soil disturbance;

e. A description of the minimum erosion and sediment control practices to be installed or implemented for each *construction activity* that will result in soil disturbance. Include a schedule that identifies the timing of initial placement or implementation of each erosion and sediment control practice and the minimum time frames that each practice should remain in place or be implemented;

f. A temporary and permanent soil stabilization plan that meets the requirements of this general permit and the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016, for each stage of the project, including initial land clearing and grubbing to project completion and achievement of *final stabilization*;

g. A site map/construction drawing(s) showing the specific location(s), size(s), and length(s) of each erosion and sediment control practice;

h. The dimensions, material specifications, installation details, and operation and maintenance requirements for all erosion and sediment control practices. Include the location and sizing of any temporary sediment basins and structural practices that will be used to divert flows from exposed soils;

i. A maintenance inspection schedule for the contractor(s) identified in Part III.A.6. of this permit, to ensure continuous and effective operation of the erosion and sediment control practices. The maintenance inspection schedule shall be in accordance with the requirements in the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016;

j. A description of the pollution prevention measures that will be used to control litter, construction chemicals and construction debris from becoming a *pollutant* source in the stormwater *discharges*;

k. A description and location of any stormwater *discharges* associated with industrial activity other than construction at the site, including, but not limited to, stormwater *discharges* from asphalt plants and concrete plants located on the *construction site*; and

l. Identification of any elements of the design that are not in conformance with the design criteria in the technical standard, New York State Standards and Specifications for Erosion and Sediment Control, dated November 2016. Include the reason for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

2. Post-construction stormwater management practice component – The *owner or operator* of any construction project identified in Table 2 of Appendix B as needing post-construction stormwater management practices shall prepare a SWPPP that includes practices designed in conformance with the applicable *sizing criteria* in Part I.C.2.a., c. or d. of this permit and the *performance criteria* in the technical standard, New York State Stormwater Management Design Manual dated January 2015

   Where post-construction stormwater management practices are not designed in conformance with the *performance criteria* in the technical standard, the *owner or operator* must include in the SWPPP the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the technical standard.

   The post-construction stormwater management practice component of the SWPPP shall include the following:

   a. Identification of all post-construction stormwater management practices to be constructed as part of the project. Include the dimensions, material specifications and installation details for each post-construction stormwater management practice;

b. A site map/construction drawing(s) showing the specific location and size of each post-construction stormwater management practice;

c. A Stormwater Modeling and Analysis Report that includes:
   (i) Map(s) showing pre-development conditions, including watershed/subcatchments boundaries, flow paths/routing, and design points;

   (ii) Map(s) showing post-development conditions, including watershed/subcatchments boundaries, flow paths/routing, design points and post-construction stormwater management practices;

   (iii) Results of stormwater modeling (i.e. hydrology and hydraulic analysis) for the required storm events. Include supporting calculations (model runs), methodology, and a summary table that compares pre and post-development runoff rates and volumes for the different storm events;

   (iv) Summary table, with supporting calculations, which demonstrates that each post-construction stormwater management practice has been designed in conformance with the *sizing criteria* included in the Design Manual;

   (v) Identification of any *sizing criteria* that is not required based on the requirements included in Part I.C. of this permit; and

   (vi) Identification of any elements of the design that are not in conformance with the *performance criteria* in the Design Manual. Include the reason(s) for the deviation or alternative design and provide information which demonstrates that the deviation or alternative design is *equivalent* to the Design Manual;

d. Soil testing results and locations (test pits, borings);

e. Infiltration test results, when required; and

f. An operations and maintenance plan that includes inspection and maintenance schedules and actions to ensure continuous and effective operation of each post-construction stormwater management practice. The plan shall identify the entity that will be responsible for the long term operation and maintenance of each practice.

3. Enhanced Phosphorus Removal Standards - All construction projects identified in Table 2 of Appendix B that are located in the watersheds identified in Appendix C shall prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the applicable *sizing criteria* in Part I.C.2. b., c. or d. of this permit and the *performance criteria,* Enhanced Phosphorus Removal Standards included in the Design Manual. At a minimum, the post-construction stormwater management practice component of the SWPPP shall include items 2.a - 2.f. above.

C. Required SWPPP Components by Project Type

Unless otherwise notified by the Department, *owners or operators* of *construction activities* identified in Table 1 of Appendix B are required to prepare a SWPPP that only includes erosion and sediment control practices designed in conformance with Part III.B.1 of this permit. *Owners or operators* of the *construction activities* identified in Table 2 of Appendix B shall prepare a SWPPP that also includes post-construction stormwater management practices designed in conformance with Part III.B.2 or 3 of this permit.

Part IV. INSPECTION AND MAINTENANCE REQUIREMENTS

A. General Construction Site Inspection and Maintenance Requirements

1. The *owner or operator* must ensure that all erosion and sediment control practices (including pollution prevention measures) and all post-construction stormwater management practices identified in the SWPPP are inspected and maintained in accordance with Part IV.B. and C. of this permit.

2. The terms of this permit shall not be construed to prohibit the State of New York from exercising any authority pursuant to the ECL, common law or federal law, or prohibit New York State from taking any measures, whether civil or criminal, to prevent violations of the laws of the State of New York or protect the public health and safety and/or the environment.

B. Contractor Maintenance Inspection Requirements

1. The *owner or operator* of each *construction activity* identified in Tables 1 and 2 of Appendix B shall have a *trained contractor* inspect the erosion and sediment control practices and pollution prevention measures being implemented within the active work area daily to ensure that they are being maintained in effective operating condition at all times. If deficiencies are identified, the contractor shall

begin implementing corrective actions within one business day and shall complete the corrective actions in a reasonable time frame.

2. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and *temporary stabilization* measures have been applied to all disturbed areas, the *trained contractor* can stop conducting the maintenance inspections. The *trained contractor* shall begin conducting the maintenance inspections in accordance with Part IV.B.1. of this permit as soon as soil disturbance activities resume.

3. For construction sites where soil disturbance activities have been shut down with partial project completion, the *trained contractor* can stop conducting the maintenance inspections if all areas disturbed as of the project shutdown date have achieved *final stabilization* and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational.

C. Qualified Inspector Inspection Requirements

The *owner or operator* shall have a *qualified inspector* conduct site inspections in conformance with the following requirements:

[Note: The *trained contractor* identified in Part III.A.6. and IV.B. of this permit **cannot** conduct the *qualified inspector* site inspections unless they meet the *qualified inspector* qualifications included in Appendix A. In order to perform these inspections, the *trained contractor* would have to be a:

- licensed Professional Engineer,
- Certified Professional in Erosion and Sediment Control (CPESC),
- New York State Erosion and Sediment Control Certificate Program holder
- Registered Landscape Architect, or
- someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided they have received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity].

1. A *qualified inspector* shall conduct site inspections for all *construction activities* identified in Tables 1 and 2 of Appendix B, with the exception of:

   a. the construction of a single family residential subdivision with 25% or less *impervious cover* at total site build-out that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres and is not located in one of the watersheds listed in Appendix C and not directly discharging to one of the 303(d) segments listed in Appendix E;

b. the construction of a single family home that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres and is not located in one of the watersheds listed in Appendix C and not directly discharging to one of the 303(d) segments listed in Appendix E;

c. construction on agricultural property that involves a soil disturbance of one (1) or more acres of land but less than five (5) acres; and

d. *construction activities* located in the watersheds identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.

2. Unless otherwise notified by the Department, the *qualified inspector* shall conduct site inspections in accordance with the following timetable:

   a. For construction sites where soil disturbance activities are on-going, the *qualified inspector* shall conduct a site inspection at least once every seven (7) calendar days.

   b. For construction sites where soil disturbance activities are on-going and the *owner or operator* has received authorization in accordance with Part II.D.3 to disturb greater than five (5) acres of soil at any one time, the *qualified inspector* shall conduct at least two (2) site inspections every seven (7) calendar days. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.

   c. For construction sites where soil disturbance activities have been temporarily suspended (e.g. winter shutdown) and *temporary stabilization* measures have been applied to all disturbed areas, the *qualified inspector* shall conduct a site inspection at least once every thirty (30) calendar days. The *owner or operator* shall notify the DOW Water (SPDES) Program contact at the Regional Office (see contact information in Appendix F) or, in areas under the jurisdiction of a *regulated, traditional land use control MS4,* the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*) in writing prior to reducing the frequency of inspections.

d. For construction sites where soil disturbance activities have been shut down with partial project completion, the *qualified inspector* can stop conducting inspections if all areas disturbed as of the project shutdown date have achieved *final stabilization* <u>and</u> all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational. The *owner or operator* shall notify the DOW Water (SPDES) Program contact at the Regional Office (see contact information in Appendix F) or, in areas under the jurisdiction of a *regulated, traditional land use control MS4,* the *regulated, traditional land use control MS4* (provided the *regulated, traditional land use control MS4* is not the *owner or operator* of the *construction activity*) in writing prior to the shutdown. If soil disturbance activities are not resumed within 2 years from the date of shutdown, the *owner or operator* shall have the *qualified inspector* perform a final inspection and certify that all disturbed areas have achieved *final stabilization,* <u>and</u> all temporary, structural erosion and sediment control measures have been removed*;* and that all post-construction stormwater management practices have been constructed in conformance with the SWPPP by signing the "*Final Stabilization*" and "Post-Construction Stormwater Management Practice" certification statements on the NOT. The *owner or operator* shall then submit the completed NOT form to the address in Part II.B.1 of this permit.

e. For construction sites that directly *discharge* to one of the 303(d) segments listed in Appendix E or is located in one of the watersheds listed in Appendix C, the *qualified inspector* shall conduct at least two (2) site inspections every seven (7) calendar days. The two (2) inspections shall be separated by a minimum of two (2) full calendar days.

3. At a minimum, the *qualified inspector* shall inspect all erosion and sediment control practices and pollution prevention measures to ensure integrity and effectiveness, all post-construction stormwater management practices under construction to ensure that they are constructed in conformance with the SWPPP, all areas of disturbance that have not achieved *final stabilization,* all points of *discharge* to natural surface waterbodies located within, or immediately adjacent to, the property boundaries of the *construction site*, and all points of *discharge* from the *construction site*.

4. The *qualified inspector* shall prepare an inspection report subsequent to each and every inspection. At a minimum, the inspection report shall include and/or address the following:

a. Date and time of inspection;

b. Name and title of person(s) performing inspection;

c. A description of the weather and soil conditions (e.g. dry, wet, saturated) at the time of the inspection;

d. A description of the condition of the runoff at all points of *discharge* from the *construction site*. This shall include identification of any *discharges* of sediment from the *construction site*. Include *discharges* from conveyance systems (i.e. pipes, culverts, ditches, etc.) and overland flow;

e. A description of the condition of all natural surface waterbodies located within, or immediately adjacent to, the property boundaries of the *construction site* which receive runoff from disturbed areas. This shall include identification of any *discharges* of sediment to the surface waterbody;

f. Identification of all erosion and sediment control practices and pollution prevention measures that need repair or maintenance;

g. Identification of all erosion and sediment control practices and pollution prevention measures that were not installed properly or are not functioning as designed and need to be reinstalled or replaced;

h. Description and sketch of areas with active soil disturbance activity, areas that have been disturbed but are inactive at the time of the inspection, and areas that have been stabilized (temporary and/or final) since the last inspection;

i. Current phase of construction of all post-construction stormwater management practices and identification of all construction that is not in conformance with the SWPPP and technical standards;

j. Corrective action(s) that must be taken to install, repair, replace or maintain erosion and sediment control practices and pollution prevention measures; and to correct deficiencies identified with the construction of the post-construction stormwater management practice(s);

k. Identification and status of all corrective actions that were required by previous inspection; and

l. Digital photographs, with date stamp, that clearly show the condition of all practices that have been identified as needing corrective actions. The *qualified inspector* shall attach paper color copies of the digital photographs to the inspection report being maintained onsite within seven (7) calendar days of the date of the inspection. The *qualified inspector* shall also take digital photographs, with date stamp, that clearly show the condition of the practice(s) after the corrective action has been completed. The *qualified inspector* shall attach paper color copies of the digital photographs to the inspection report that documents the completion of the corrective action work within seven (7) calendar days of that inspection.

5. Within one business day of the completion of an inspection, the *qualified inspector* shall notify the *owner or operator* and appropriate contractor or subcontractor identified in Part III.A.6. of this permit of any corrective actions that need to be taken. The contractor or subcontractor shall begin implementing the corrective actions within one business day of this notification and shall complete the corrective actions in a reasonable time frame.

6. All inspection reports shall be signed by the *qualified inspector.* Pursuant to Part II.D.2. of this permit, the inspection reports shall be maintained on site with the SWPPP.

Part V. TERMINATION OF PERMIT COVERAGE

A. Termination of Permit Coverage

1. An *owner or operator* that is eligible to terminate coverage under this permit must submit a completed NOT form to the address in Part II.B.1 of this permit. The NOT form shall be one which is associated with this permit, signed in accordance with Part VII.H of this permit.

2. An *owner or operator* may terminate coverage when one or more the following conditions have been met:

   a. Total project completion - All *construction activity* identified in the SWPPP has been completed; <u>and</u> all areas of disturbance have achieved *final stabilization*; <u>and</u> all temporary, structural erosion and sediment control measures have been removed; <u>and</u> all post-construction stormwater management practices have been constructed in conformance with the SWPPP and are operational;

b. Planned shutdown with partial project completion - All soil disturbance activities have ceased; and all areas disturbed as of the project shutdown date have achieved *final stabilization*; and all temporary, structural erosion and sediment control measures have been removed; and all post-construction stormwater management practices required for the completed portion of the project have been constructed in conformance with the SWPPP and are operational;

c. A new *owner or operator* has obtained coverage under this permit in accordance with Part II.F. of this permit.

d. The *owner or operator* obtains coverage under an alternative SPDES general permit or an individual SPDES permit.

3. For *construction activities* meeting subdivision 2a. or 2b. of this Part, the *owner or operator* shall have the *qualified inspector* perform a final site inspection prior to submitting the NOT. The *qualified inspector* shall, by signing the "*Final Stabilization*" and "Post-Construction Stormwater Management Practice certification statements on the NOT, certify that all the requirements in Part V.A.2.a. or b. of this permit have been achieved.

4. For *construction activities* that are subject to the requirements of a *regulated, traditional land use control MS4* and meet subdivision 2a. or 2b. of this Part, the *owner or operator* shall have the *regulated, traditional land use control MS4* sign the "MS4 Acceptance" statement on the NOT in accordance with the requirements in Part VII.H. of this permit. The *regulated, traditional land use control MS4* official, by signing this statement, has determined that it is acceptable for the *owner or operator* to submit the NOT in accordance with the requirements of this Part. The *regulated, traditional land use control MS4* can make this determination by performing a final site inspection themselves or by accepting the *qualified inspector*'s final site inspection certification(s) required in Part V.A.3. of this permit.

5. For *construction activities* that require post-construction stormwater management practices and meet subdivision 2a. of this Part, the *owner or operator* must, prior to submitting the NOT, ensure one of the following:

a. the post-construction stormwater management practice(s) and any right-of-way(s) needed to maintain such practice(s) have been deeded to the municipality in which the practice(s) is located,

b. an executed maintenance agreement is in place with the municipality that will maintain the post-construction stormwater management practice(s),

c. for post-construction stormwater management practices that are privately owned, the *owner or operator* has a mechanism in place that requires operation and maintenance of the practice(s) in accordance with the operation and maintenance plan, such as a deed covenant in the *owner or operator's* deed of record,

d. for post-construction stormwater management practices that are owned by a public or private institution (e.g. school, university, hospital), government agency or authority, or public utility; the *owner or operator* has policy and procedures in place that ensures operation and maintenance of the practices in accordance with the operation and maintenance plan.

Part VI. REPORTING AND RETENTION RECORDS

A. Record Retention

The *owner or operator* shall retain a copy of the NOI, NOI Acknowledgment Letter, SWPPP, MS4 SWPPP Acceptance form and any inspection reports that were prepared in conjunction with this permit for a period of at least five (5) years from the date that the Department receives a complete NOT submitted in accordance with Part V. of this general permit.

B. Addresses

With the exception of the NOI, NOT, and MS4 SWPPP Acceptance form (which must be submitted to the address referenced in Part II.B.1 of this permit), all written correspondence requested by the Department, including individual permit applications, shall be sent to the address of the appropriate DOW Water (SPDES) Program contact at the Regional Office listed in Appendix F.

Part VII. STANDARD PERMIT CONDITIONS

A. Duty to Comply

The *owner or operator* must comply with all conditions of this permit. All contractors and subcontractors associated with the project must comply with the terms of the SWPPP. Any non-compliance with this permit constitutes a violation of the Clean Water

Act (CWA) and the ECL and is grounds for an enforcement action against the *owner or operator* and/or the contractor/subcontractor; permit revocation, suspension or modification; or denial of a permit renewal application. Upon a finding of significant non-compliance with this permit or the applicable SWPPP, the Department may order an immediate stop to all *construction activity* at the site until the non-compliance is remedied. The stop work order shall be in writing, shall describe the non-compliance in detail, and shall be sent to the *owner or operator*.

If any human remains or archaeological remains are encountered during excavation, the *owner or operator* must immediately cease, or cause to cease, all *construction activity* in the area of the remains and notify the appropriate Regional Water Engineer (RWE). *Construction activity* shall not resume until written permission to do so has been received from the RWE.

B. Continuation of the Expired General Permit

This permit expires five (5) years from the effective date. If a new general permit is not issued prior to the expiration of this general permit, an *owner or operator* with coverage under this permit may continue to operate and *discharge* in accordance with the terms and conditions of this general permit, if it is extended pursuant to the State Administrative Procedure Act and 6 NYCRR Part 621, until a new general permit is issued.

C. Enforcement

Failure of the *owner or operator,* its contractors, subcontractors, agents and/or assigns to strictly adhere to any of the permit requirements contained herein shall constitute a violation of this permit. There are substantial criminal, civil, and administrative penalties associated with violating the provisions of this permit. Fines of up to $37,500 per day for each violation and imprisonment for up to fifteen (15) years may be assessed depending upon the nature and degree of the offense.

D. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for an *owner or operator* in an enforcement action that it would have been necessary to halt or reduce the *construction activity* in order to maintain compliance with the conditions of this permit.

E. Duty to Mitigate

The *owner or operator* and its contractors and subcontractors shall take all reasonable steps to *minimize* or prevent any *discharge* in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

F. Duty to Provide Information

The *owner or operator* shall furnish to the Department, within a reasonable specified time period of a written request, all documentation necessary to demonstrate eligibility and any information to determine compliance with this permit or to determine whether cause exists for modifying or revoking this permit, or suspending or denying coverage under this permit, in accordance with the terms and conditions of this permit. The NOI, SWPPP and inspection reports required by this permit are public documents that the *owner or operator* must make available for review and copying by any person within five (5) business days of the *owner or operator* receiving a written request by any such person to review these documents. Copying of documents will be done at the requester's expense.

G. Other Information

When the *owner or operator* becomes aware that they failed to submit any relevant facts, or submitted incorrect information in the NOI or in any of the documents required by this permit , or have made substantive revisions to the SWPPP (e.g. the scope of the project changes significantly, the type of post-construction stormwater management practice(s) changes, there is a reduction in the sizing of the post-construction stormwater management practice, or there is an increase in the disturbance area or *impervious area*), which were not reflected in the original NOI submitted to the Department, they shall promptly submit such facts or information to the Department using the contact information in Part II.A. of this permit. Failure of the *owner or operator* to correct or supplement any relevant facts within five (5) business days of becoming aware of the deficiency shall constitute a violation of this permit.

H. Signatory Requirements

1. All NOIs and NOTs shall be signed as follows:

    a. For a corporation these forms shall be signed by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(i) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or

(ii) the manager of one or more manufacturing, production or operating facilities, provided the manager is authorized to make management decisions which govern the operation of the regulated facility including having the explicit or implicit duty of making major capital investment recommendations, and initiating and directing other comprehensive measures to assure long term environmental compliance with environmental laws and regulations; the manager can ensure that the necessary systems are established or actions taken to gather complete and accurate information for permit application requirements; and where authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

b. For a partnership or sole proprietorship these forms shall be signed by a general partner or the proprietor, respectively; or

c. For a municipality, State, Federal, or other public agency these forms shall be signed by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(i) the chief executive officer of the agency, or

(ii) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

2. The SWPPP and other information requested by the Department shall be signed by a person described in Part VII.H.1. of this permit or by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. The authorization is made in writing by a person described in Part VII.H.1. of this permit;

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of *equivalent* responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position) and,

c. The written authorization shall include the name, title and signature of the authorized representative and be attached to the SWPPP.

3. All inspection reports shall be signed by the *qualified inspector* that performs the inspection.

4. The MS4 SWPPP Acceptance form shall be signed by the principal executive officer or ranking elected official from the *regulated, traditional land use control MS4,* or by a duly authorized representative of that person.

   It shall constitute a permit violation if an incorrect and/or improper signatory authorizes any required forms, SWPPP and/or inspection reports.

I. Property Rights

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations. *Owners or operators* must obtain any applicable conveyances, easements, licenses and/or access to real property prior to *commencing construction activity*.

J. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

K. Requirement to Obtain Coverage Under an Alternative Permit

1. The Department may require any owner or operator authorized by this permit to apply for and/or obtain either an individual SPDES permit or another SPDES general permit. When the Department requires any discharger authorized by a general permit to apply for an individual SPDES permit, it shall notify the discharger in writing that a permit application is required. This notice shall

include a brief statement of the reasons for this decision, an application form, a statement setting a time frame for the owner or operator to file the application for an individual SPDES permit, and a deadline, not sooner than 180 days from owner or operator receipt of the notification letter, whereby the authorization to discharge under this general permit shall be terminated. Applications must be submitted to the appropriate Permit Administrator at the Regional Office. The Department may grant additional time upon demonstration, to the satisfaction of the Department, that additional time to apply for an alternative authorization is necessary or where the Department has not provided a permit determination in accordance with Part 621 of this Title.

2. When an individual SPDES permit is issued to a discharger authorized to *discharge* under a general SPDES permit for the same *discharge*(s), the general permit authorization for outfalls authorized under the individual SPDES permit is automatically terminated on the effective date of the individual permit unless termination is earlier in accordance with 6 NYCRR Part 750.

L. Proper Operation and Maintenance

The *owner or operator* shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the *owner or operator* to achieve compliance with the conditions of this permit and with the requirements of the SWPPP.

M. Inspection and Entry

The *owner or operator* shall allow an authorized representative of the Department, EPA, applicable county health department, or, in the case of a *construction site* which *discharges* through an *MS4*, an authorized representative of the *MS4* receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the owner’s or operator's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit;

2. Have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and

3. Inspect at reasonable times any facilities or equipment (including monitoring and control equipment), practices or operations regulated or required by this permit.

4. Sample or monitor at reasonable times, for purposes of assuring permit compliance or as otherwise authorized by the Act or ECL, any substances or parameters at any location.

N. Permit Actions

This permit may, at any time, be modified, suspended, revoked, or renewed by the Department in accordance with 6 NYCRR Part 621. The filing of a request by the *owner or operator* for a permit modification, revocation and reissuance, termination, a notification of planned changes or anticipated noncompliance does not limit, diminish and/or stay compliance with any terms of this permit.

O. Definitions

Definitions of key terms are included in Appendix A of this permit.

P. Re-Opener Clause

1. If there is evidence indicating potential or realized impacts on water quality due to any stormwater discharge associated with construction activity covered by this permit, the owner or operator of such discharge may be required to obtain an individual permit or alternative general permit in accordance with Part VII.K. of this permit or the permit may be modified to include different limitations and/or requirements.

2. Any Department initiated permit modification, suspension or revocation will be conducted in accordance with 6 NYCRR Part 621, 6 NYCRR 750-1.18, and 6 NYCRR 750-1.20.

Q. Penalties for Falsification of Forms and Reports

In accordance with 6NYCRR Part 750-2.4 and 750-2.5, any person who knowingly makes any false material statement, representation, or certification in any application, record, report or other document filed or required to be maintained under this permit, including reports of compliance or noncompliance shall, upon conviction, be punished in accordance with ECL §71-1933 and or Articles 175 and 210 of the New York State Penal Law.

R. Other Permits

Nothing in this permit relieves the *owner or operator* from a requirement to obtain any other permits required by law.

APPENDIX A – Acronyms and Definitions

Acronyms

APO – Agency Preservation Officer
BMP – Best Management Practice
CPESC – Certified Professional in Erosion and Sediment Control
Cpv – Channel Protection Volume
CWA – Clean Water Act (or the Federal Water Pollution Control Act, 33 U.S.C. §1251 et seq)
DOW – Division of Water
EAF – Environmental Assessment Form
ECL - Environmental Conservation Law
EPA – U. S. Environmental Protection Agency
HSG – Hydrologic Soil Group
MS4 – Municipal Separate Storm Sewer System
NOI – Notice of Intent
NOT – Notice of Termination
NPDES – National Pollutant Discharge Elimination System
OPRHP – Office of Parks, Recreation and Historic Places
Qf – Extreme Flood
Qp – Overbank Flood
RRv – Runoff Reduction Volume
RWE – Regional Water Engineer
SEQR – State Environmental Quality Review
SEQRA - State Environmental Quality Review Act
SHPA – State Historic Preservation Act
SPDES – State Pollutant Discharge Elimination System
SWPPP – Stormwater Pollution Prevention Plan
TMDL – Total Maximum Daily Load
UPA – Uniform Procedures Act
USDA – United States Department of Agriculture
WQv – Water Quality Volume

Definitions

<u>All definitions in this section are solely for the purposes of this permit.</u>

Agricultural Building – a structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products; excluding any structure designed, constructed or used, in whole or in part, for human habitation, as a place of employment where agricultural products are processed, treated or packaged, or as a place used by the public.

Agricultural Property –means the land for construction of a barn, *agricultural building*, silo, stockyard, pen or other structural practices identified in Table II in the "Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State" prepared by the Department in cooperation with agencies of New York Nonpoint Source Coordinating Committee (dated June 2007).

Alter Hydrology from Pre to Post-Development Conditions - means the post-development peak flow rate(s) has increased by more than 5% of the pre-developed condition for the design storm of interest (e.g. 10 yr and 100 yr).

Combined Sewer - means a sewer that is designed to collect and convey both "sewage" and "stormwater".

Commence (Commencement of) Construction Activities - means the initial disturbance of soils associated with clearing, grading or excavation activities; or other construction related activities that disturb or expose soils such as demolition, stockpiling of fill material, and the initial installation of erosion and sediment control practices required in the SWPPP. See definition for "*Construction Activity(ies)*" also.

Construction Activity(ies) - means any clearing, grading, excavation, filling, demolition or stockpiling activities that result in soil disturbance. Clearing activities can include, but are not limited to, logging equipment operation, the cutting and skidding of trees, stump removal and/or brush root removal. Construction activity does not include routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility.

Construction Site – means the land area where *construction activity(ies)* will occur. See definition for "*Commence (Commencement of) Construction Activities"* and "*Larger Common Plan of Development or Sale" also.*

Dewatering – means the act of draining rainwater and/or groundwater from building foundations, vaults or excavations/trenches.

Direct Discharge (to a specific surface waterbody) - means that runoff flows from a *construction site* by overland flow and the first point of discharge is the specific surface waterbody, or runoff flows from a *construction site* to a separate storm sewer system and the first point of discharge from the separate storm sewer system is the specific surface waterbody.

Discharge(s) - means any addition of any pollutant to waters of the State through an outlet or *point source*.

Embankment –means an earthen or rock slope that supports a road/highway.

Endangered or Threatened Species – see 6 NYCRR Part 182 of the Department's rules and regulations for definition of terms and requirements.

Environmental Conservation Law (ECL) - means chapter 43-B of the Consolidated Laws of the State of New York, entitled the Environmental Conservation Law.

Equivalent (Equivalence) – means that the practice or measure meets all the performance, longevity, maintenance, and safety objectives of the technical standard and will provide an equal or greater degree of water quality protection.

Final Stabilization - means that all soil disturbance activities have ceased and a uniform, perennial vegetative cover with a density of eighty (80) percent over the entire pervious surface has been established; or other equivalent stabilization measures, such as permanent landscape mulches, rock rip-rap or washed/crushed stone have been applied on all disturbed areas that are not covered by permanent structures, concrete or pavement.

General SPDES permit - means a SPDES permit issued pursuant to 6 NYCRR Part 750-1.21 and Section 70-0117 of the ECL authorizing a category of discharges.

Groundwater(s) - means waters in the saturated zone. The saturated zone is a subsurface zone in which all the interstices are filled with water under pressure greater than that of the atmosphere. Although the zone may contain gas-filled interstices or interstices filled with fluids other than water, it is still considered saturated.

Historic Property – means any building, structure, site, object or district that is listed on the State or National Registers of Historic Places or is determined to be eligible for listing on the State or National Registers of Historic Places.

Impervious Area (Cover) - means all impermeable surfaces that cannot effectively infiltrate rainfall. This includes paved, concrete and gravel surfaces (i.e. parking lots, driveways, roads, runways and sidewalks); building rooftops and miscellaneous impermeable structures such as patios, pools, and sheds.

Infeasible – means not technologically possible, or not economically practicable and achievable in light of best industry practices.

Larger Common Plan of Development or Sale - means a contiguous area where multiple separate and distinct *construction activities* are occurring, or will occur, under one plan. The term "plan" in "larger common plan of development or sale" is broadly defined as any announcement or piece of documentation (including a sign, public notice or hearing, marketing plan, advertisement, drawing, permit application, State Environmental Quality Review Act (SEQRA) environmental assessment form or other documents, zoning request, computer design, etc.) or physical demarcation (including boundary signs, lot stakes, surveyor markings, etc.) indicating that *construction activities* may occur on a specific plot.

For discrete construction projects that are located within a larger common plan of development or sale that are at least 1/4 mile apart, each project can be treated as a separate plan of development or sale provided any interconnecting road, pipeline or utility project that is part of the same "common plan" is not concurrently being disturbed.

Minimize – means reduce and/or eliminate to the extent achievable using control measures (including best management practices) that are technologically available and economically practicable and achievable in light of best industry practices.

Municipal Separate Storm Sewer (MS4) - a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains):

(i) Owned or operated by a State, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to surface waters of the State*;*
(ii) Designed or used for collecting or conveying stormwater;
(iii) Which is not a *combined sewer*; and
(iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR 122.2.

National Pollutant Discharge Elimination System (NPDES) - means the national system for the issuance of wastewater and stormwater permits under the Federal Water Pollution Control Act (Clean Water Act).

Natural Buffer –means an undisturbed area with natural cover running along a surface water (e.g. wetland, stream, river, lake, etc.).

New Development – means any land disturbance that does not meet the definition of Redevelopment Activity included in this appendix.

New York State Erosion and Sediment Control Certificate Program – a certificate program that establishes and maintains a process to identify and recognize individuals who are capable of developing, designing, inspecting and maintaining erosion and sediment control plans on projects that disturb soils in New York State. The certificate program is administered by the New York State Conservation District Employees Association.

NOI Acknowledgment Letter - means the letter that the Department sends to an owner or operator to acknowledge the Department's receipt and acceptance of a complete Notice of Intent. This letter documents the owner's or operator's authorization to discharge in accordance with the general permit for stormwater discharges from *construction activity*.

Nonpoint Source - means any source of water pollution or pollutants which is not a discrete conveyance or *point source* permitted pursuant to Title 7 or 8 of Article 17 of the Environmental Conservation Law (see ECL Section 17-1403).

Overbank –means flow events that exceed the capacity of the stream channel and spill out into the adjacent floodplain.

Owner or Operator - means the person, persons or legal entity which owns or leases the property on which the *construction activity* is occurring; an entity that has operational control over the construction plans and specifications, including the ability to make modifications to the plans and specifications; and/or an entity that has day-to-day operational control of those activities at a project that are necessary to ensure compliance with the permit conditions.

Performance Criteria – means the design criteria listed under the "Required Elements" sections in Chapters 5, 6 and 10 of the technical standard, New York State Stormwater Management Design Manual, dated January 2015. It does not include the Sizing Criteria (i.e. WQv, RRv, Cpv, Qp and Qf) in Part I.C.2. of the permit.

Point Source - means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel or other floating craft, or landfill leachate collection system from which *pollutants* are or may be discharged.

Pollutant - means dredged spoil, filter backwash, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand and industrial, municipal, agricultural waste and ballast discharged into water; which may cause or might reasonably be expected to cause pollution of the waters of the state in contravention of the standards or guidance values adopted as provided in 6 NYCRR Parts 700 et seq .

Qualified Inspector - means a person that is knowledgeable in the principles and practices of erosion and sediment control, such as a licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, New York State Erosion and Sediment Control Certificate Program holder or other Department endorsed individual(s).

It can also mean someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided that person has training in the principles and practices of erosion and sediment control. Training in the principles and practices of erosion and sediment control means that the individual working under the direct supervision of the licensed Professional Engineer or Registered Landscape Architect has received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity. After receiving the initial training, the individual working under the direct supervision of the licensed Professional Engineer or Registered Landscape Architect shall receive four (4) hours of training every three (3) years.

It can also mean a person that meets the *Qualified Professional* qualifications in addition to the *Qualified Inspector* qualifications.

Note: Inspections of any post-construction stormwater management practices that include structural components, such as a dam for an impoundment, shall be performed by a licensed Professional Engineer.

Qualified Professional - means a person that is knowledgeable in the principles and practices of stormwater management and treatment, such as a licensed Professional Engineer, Registered Landscape Architect or other Department endorsed individual(s). Individuals preparing SWPPPs that require the post-construction stormwater management practice component must have an understanding of the principles of hydrology, water quality management practice design, water quantity control design, and, in many cases, the principles of hydraulics. All components of the SWPPP that involve the practice of engineering, as defined by the NYS Education Law (see Article 145), shall be prepared by, or under the direct supervision of, a professional engineer licensed to practice in the State of New York.

Redevelopment Activity(ies) – means the disturbance and reconstruction of existing impervious area, including impervious areas that were removed from a project site within five (5) years of preliminary project plan submission to the local government (i.e. site plan, subdivision, etc.).

Regulated, Traditional Land Use Control MS4 - means a city, town or village with land use control authority that is authorized to discharge under New York State DEC's

SPDES General Permit For Stormwater Discharges from Municipal Separate Stormwater Sewer Systems (MS4s) or the City of New York's Individual SPDES Permit for their Municipal Separate Storm Sewer Systems (NY-0287890).

Routine Maintenance Activity - means *construction activity* that is performed to maintain the original line and grade, hydraulic capacity, or original purpose of a facility, including, but not limited to:

- Re-grading of gravel roads or parking lots,
- Cleaning and shaping of existing roadside ditches and culverts that maintains the approximate original line and grade, and hydraulic capacity of the ditch,
- Cleaning and shaping of existing roadside ditches that does not maintain the approximate original grade, hydraulic capacity and purpose of the ditch if the changes to the line and grade, hydraulic capacity or purpose of the ditch are installed to improve water quality and quantity controls (e.g. installing grass lined ditch),
- Placement of aggregate shoulder backing that stabilizes the transition between the road shoulder and the ditch or *embankment*,
- Full depth milling and filling of existing asphalt pavements, replacement of concrete pavement slabs, and similar work that does not expose soil or disturb the bottom six (6) inches of subbase material,
- Long-term use of equipment storage areas at or near highway maintenance facilities,
- Removal of sediment from the edge of the highway to restore a previously existing sheet-flow drainage connection from the highway surface to the highway ditch or *embankment*,
- Existing use of Canal Corp owned upland disposal sites for the canal, and
- Replacement of curbs, gutters, sidewalks and guide rail posts.

Site limitations – means site conditions that prevent the use of an infiltration technique and or infiltration of the total WQv. Typical site limitations include: seasonal high groundwater, shallow depth to bedrock, and soils with an infiltration rate less than 0.5 inches/hour. The existence of site limitations shall be confirmed and documented using actual field testing (i.e. test pits, soil borings, and infiltration test) or using information from the most current United States Department of Agriculture (USDA) Soil Survey for the County where the project is located.

Sizing Criteria – means the criteria included in Part I.C.2 of the permit that are used to size post-construction stormwater management control practices. The criteria include; Water Quality Volume (WQv), Runoff Reduction Volume (RRv), Channel Protection Volume (Cpv), *Overbank* Flood (Qp), and Extreme Flood (Qf).

State Pollutant Discharge Elimination System (SPDES) - means the system established pursuant to Article 17 of the ECL and 6 NYCRR Part 750 for issuance of permits authorizing discharges to the waters of the state.

Steep Slope – means land area designated on the current United States Department of Agriculture ("USDA") Soil Survey as Soil Slope Phase "D", (provided the map unit name is inclusive of slopes greater than 25%) , or Soil Slope Phase E or F, (regardless of the map unit name), or a combination of the three designations.

Streambank – as used in this permit, means the terrain alongside the bed of a creek or stream. The bank consists of the sides of the channel, between which the flow is confined.

Stormwater Pollution Prevention Plan (SWPPP) – means a project specific report, including construction drawings, that among other things: describes the construction activity(ies), identifies the potential sources of pollution at the *construction site*; describes and shows the stormwater controls that will be used to control the pollutants (i.e. erosion and sediment controls; for many projects, includes post-construction stormwater management controls); and identifies procedures the *owner or operator* will implement to comply with the terms and conditions of the permit. See Part III of the permit for a complete description of the information that must be included in the SWPPP.

Surface Waters of the State - shall be construed to include lakes, bays, sounds, ponds, impounding reservoirs, springs, rivers, streams, creeks, estuaries, marshes, inlets, canals, the Atlantic ocean within the territorial seas of the state of New York and all other bodies of surface water, natural or artificial, inland or coastal, fresh or salt, public or private (except those private waters that do not combine or effect a junction with natural surface waters), which are wholly or partially within or bordering the state or within its jurisdiction. Waters of the state are further defined in 6 NYCRR Parts 800 to 941.

Temporarily Ceased – means that an existing disturbed area will not be disturbed again within 14 calendar days of the previous soil disturbance.

Temporary Stabilization - means that exposed soil has been covered with material(s) as set forth in the technical standard, New York Standards and Specifications for Erosion and Sediment Control, to prevent the exposed soil from eroding. The materials can include, but are not limited to, mulch, seed and mulch, and erosion control mats (e.g. jute twisted yarn, excelsior wood fiber mats).

Total Maximum Daily Loads (TMDLs) - A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and *nonpoint source*s. It is a calculation of the maximum amount of a pollutant that a waterbody can receive on a daily basis and still meet *water quality standards*, and an allocation of that amount to the pollutant's sources. A TMDL stipulates wasteload allocations (WLAs) for *point source* discharges, load allocations (LAs) for *nonpoint source*s, and a margin of safety (MOS).

Trained Contractor - means an employee from the contracting (construction) company, identified in Part III.A.6., that has received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity. After receiving the initial training, the *trained contractor* shall receive four (4) hours of training every three (3) years.

It can also mean an employee from the contracting (construction) company, identified in Part III.A.6., that meets the *qualified inspector* qualifications (e.g. licensed Professional Engineer, Certified Professional in Erosion and Sediment Control (CPESC), Registered Landscape Architect, New York State Erosion and Sediment Control Certificate Program holder, or someone working under the direct supervision of, and at the same company as, the licensed Professional Engineer or Registered Landscape Architect, provided they have received four (4) hours of Department endorsed training in proper erosion and sediment control principles from a Soil and Water Conservation District, or other Department endorsed entity).

The *trained contractor* is responsible for the day to day implementation of the SWPPP.

Uniform Procedures Act (UPA) Permit - means a permit required under 6 NYCRR Part 621 of the Environmental Conservation Law (ECL), Article 70.

Water Quality Standard - means such measures of purity or quality for any waters in relation to their reasonable and necessary use as promulgated in 6 NYCRR Part 700 et seq.

APPENDIX B – Required SWPPP Components by Project Type

Table 1
Construction Activities that Require the Preparation of a SWPPP That Only Includes Erosion and Sediment Controls

The following construction activities that involve soil disturbances of one (1) or more acres of land, but less than five (5) acres: • Single family home not located in one of the watersheds listed in Appendix C or not *directly discharging* to one of the 303(d) segments listed in Appendix E • Single family residential subdivisions with 25% or less impervious cover at total site build-out and not located in one of the watersheds listed in Appendix C and not directly discharging to one of the 303(d) segments listed in Appendix E • Construction of a barn or other *agricultural building*, silo, stock yard or pen.
The following construction activities that involve soil disturbances between five thousand (5000) square feet and one (1) acre of land: All construction activities located in the watersheds identified in Appendix D that involve soil disturbances between five thousand (5,000) square feet and one (1) acre of land.
The following construction activities that involve soil disturbances of one (1) or more acres of land: • Installation of underground, linear utilities; such as gas lines, fiber-optic cable, cable TV, electric, telephone, sewer mains, and water mains • Environmental enhancement projects, such as wetland mitigation projects, stormwater retrofits and stream restoration projects • Pond construction • Linear bike paths running through areas with vegetative cover, including bike paths surfaced with an impervious cover • Cross-country ski trails and walking/hiking trails • Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are not part of residential, commercial or institutional development; • Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that include incidental shoulder or curb work along an existing highway to support construction of the sidewalk, bike path or walking path. • Slope stabilization projects • Slope flattening that changes the grade of the site, but does not significantly change the runoff characteristics

Table 1 (Continued) CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP
THAT ONLY INCLUDES EROSION AND SEDIMENT CONTROLS

The following construction activities that involve soil disturbances of one (1) or more acres of land:

- Spoil areas that will be covered with vegetation
- Vegetated open space projects (i.e. recreational parks, lawns, meadows, fields, downhill ski trails) excluding projects that *alter hydrology from pre to post development* conditions,
- Athletic fields (natural grass) that do not include the construction or reconstruction of *impervious area* <u>and</u> do not *alter hydrology from pre to post development* conditions
- Demolition project where vegetation will be established, and no redevelopment is planned
- Overhead electric transmission line project that does not include the construction of permanent access roads or parking areas surfaced with *impervious cover*
- Structural practices as identified in Table II in the "Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State", excluding projects that involve soil disturbances of greater than five acres and construction activities that include the construction or reconstruction of impervious area
- Temporary access roads, median crossovers, detour roads, lanes, or other temporary impervious areas that will be restored to pre-construction conditions once the construction activity is complete

Table 2

CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP THAT INCLUDES POST-CONSTRUCTION STORMWATER MANAGEMENT PRACTICES

The following construction activities that involve soil disturbances of one (1) or more acres of land:

- Single family home located in one of the watersheds listed in Appendix C or *directly discharging* to one of the 303(d) segments listed in Appendix E
- Single family home that disturbs five (5) or more acres of land
- Single family residential subdivisions located in one of the watersheds listed in Appendix C or *directly discharging* to one of the 303(d) segments listed in Appendix E
- Single family residential subdivisions that involve soil disturbances of between one (1) and five (5) acres of land with greater than 25% impervious cover at total site build-out
- Single family residential subdivisions that involve soil disturbances of five (5) or more acres of land, and single family residential subdivisions that involve soil disturbances of less than five (5) acres that are part of a larger common plan of development or sale that will ultimately disturb five or more acres of land
- Multi-family residential developments; includes duplexes, townhomes, condominiums, senior housing complexes, apartment complexes, and mobile home parks
- Airports
- Amusement parks
- Breweries, cideries, and wineries, including establishments constructed on agricultural land
- Campgrounds
- Cemeteries that include the construction or reconstruction of impervious area (>5% of disturbed area) or *alter the hydrology from pre to post development* conditions
- Commercial developments
- Churches and other places of worship
- Construction of a barn or other *agricultural building* (e.g. silo) and structural practices as identified in Table II in the “Agricultural Management Practices Catalog for Nonpoint Source Pollution in New York State” that include the construction or reconstruction of *impervious area*, excluding projects that involve soil disturbances of less than five acres.
- Golf courses
- Institutional development; includes hospitals, prisons, schools and colleges
- Industrial facilities; includes industrial parks
- Landfills
- Municipal facilities; includes highway garages, transfer stations, office buildings, POTW’s, water treatment plants, and water storage tanks
- Office complexes
- Playgrounds that include the construction or reconstruction of impervious area
- Sports complexes
- Racetracks; includes racetracks with earthen (dirt) surface
- Road construction or reconstruction, including roads constructed as part of the construction activities listed in Table 1

Table 2 (Continued)

CONSTRUCTION ACTIVITIES THAT REQUIRE THE PREPARATION OF A SWPPP THAT INCLUDES POST-CONSTRUCTION STORMWATER MANAGEMENT PRACTICES

The following construction activities that involve soil disturbances of one (1) or more acres of land:

- Parking lot construction or reconstruction, including parking lots constructed as part of the construction activities listed in Table 1
- Athletic fields (natural grass) that include the construction or reconstruction of impervious area (>5% of disturbed area) or *alter the hydrology from pre to post development* conditions
- Athletic fields with artificial turf
- Permanent access roads, parking areas, substations, compressor stations and well drilling pads, surfaced with *impervious cover,* and constructed as part of an over-head electric transmission line project, wind-power project, cell tower project, oil or gas well drilling project, sewer or water main project or other linear utility project
- Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a residential, commercial or institutional development
- Sidewalk, bike path or walking path projects, surfaced with an impervious cover, that are part of a highway construction or reconstruction project
- All other construction activities that include the construction or reconstruction of *impervious area* <u>or</u> *alter the hydrology from pre to post development* conditions, <u>and</u> are not listed in Table 1

APPENDIX C – Watersheds Requiring Enhanced Phosphorus Removal

Watersheds where *owners or operators* of construction activities identified in Table 2 of Appendix B must prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the Enhanced Phosphorus Removal Standards included in the technical standard, New York State Stormwater Management Design Manual ("Design Manual").

- Entire New York City Watershed located east of the Hudson River **-** Figure 1
- Onondaga Lake Watershed **-** Figure 2
- Greenwood Lake Watershed **-**Figure 3
- Oscawana Lake Watershed – Figure 4
- Kinderhook Lake Watershed – Figure 5

Figure 1 - New York City Watershed East of the Hudson

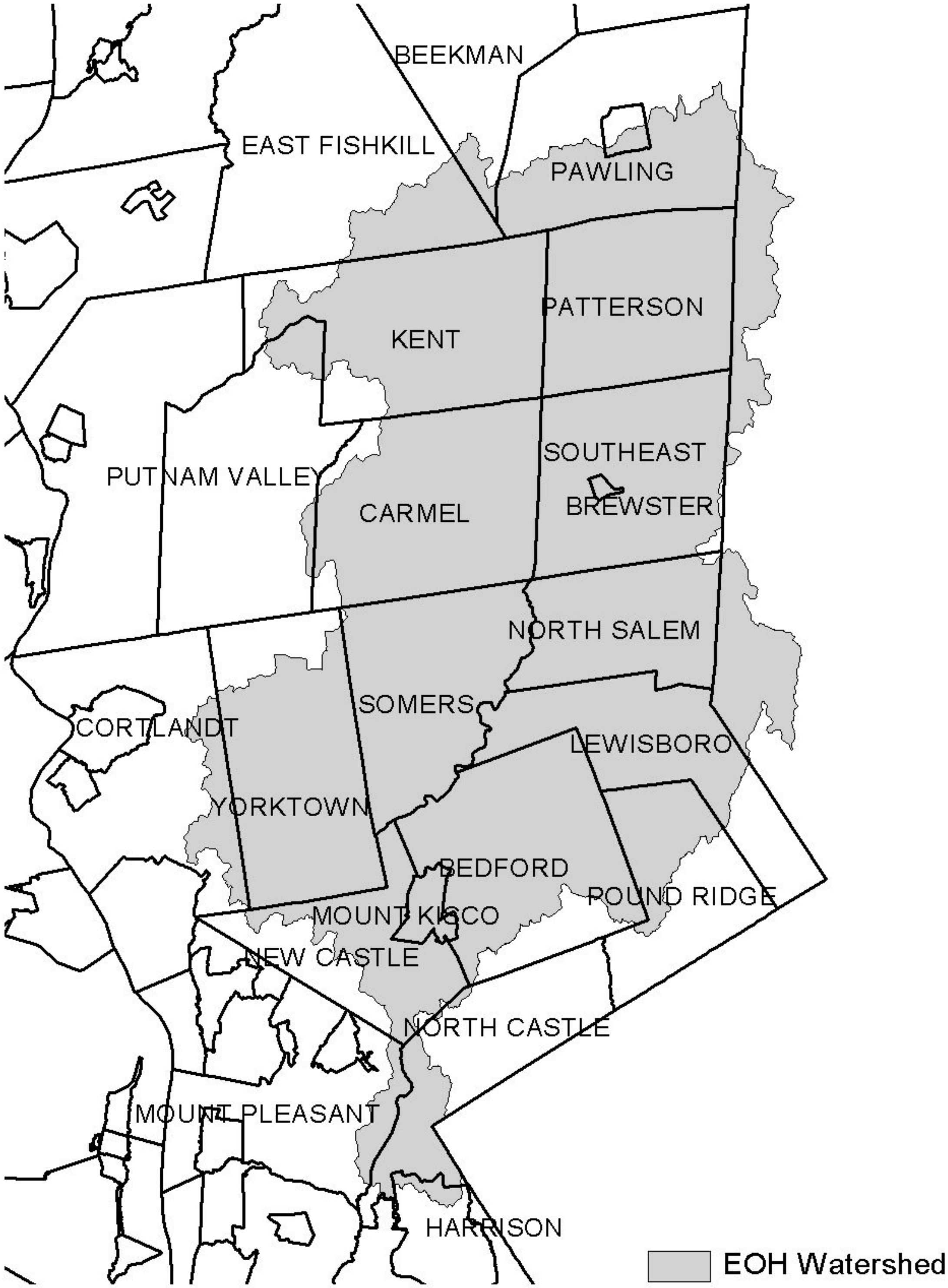


Figure 2 - Onondaga Lake Watershed

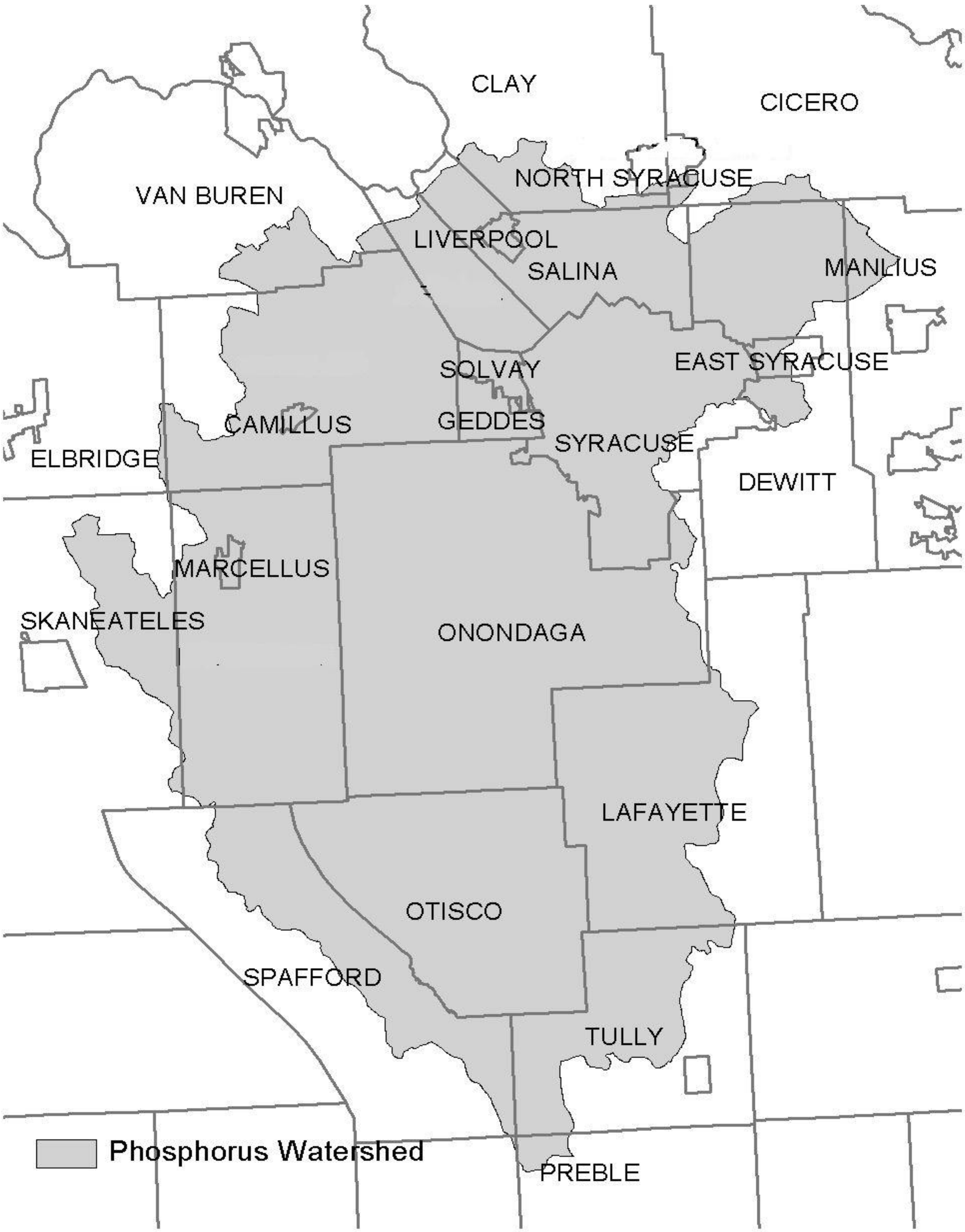
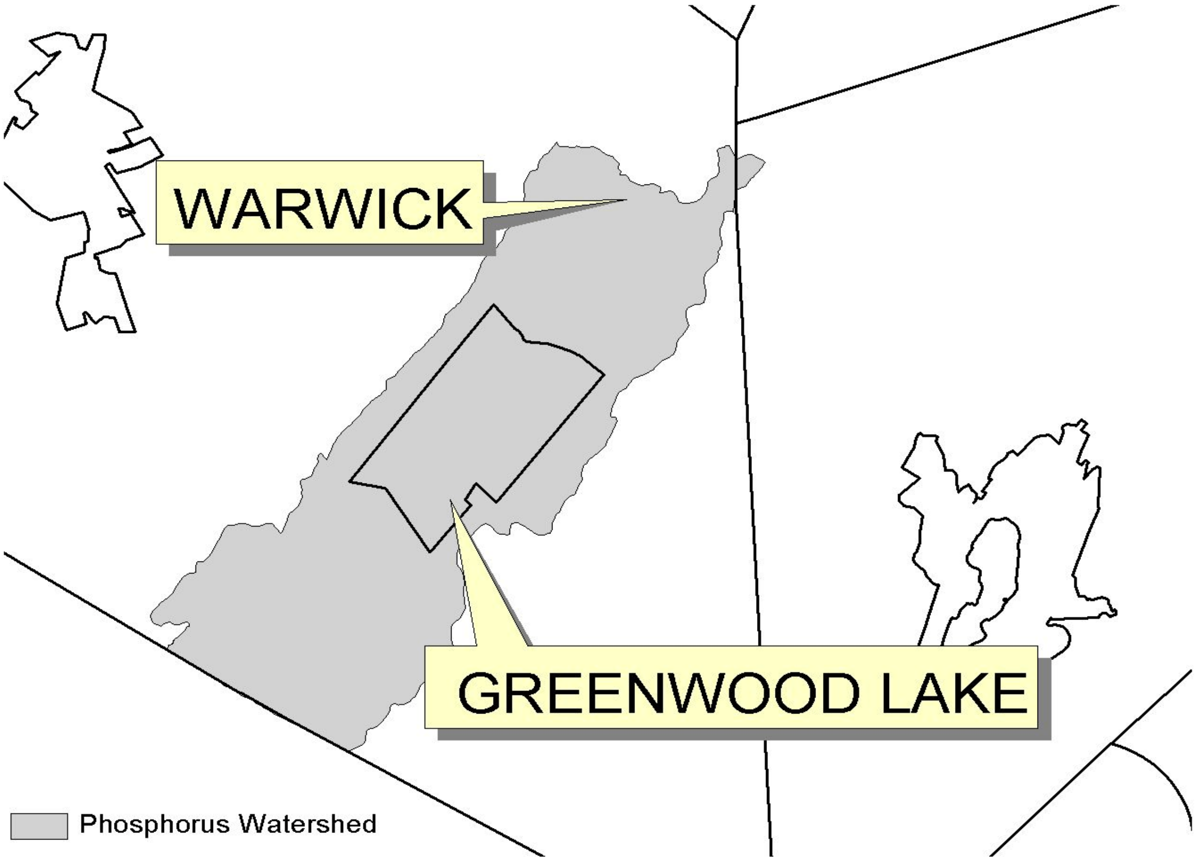


Figure 3 - Greenwood Lake Watershed



<u>Figure 4 - Oscawana Lake Watershed</u>

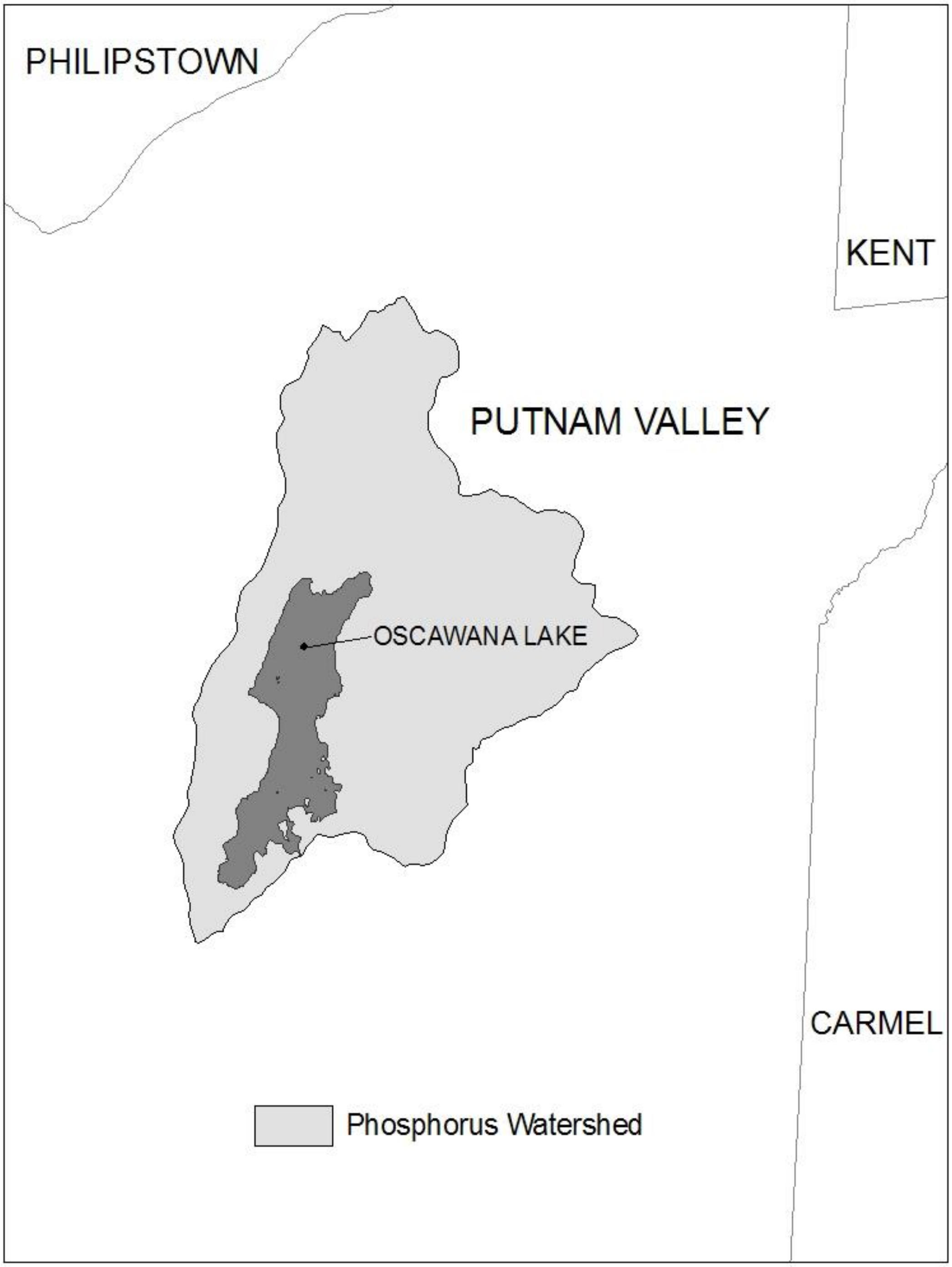
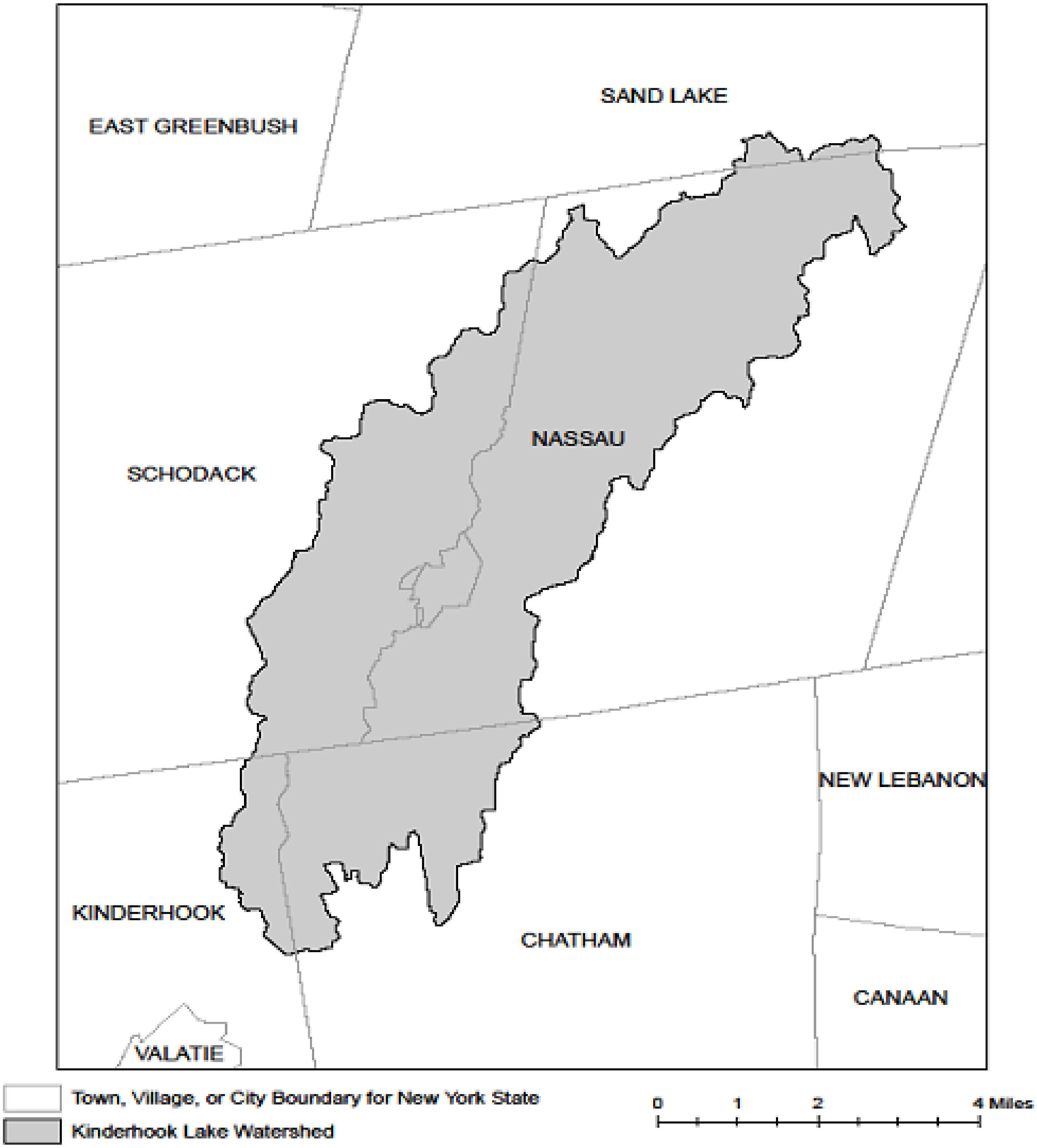


Figure 5 - Kinderhook Lake Watershed



APPENDIX D – Watersheds with Lower Disturbance Threshold

Watersheds where *owners or operators* of construction activities that involve soil disturbances between five thousand (5000) square feet and one (1) acre of land must obtain coverage under this permit.

Entire New York City Watershed that is located east of the Hudson River **-** See Figure 1 in Appendix C

APPENDIX E – 303(d) Segments Impaired by Construction Related Pollutant(s)

List of 303(d) segments impaired by pollutants related to *construction activity* (e.g. silt, sediment or nutrients). The list was developed using "The Final New York State 2016 Section 303(d) List of Impaired Waters Requiring a TMDL/Other Strategy" dated November 2016. *Owners or operators* of single family home and single family residential subdivisions with 25% or less total impervious cover at total site build-out that involve soil disturbances of one or more acres of land, but less than 5 acres, and *directly discharge* to one of the listed segments below shall prepare a SWPPP that includes post-construction stormwater management practices designed in conformance with the New York State Stormwater Management Design Manual ("Design Manual"), dated January 2015.

COUNTY	WATERBODY	POLLUTANT
Albany	Ann Lee (Shakers) Pond, Stump Pond	Nutrients
Albany	Basic Creek Reservoir	Nutrients
Allegany	Amity Lake, Saunders Pond	Nutrients
Bronx	Long Island Sound, Bronx	Nutrients
Bronx	Van Cortlandt Lake	Nutrients
Broome	Fly Pond, Deer Lake, Sky Lake	Nutrients
Broome	Minor Tribs to Lower Susquehanna (north)	Nutrients
Broome	Whitney Point Lake/Reservoir	Nutrients
Cattaraugus	Allegheny River/Reservoir	Nutrients
Cattaraugus	Beaver (Alma) Lake	Nutrients
Cattaraugus	Case Lake	Nutrients
Cattaraugus	Linlyco/Club Pond	Nutrients
Cayuga	Duck Lake	Nutrients
Cayuga	Little Sodus Bay	Nutrients
Chautauqua	Bear Lake	Nutrients
Chautauqua	Chadakoin River and tribs	Nutrients
Chautauqua	Chautauqua Lake, North	Nutrients
Chautauqua	Chautauqua Lake, South	Nutrients
Chautauqua	Findley Lake	Nutrients
Chautauqua	Hulburt/Clymer Pond	Nutrients
Clinton	Great Chazy River, Lower, Main Stem	Silt/Sediment
Clinton	Lake Champlain, Main Lake, Middle	Nutrients
Clinton	Lake Champlain, Main Lake, North	Nutrients
Columbia	Kinderhook Lake	Nutrients
Columbia	Robinson Pond	Nutrients
Cortland	Dean Pond	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Dutchess	Fall Kill and tribs	Nutrients
Dutchess	Hillside Lake	Nutrients
Dutchess	Wappingers Lake	Nutrients
Dutchess	Wappingers Lake	Silt/Sediment
Erie	Beeman Creek and tribs	Nutrients
Erie	Ellicott Creek, Lower, and tribs	Silt/Sediment
Erie	Ellicott Creek, Lower, and tribs	Nutrients
Erie	Green Lake	Nutrients
Erie	Little Sister Creek, Lower, and tribs	Nutrients
Erie	Murder Creek, Lower, and tribs	Nutrients
Erie	Rush Creek and tribs	Nutrients
Erie	Scajaquada Creek, Lower, and tribs	Nutrients
Erie	Scajaquada Creek, Middle, and tribs	Nutrients
Erie	Scajaquada Creek, Upper, and tribs	Nutrients
Erie	South Branch Smoke Cr, Lower, and tribs	Silt/Sediment
Erie	South Branch Smoke Cr, Lower, and tribs	Nutrients
Essex	Lake Champlain, Main Lake, South	Nutrients
Essex	Lake Champlain, South Lake	Nutrients
Essex	Willsboro Bay	Nutrients
Genesee	Bigelow Creek and tribs	Nutrients
Genesee	Black Creek, Middle, and minor tribs	Nutrients
Genesee	Black Creek, Upper, and minor tribs	Nutrients
Genesee	Bowen Brook and tribs	Nutrients
Genesee	LeRoy Reservoir	Nutrients
Genesee	Oak Orchard Cr, Upper, and tribs	Nutrients
Genesee	Tonawanda Creek, Middle, Main Stem	Nutrients
Greene	Schoharie Reservoir	Silt/Sediment
Greene	Sleepy Hollow Lake	Silt/Sediment
Herkimer	Steele Creek tribs	Silt/Sediment
Herkimer	Steele Creek tribs	Nutrients
Jefferson	Moon Lake	Nutrients
Kings	Hendrix Creek	Nutrients
Kings	Prospect Park Lake	Nutrients
Lewis	Mill Creek/South Branch, and tribs	Nutrients
Livingston	Christie Creek and tribs	Nutrients
Livingston	Conesus Lake	Nutrients
Livingston	Mill Creek and minor tribs	Silt/Sediment
Monroe	Black Creek, Lower, and minor tribs	Nutrients
Monroe	Buck Pond	Nutrients
Monroe	Cranberry Pond	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Monroe	Lake Ontario Shoreline, Western	Nutrients
Monroe	Long Pond	Nutrients
Monroe	Mill Creek and tribs	Nutrients
Monroe	Mill Creek/Blue Pond Outlet and tribs	Nutrients
Monroe	Minor Tribs to Irondequoit Bay	Nutrients
Monroe	Rochester Embayment - East	Nutrients
Monroe	Rochester Embayment - West	Nutrients
Monroe	Shipbuilders Creek and tribs	Nutrients
Monroe	Thomas Creek/White Brook and tribs	Nutrients
Nassau	Beaver Lake	Nutrients
Nassau	Camaans Pond	Nutrients
Nassau	East Meadow Brook, Upper, and tribs	Silt/Sediment
Nassau	East Rockaway Channel	Nutrients
Nassau	Grant Park Pond	Nutrients
Nassau	Hempstead Bay	Nutrients
Nassau	Hempstead Lake	Nutrients
Nassau	Hewlett Bay	Nutrients
Nassau	Hog Island Channel	Nutrients
Nassau	Long Island Sound, Nassau County Waters	Nutrients
Nassau	Massapequa Creek and tribs	Nutrients
Nassau	Milburn/Parsonage Creeks, Upp, and tribs	Nutrients
Nassau	Reynolds Channel, west	Nutrients
Nassau	Tidal Tribs to Hempstead Bay	Nutrients
Nassau	Tribs (fresh) to East Bay	Nutrients
Nassau	Tribs (fresh) to East Bay	Silt/Sediment
Nassau	Tribs to Smith/Halls Ponds	Nutrients
Nassau	Woodmere Channel	Nutrients
New York	Harlem Meer	Nutrients
New York	The Lake in Central Park	Nutrients
Niagara	Bergholtz Creek and tribs	Nutrients
Niagara	Hyde Park Lake	Nutrients
Niagara	Lake Ontario Shoreline, Western	Nutrients
Niagara	Lake Ontario Shoreline, Western	Nutrients
Oneida	Ballou, Nail Creeks and tribs	Nutrients
Onondaga	Harbor Brook, Lower, and tribs	Nutrients
Onondaga	Ley Creek and tribs	Nutrients
Onondaga	Minor Tribs to Onondaga Lake	Nutrients
Onondaga	Ninemile Creek, Lower, and tribs	Nutrients
Onondaga	Onondaga Creek, Lower, and tribs	Nutrients
Onondaga	Onondaga Creek, Middle, and tribs	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Onondaga	Onondaga Lake, northern end	Nutrients
Onondaga	Onondaga Lake, southern end	Nutrients
Ontario	Great Brook and minor tribs	Silt/Sediment
Ontario	Great Brook and minor tribs	Nutrients
Ontario	Hemlock Lake Outlet and minor tribs	Nutrients
Ontario	Honeoye Lake	Nutrients
Orange	Greenwood Lake	Nutrients
Orange	Monhagen Brook and tribs	Nutrients
Orange	Orange Lake	Nutrients
Orleans	Lake Ontario Shoreline, Western	Nutrients
Orleans	Lake Ontario Shoreline, Western	Nutrients
Oswego	Lake Neatahwanta	Nutrients
Oswego	Pleasant Lake	Nutrients
Putnam	Bog Brook Reservoir	Nutrients
Putnam	Boyd Corners Reservoir	Nutrients
Putnam	Croton Falls Reservoir	Nutrients
Putnam	Diverting Reservoir	Nutrients
Putnam	East Branch Reservoir	Nutrients
Putnam	Lake Carmel	Nutrients
Putnam	Middle Branch Reservoir	Nutrients
Putnam	Oscawana Lake	Nutrients
Putnam	Palmer Lake	Nutrients
Putnam	West Branch Reservoir	Nutrients
Queens	Bergen Basin	Nutrients
Queens	Flushing Creek/Bay	Nutrients
Queens	Jamaica Bay, Eastern, and tribs (Queens)	Nutrients
Queens	Kissena Lake	Nutrients
Queens	Meadow Lake	Nutrients
Queens	Willow Lake	Nutrients
Rensselaer	Nassau Lake	Nutrients
Rensselaer	Snyders Lake	Nutrients
Richmond	Grasmere Lake/Bradys Pond	Nutrients
Rockland	Congers Lake, Swartout Lake	Nutrients
Rockland	Rockland Lake	Nutrients
Saratoga	Ballston Lake	Nutrients
Saratoga	Dwaas Kill and tribs	Silt/Sediment
Saratoga	Dwaas Kill and tribs	Nutrients
Saratoga	Lake Lonely	Nutrients
Saratoga	Round Lake	Nutrients
Saratoga	Tribs to Lake Lonely	Nutrients

303(d) Segments Impaired by Construction Related Pollutant(s)

Schenectady	Collins Lake	Nutrients
Schenectady	Duane Lake	Nutrients
Schenectady	Mariaville Lake	Nutrients
Schoharie	Engleville Pond	Nutrients
Schoharie	Summit Lake	Nutrients
Seneca	Reeder Creek and tribs	Nutrients
St.Lawrence	Black Lake Outlet/Black Lake	Nutrients
St.Lawrence	Fish Creek and minor tribs	Nutrients
Steuben	Smith Pond	Nutrients
Suffolk	Agawam Lake	Nutrients
Suffolk	Big/Little Fresh Ponds	Nutrients
Suffolk	Canaan Lake	Silt/Sediment
Suffolk	Canaan Lake	Nutrients
Suffolk	Flanders Bay, West/Lower Sawmill Creek	Nutrients
Suffolk	Fresh Pond	Nutrients
Suffolk	Great South Bay, East	Nutrients
Suffolk	Great South Bay, Middle	Nutrients
Suffolk	Great South Bay, West	Nutrients
Suffolk	Lake Ronkonkoma	Nutrients
Suffolk	Long Island Sound, Suffolk County, West	Nutrients
Suffolk	Mattituck (Marratooka) Pond	Nutrients
Suffolk	Meetinghouse/Terrys Creeks and tribs	Nutrients
Suffolk	Mill and Seven Ponds	Nutrients
Suffolk	Millers Pond	Nutrients
Suffolk	Moriches Bay, East	Nutrients
Suffolk	Moriches Bay, West	Nutrients
Suffolk	Peconic River, Lower, and tidal tribs	Nutrients
Suffolk	Quantuck Bay	Nutrients
Suffolk	Shinnecock Bay and Inlet	Nutrients
Suffolk	Tidal tribs to West Moriches Bay	Nutrients
Sullivan	Bodine, Montgomery Lakes	Nutrients
Sullivan	Davies Lake	Nutrients
Sullivan	Evens Lake	Nutrients
Sullivan	Pleasure Lake	Nutrients
Tompkins	Cayuga Lake, Southern End	Nutrients
Tompkins	Cayuga Lake, Southern End	Silt/Sediment
Tompkins	Owasco Inlet, Upper, and tribs	Nutrients
Ulster	Ashokan Reservoir	Silt/Sediment
Ulster	Esopus Creek, Upper, and minor tribs	Silt/Sediment
Warren	Hague Brook and tribs	Silt/Sediment

303(d) Segments Impaired by Construction Related Pollutant(s)

Warren	Huddle/Finkle Brooks and tribs	Silt/Sediment
Warren	Indian Brook and tribs	Silt/Sediment
Warren	Lake George	Silt/Sediment
Warren	Tribs to L.George, Village of L George	Silt/Sediment
Washington	Cossayuna Lake	Nutrients
Washington	Lake Champlain, South Bay	Nutrients
Washington	Tribs to L.George, East Shore	Silt/Sediment
Washington	Wood Cr/Champlain Canal and minor tribs	Nutrients
Wayne	Port Bay	Nutrients
Westchester	Amawalk Reservoir	Nutrients
Westchester	Blind Brook, Upper, and tribs	Silt/Sediment
Westchester	Cross River Reservoir	Nutrients
Westchester	Lake Katonah	Nutrients
Westchester	Lake Lincolndale	Nutrients
Westchester	Lake Meahagh	Nutrients
Westchester	Lake Mohegan	Nutrients
Westchester	Lake Shenorock	Nutrients
Westchester	Long Island Sound, Westchester (East)	Nutrients
Westchester	Mamaroneck River, Lower	Silt/Sediment
Westchester	Mamaroneck River, Upper, and minor tribs	Silt/Sediment
Westchester	Muscoot/Upper New Croton Reservoir	Nutrients
Westchester	New Croton Reservoir	Nutrients
Westchester	Peach Lake	Nutrients
Westchester	Reservoir No.1 (Lake Isle)	Nutrients
Westchester	Saw Mill River, Lower, and tribs	Nutrients
Westchester	Saw Mill River, Middle, and tribs	Nutrients
Westchester	Sheldrake River and tribs	Silt/Sediment
Westchester	Sheldrake River and tribs	Nutrients
Westchester	Silver Lake	Nutrients
Westchester	Teatown Lake	Nutrients
Westchester	Titicus Reservoir	Nutrients
Westchester	Truesdale Lake	Nutrients
Westchester	Wallace Pond	Nutrients
Wyoming	Java Lake	Nutrients
Wyoming	Silver Lake	Nutrients

APPENDIX F – List of NYS DEC Regional Offices

Region	COVERING THE FOLLOWING COUNTIES:	DIVISION OF ENVIRONMENTAL PERMITS (DEP) PERMIT ADMINISTRATORS	DIVISION OF WATER (DOW) WATER (SPDES) PROGRAM
1	NASSAU AND SUFFOLK	50 CIRCLE ROAD STONY BROOK, NY 11790 TEL. (631) 444-0365	50 CIRCLE ROAD STONY BROOK, NY 11790-3409 TEL. (631) 444-0405
2	BRONX, KINGS, NEW YORK, QUEENS AND RICHMOND	1 HUNTERS POINT PLAZA, 47-40 21ST ST. LONG ISLAND CITY, NY 11101-5407 TEL. (718) 482-4997	1 HUNTERS POINT PLAZA, 47-40 21ST ST. LONG ISLAND CITY, NY 11101-5407 TEL. (718) 482-4933
3	DUTCHESS, ORANGE, PUTNAM, ROCKLAND, SULLIVAN, ULSTER AND WESTCHESTER	21 SOUTH PUTT CORNERS ROAD NEW PALTZ, NY 12561-1696 TEL. (845) 256-3059	100 HILLSIDE AVENUE, SUITE 1W WHITE PLAINS, NY 10603 TEL. (914) 428 - 2505
4	ALBANY, COLUMBIA, DELAWARE, GREENE, MONTGOMERY, OTSEGO, RENSSELAER, SCHENECTADY AND SCHOHARIE	1150 NORTH WESTCOTT ROAD SCHENECTADY, NY 12306-2014 TEL. (518) 357-2069	1130 NORTH WESTCOTT ROAD SCHENECTADY, NY 12306-2014 TEL. (518) 357-2045
5	CLINTON, ESSEX, FRANKLIN, FULTON, HAMILTON, SARATOGA, WARREN AND WASHINGTON	1115 STATE ROUTE 86, PO BOX 296 RAY BROOK, NY 12977-0296 TEL. (518) 897-1234	232 GOLF COURSE ROAD WARRENSBURG, NY 12885-1172 TEL. (518) 623-1200
6	HERKIMER, JEFFERSON, LEWIS, ONEIDA AND ST. LAWRENCE	STATE OFFICE BUILDING 317 WASHINGTON STREET WATERTOWN, NY 13601-3787 TEL. (315) 785-2245	STATE OFFICE BUILDING 207 GENESEE STREET UTICA, NY 13501-2885 TEL. (315) 793-2554
7	BROOME, CAYUGA, CHENANGO, CORTLAND, MADISON, ONONDAGA, OSWEGO, TIOGA AND TOMPKINS	615 ERIE BLVD. WEST SYRACUSE, NY 13204-2400 TEL. (315) 426-7438	615 ERIE BLVD. WEST SYRACUSE, NY 13204-2400 TEL. (315) 426-7500
8	CHEMUNG, GENESEE, LIVINGSTON, MONROE, ONTARIO, ORLEANS, SCHUYLER, SENECA, STEUBEN, WAYNE AND YATES	6274 EAST AVON-LIMA ROADAVON, NY 14414-9519 TEL. (585) 226-2466	6274 EAST AVON-LIMA RD. AVON, NY 14414-9519 TEL. (585) 226-2466
9	ALLEGANY, CATTARAUGUS, CHAUTAUQUA, ERIE, NIAGARA AND WYOMING	270 MICHIGAN AVENUE BUFFALO, NY 14203-2999 TEL. (716) 851-7165	270 MICHIGAN AVENUE BUFFALO, NY 14203-2999 TEL. (716) 851-7070

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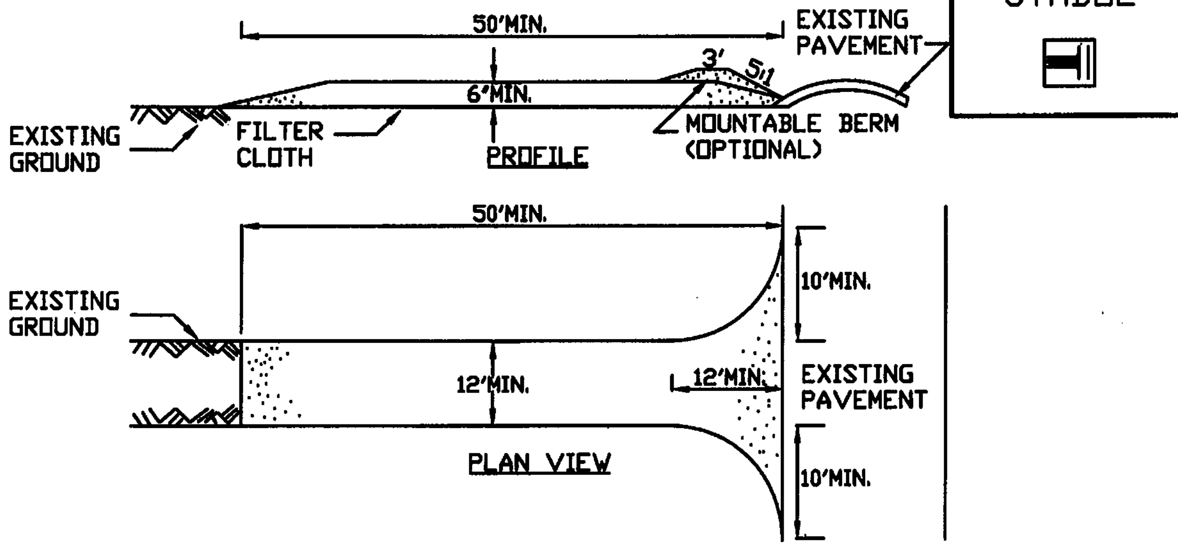
APPENDIX Q: EROSION & SEDIMENT CONTROL DETAILS & BEST MANAGEMENT PRACTICES

Figure 5A.35
Stabilized Construction Entrance

SYMBOL

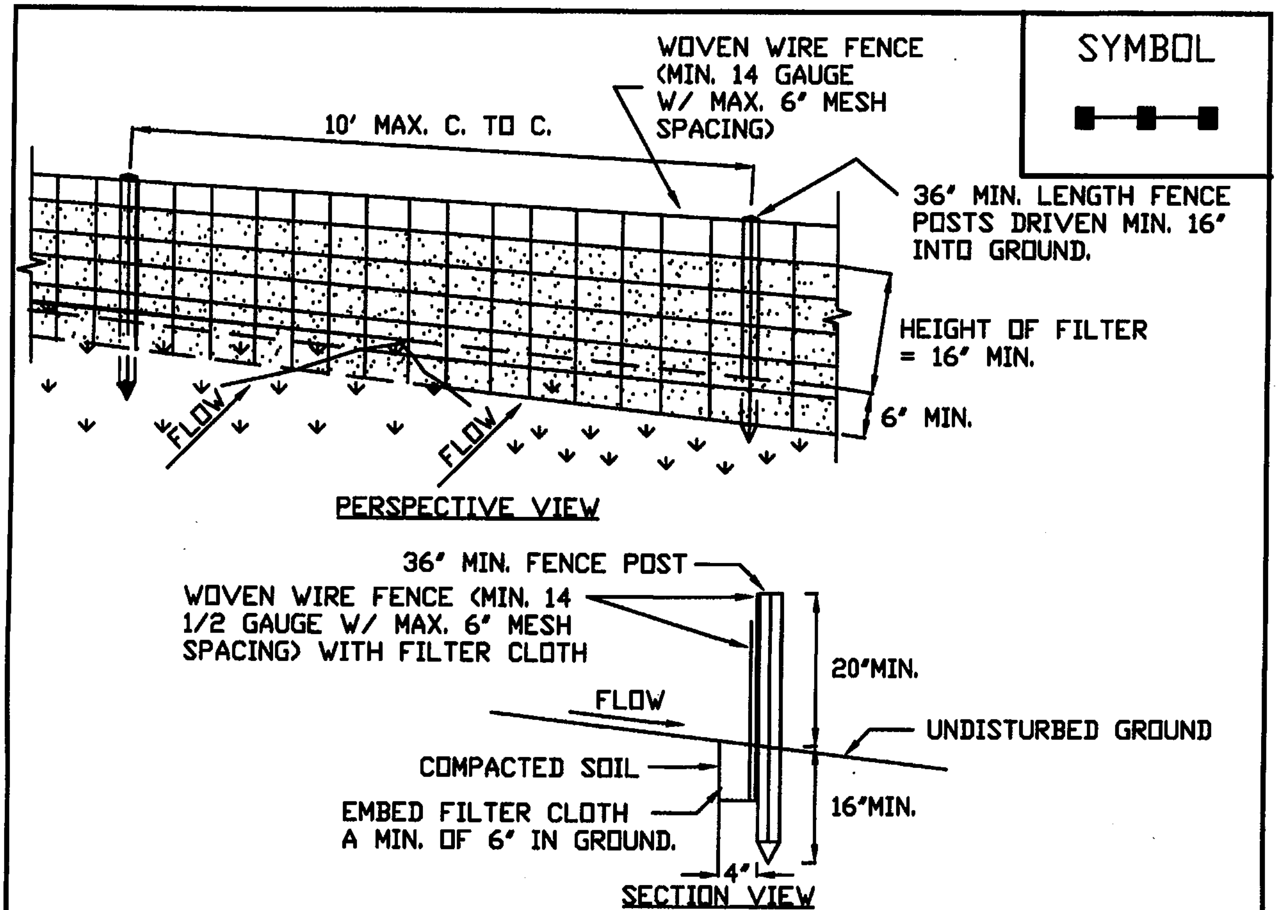


CONSTRUCTION SPECIFICATIONS

1. STONE SIZE - USE 1-4 INCH STONE, OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.
2. LENGTH - NOT LESS THAN 50 FEET (EXCEPT ON A SINGLE RESIDENCE LOT WHERE A 30 FOOT MINIMUM LENGTH WOULD APPLY).
3. THICKNESS - NOT LESS THAN SIX (6) INCHES.
4. WIDTH - TWELVE (12) FOOT MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS. TWENTY-FOUR (24) FOOT IF SINGLE ENTRANCE TO SITE.
5. GEOTEXTILE - WILL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING OF STONE.
6. SURFACE WATER - ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM WITH 5:1 SLOPES WILL BE PERMITTED.
7. MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACTED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.
8. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON A AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE.
9. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED AFTER EACH RAIN.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	STABILIZED CONSTRUCTION ENTRANCE

Figure 5A.8
Silt Fence

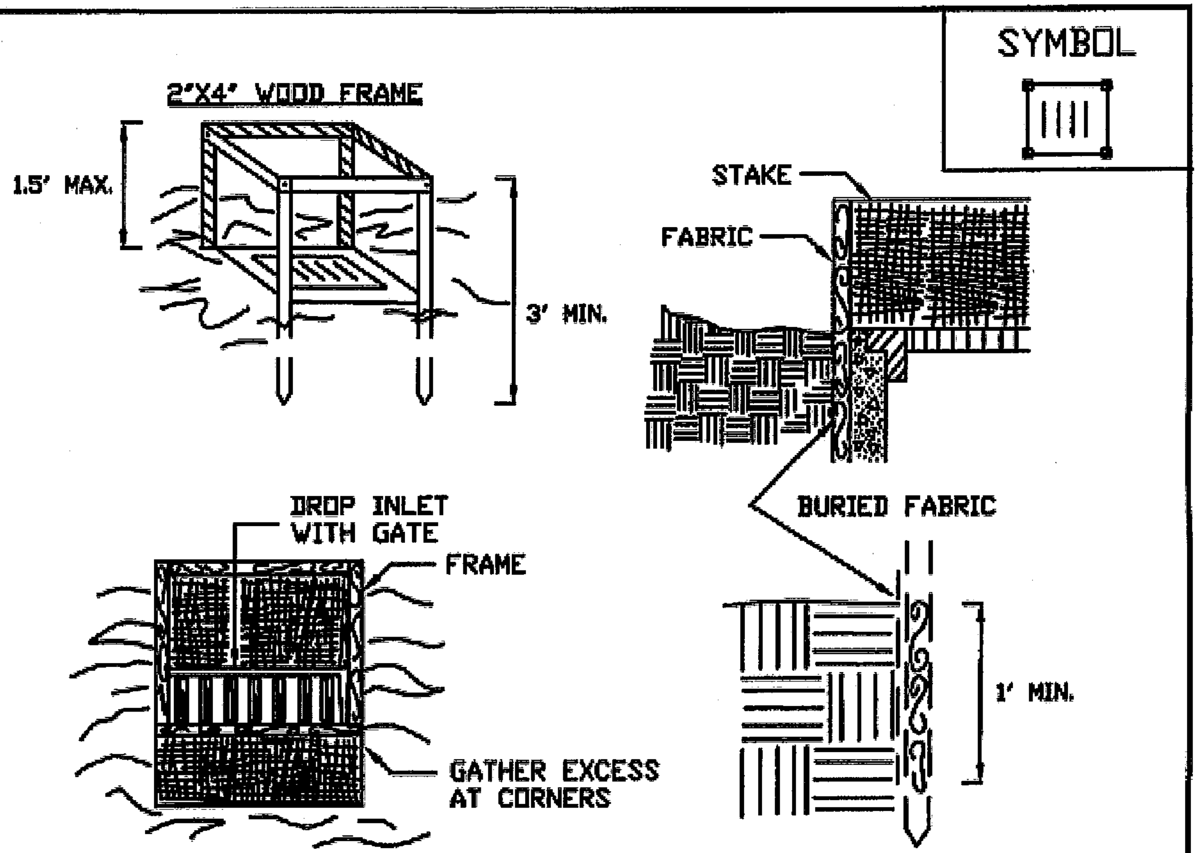


CONSTRUCTION SPECIFICATIONS

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES. POSTS SHALL BE STEEL EITHER "T" OR "U" TYPE OR HARDWOOD.
2. FILTER CLOTH TO BE TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION. FENCE SHALL BE WOVEN WIRE, 6" MAXIMUM MESH OPENING.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVER-LAPPED BY SIX INCHES AND FOLDED. FILTER CLOTH SHALL BE EITHER FILTER X, MIRAFI 100X, STABILINKA T140N, OR APPROVED EQUIVALENT.
4. PREFABRICATED UNITS SHALL BE GEOFAB, ENVIROFENCE, OR APPROVED EQUIVALENT.
5. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	SILT FENCE

Figure 5A.12
Filter Fabric Drop Inlet Protection



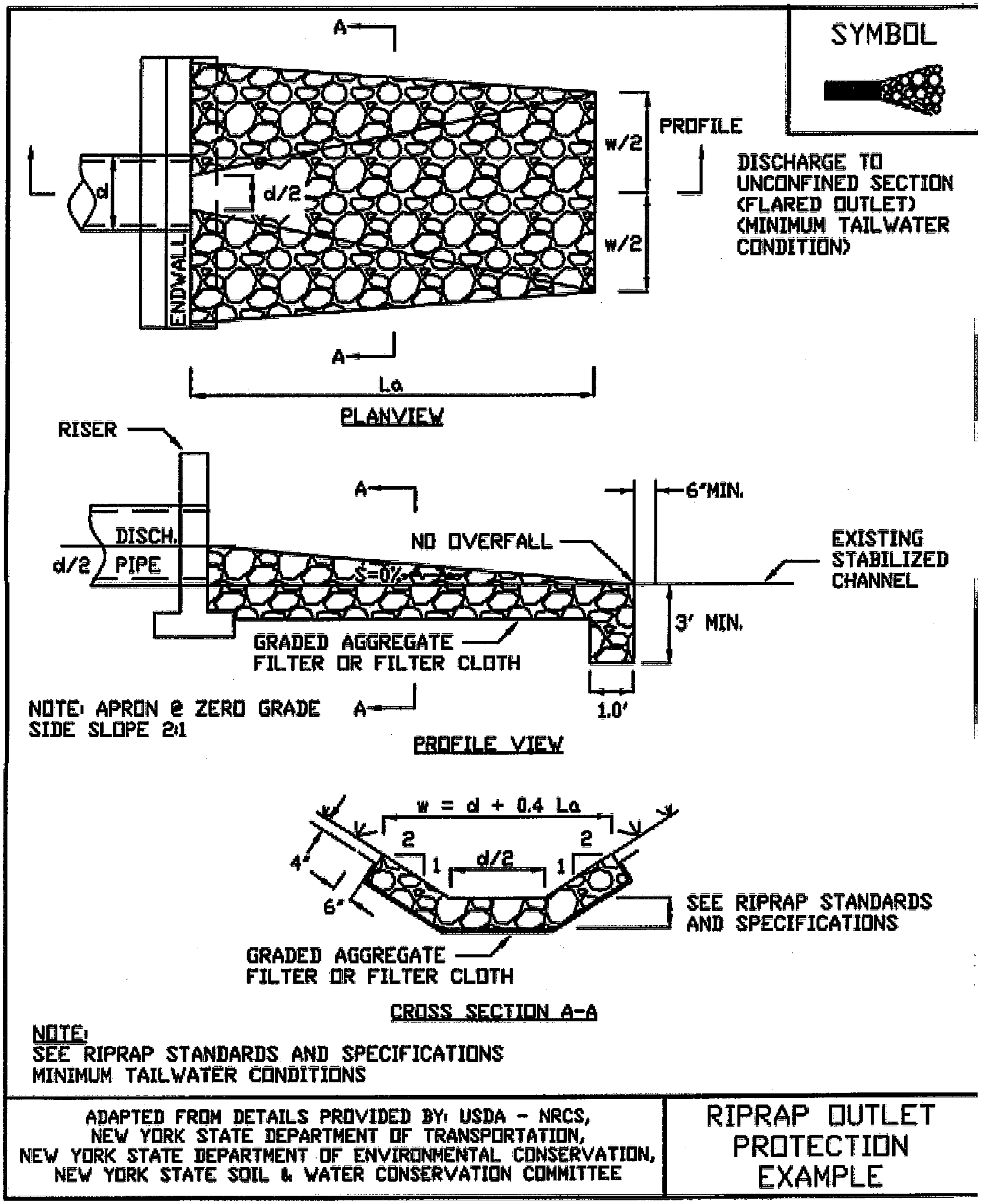
CONSTRUCTION SPECIFICATIONS

1. FILTER FABRIC SHALL HAVE AN EOS OF 40-85. BURLAP MAY BE USED FOR SHORT TERM APPLICATIONS.
2. CUT FABRIC FROM A CONTINUOUS ROLL TO ELIMINATE JOINTS. IF JOINTS ARE NEEDED THEY WILL BE OVERLAPPED TO THE NEXT STAKE.
3. STAKE MATERIALS WILL BE STANDARD 2" x 4" WOOD OR EQUIVALENT. METAL WITH A MINIMUM LENGTH OF 3 FEET.
4. SPACE STAKES EVENLY AROUND INLET 3 FEET APART AND DRIVE A MINIMUM 18 INCHES DEEP. SPANS GREATER THAN 3 FEET MAY BE BRIDGED WITH THE USE OF WIRE MESH BEHIND THE FILTER FABRIC FOR SUPPORT.
5. FABRIC SHALL BE EMBEDDED 1 FOOT MINIMUM BELOW GROUND AND BACKFILLED. IT SHALL BE SECURELY FASTENED TO THE STAKES AND FRAME.
6. A 2" x 4" WOOD FRAME SHALL BE COMPLETED AROUND THE CREST OF THE FABRIC FOR OVER FLOW STABILITY.

MAXIMUN DRAINAGE AREA 1 ACRE

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	FILTER FABRIC DROP INLET PROTECTION

Figure 5B.14
Riprap Outlet Protection Detail (1)



Agricultural Best Management Practice Systems Catalogue

NYS Soil and Water Conservation Committee

Approved June 2023

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Introduction – Purpose – Use of Catalogue

Agricultural Best Management Practice Systems Catalogue

The Agricultural Best Management Practices Catalogue was developed and approved by the NYS Soil and Water Conservation Committee in 2014 to replace The Agricultural Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in NYS. This revised and maintained Catalogue shall provide guidance during the watershed planning process to select appropriate Agricultural Best Management Practice Systems for the control and treatment of pollutants from agricultural nonpoint sources; this Catalogue will also service other NYS SWCC Cost-Share Programs. Utilizing a complete Agricultural BMP System ensures a consistent and effective approach to addressing resource concerns, provides levels of protection and benefits to the environment that partial systems may not deliver, results in an effective use of public resources, and supports the reporting and planning efforts throughout many watersheds both entirely within NYS and those extending beyond (e.g., Clean Water Act 303(d) Programs, Clean Water Plans, and TMDLs for Chesapeake Bay, Lake Champlain, Long Island Sound, Finger Lakes).

For more information on Clean Water Planning: https://www.dec.ny.gov/chemical/23835.html

What are Agricultural Best Management Practice (BMP) Systems?

Complete Agricultural BMP Systems may include one, two, or even a series of National Resources Conservation Service (NRCS) Conservation Practice Standards (CPS), referred to as Component BMPs.

Agricultural BMP Systems prevent or reduce the source or transport of substances originating from agricultural activities which may adversely affect surface and ground waters or other resources. While an Agricultural BMP System has Standards and Specifications associated with its installation, operation, and maintenance of Component BMPs, it does not impose effluent limits for specific pollutants. Rather, it provides an effective means of reducing or preventing the impact of nonpoint source pollutants from a specific resource concern. Agricultural Environmental Management (AEM) is a framework created to assist Soil and Water Conservation Districts and their partners in developing and delivering a science-based agricultural conservation program centered on local priorities and goals. A 5-Tiered AEM planning approach identifies resource concerns and Agricultural BMP System alternatives to address those concerns.

See the following for more information about the AEM 5-Tiered Approach to conservation:
https://agriculture.ny.gov/soil-and-water/agricultural-environmental-management

Resource Concerns and Agricultural Best Management Practice (BMP) Systems

The AEM Planning Process requires each individual management area or resource concern area to be clearly identified, assessed / evaluated, and planned as its own entity; this approach allows each of these areas to be planned as a complete Agricultural BMP System on their own. For example: a farm with two different barnyards, each evaluated as a possible resource concern, may be planned, and further treated by two separate Livestock Heavy Use Are Runoff Management Systems, each Agricultural BMP System unique to its own management area, considerations, and Component BMPs.

Agricultural BMP Systems and Component BMPs are expressed in unique measurable quantities and units (e.g., number, linear feet, square feet, acres); correct measurable units may be found in this Catalogue as well as the NRCS Field Office Technical Guide. Further unit descriptors in addition to required NRCS reportable units are acceptable and often beneficial (e.g., (Waste Transfer (CPS 634) - 1 NO, 100 ft), (Waste Storage Facility (CPS 313) – 1 NO, 2 Million Gallons)).

In some cases, multiple Agricultural BMP Systems may work within or adjacent one another to properly control and treat a resource concern; scenarios utilizing two or more Agricultural BMP Systems should have each System listed. For example: An Access Control System with an adjacent and supporting Riparian Buffer System, both Systems used in conjunction to address one or more resource concerns.

The Agricultural BMP Catalogue is not a design manual and should not be used to replace NRCS Conservation Practice Standards and Specifications.

Interacting with the Agricultural BMP Systems Catalogue

Updates to the Agricultural BMP Systems Catalogue may be conducted on an annual basis, as NRCS Conservation Practice Standards change, or when new information is available for incorporation. Please direct questions about content and application of this directory to the following NYS SWCC Staff:

Ron Bush, CNMP Specialist: Ronald.Bush@agriculture.ny.gov
Brendan Jordan, CNMP Specialist: Brendan.Jordan@agriculture.ny.gov
Greg Albrecht, AEM Coordinator, CNMP Specialist: Greg.Albrecht@agriculture.ny.gov

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Roofs and Covers	367
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Table II – Structural Agricultural Conservation Practices

Coverage by the SPDES General Permit for Stormwater Discharges from Construction Activity may be required if a project involving one or more of the structural agricultural conservation practices listed below will disturb one (1) or more acres (5000 square feet in the New York City Watershed East of the Hudson) of soil. See the SPDES General Permit for Stormwater Discharges from Construction Activity for more information (www.dec.ny.gov/chemical/43133.html) and contact the NYSDEC with any questions.

NRCS Conservation Practice Standard (NY) https://efotg.sc.egov.usda.gov/#/state/NY/documents/section=4&folder=-3	**Practice Code**
Access Road	560
Agrichemical Handling Facility	309
Anaerobic Digester	366
Animal Mortality Facility	316
Composting Facility	317
Dike or Levee	356
Diversion	362
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Energy Efficiency Agricultural Operation	374
Fence	382
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Grade Stabilization Structure	410
Grassed Waterway	412
Heavy Use Area Protection	561
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Irrigation Pipeline	430
Irrigation Reservoir	436
Lined Waterway or Outlet	468
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NRCS Conservation Practice Standard (NY) https://efotg.sc.egov.usda.gov/#/state/NY/documents/section=4&folder=-3	**Practice Code**
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Table III – Agricultural BMP System Lifespans

- The following listed lifespans are for Agricultural BMP Systems implemented through NYS AGM and NYS SWCC Cost-Share Programs.
- Agricultural BMP System Lifespan indicates the minimum term that Operation and Maintenance **MUST** be performed on the Agricultural BMP System. Implementation of an Operation and Maintenance (O&M) plan is required to assure efficient operation of the System and may extend the System lifespan, and its effectiveness, beyond the minimum term.
- Agricultural BMP System Design Criteria is variable depending on the Component BMPs that are used, and the specific resource concerns being addressed.

Agricultural BMP System	Lifespan (years)
Access Control System	10
Agrichemical Handling and Storage System	10
Composting System – Animal	10
Erosion Control System – Structural	10
Feed Management System	1
Integrated Pest Management Conservation System	1
Irrigation Water Management System	1
Livestock Heavy Use Area Runoff Management System	10
Manure and Agricultural Waste Treatment System	10
Nutrient Management System – Cultural	1
Pathogen Management System	10
Petroleum and Oil Products Storage System	10
Prescribed Rotational Grazing System	10
Process Wash Water Management System	10
Riparian Buffer System	10
Short-Term Waste Collection and Transfer System	10
Silage Leachate Control and Treatment System	10
Soil Health System	1 - 5
Stream Corridor and Shoreline Management System	10
Waste Storage and Transfer System	10

Access Control System

DEFINITION
An Access Control System provides for the permanent exclusion of livestock from a waterbody or hydrologically sensitive area to protect water quality.

WATER QUALITY PURPOSE
To prevent the direct deposition of manure and urine into waterbodies and hydrologically sensitive areas, and to protect the stability of the banks of a waterbody from livestock traffic.

POLLUTANT CONTROLLED
Nutrients, pathogens, biochemical oxygen demand (BOD), sediment, or thermal modification.

WHERE USED
On farmsteads, pastures, and fields where livestock have access to surface waterbodies and hydrologically sensitive areas, and a resource concern has been identified.

SYSTEM DESCRIPTION
An Access Control System involves the use of appropriate fence and associated components to exclude livestock from having significant direct access to surface waters and hydrologically sensitive areas to protect water quality. Other Component BMPs that provide an alternative source of water or allow for the controlled access to or crossing of streams may be included in the System.

In some cases, multiple Agricultural BMP Systems may work within or adjacent one another to properly control and treat a resource concern; scenarios utilizing two or more BMP Systems should have each System listed. For example: An Access Control System with an adjacent and supporting Riparian Buffer System, both Systems used in conjunction to address one or more resource concerns.

SYSTEM EFFECTIVENESS
Eliminating access of livestock to waterbodies and hydrologically sensitive areas prevents direct nutrient, pathogen, and organic matter contributions by livestock as well as protecting bank stability and vegetation, which leads to less erosion and improved wildlife habitat.

IMPACTS ON SURFACE WATER
Beneficial – reduces the risk of contamination from nutrients, pathogens, biochemical oxygen demand (BOD), sediment, and thermal modification.

IMPACTS ON GROUND WATER
Neutral - It may be beneficial in areas where groundwater is recharged directly from surface waterbodies or there is a direct surface connection to groundwater.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial by excluding livestock from the banks of waterbodies helping to maintain bank stability and vegetation reducing soil erosion and sedimentation.
Air: Neutral.
Plants: Beneficial by excluding livestock from the banks of waterbodies helping to maintain bank vegetation.

Animals: Beneficial as it can help protect riparian vegetation that in turn provides habitat, wildlife corridors and water quality benefits.
Humans: Beneficial by improving overall water quality and recreational opportunities.
Energy: Neutral but may be negative if alternative water requires pumping.

ADVANTAGES TO FARM

- Easy to implement.
- Relative low cost.
- Could improve neighbor relations due to livestock control and increased aesthetics in the stream corridor.

DISADVANTAGES TO FARM

- Requires fence maintenance and potential replacement after flood events.
- Often requires the installation of an alternative water supply system.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Some factors impacting cost include the type of livestock involved, the length and type of fence needed, the need for alternative water, and stream crossings.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the System:

- Pastures within the Access Control System shall be managed and maintained to remain vegetated, and the development of future resource concerns shall be avoided (e.g., heavily disturbed areas, runoff to nearby Highly Sensitive Areas).
- Basic maintenance to fence, crossings, and watering stations is needed.
- Periodic access of livestock to protected areas may be allowed, if in line with NRCS CPS Access Control, Riparian Herbaceous Buffer, or other relevant Standard operation and maintenance guidelines.
- Significant flooding may result in the need for repair or replacement.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

For the most current information on each NRCS Conservation Practice Standard, please go to the NY Field Office Technical Guide (FOTG) at https://efotg.sc.egov.usda.gov/#/state/NY/documents.
Use the drop box in the left side to reach Section 4 – Practice Standards and Supporting Documents, click on the folder for Conservation Practice Standards & Support Documents and locate the appropriate practice. Under each practice, you will find, at the minimum, the practice standard. You may also find: a Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Access Control	472	Acre	April 2019	10
Fence	382	Feet	October 2022	20
Trails and Walkways	575	Feet	September 2021	10
Access Road	560	Feet	March 2021	10
Watering Facility	614	Number	March 2021	10
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Livestock Pipeline	516	Feet	March 2021	20
Pond	378	Number	May 2018	20
Pumping Plant	533	Number	October 2022	15
Spring Development	574	Number	September 2021	20
Structure for Water Control	587	Number	March 2019	20
Stream Crossing	578	Number	January 2023	10
Water Well	642	Number	March 2021	20
Field Border	386	Acre	October 2017	10

*This is a listing of the primary Component BMPs to use but is not all inclusive and other NRCS Conservation Practice Standards may be utilized. Please check with a SWCC representative for approval.

**NYS Program Lifespans (listed above in Table III) refers to the minimum time period that a program participant must perform Operation and Maintenance of an Agricultural BMP System and the Component BMPs. Alternatively, NRCS CPS Lifespans (as found in the Standards) refer to specific design criteria and defines how long a conservation practice should function under an appropriate level of Operation and Maintenance. To meet NRCS Standards, a conservation practice must be designed to meet the CPS Lifespan, and all materials and installation methods must meet or exceed the NRCS defined Lifespan criteria.

REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Pasture Management AEM Tier 2 Worksheet and Information Sheet
- Stream and Floodplain Management AEM Tier 2 Worksheet and Information Sheet

Agrichemical Handling and Storage System

DEFINITION
A permanent structure, with associated operation and maintenance procedures, that includes an impervious surface to provide an environmentally safe on-farm area for agrichemical storage, handling, mixing, loading, recovery, and rinsing.

WATER QUALITY PURPOSE
To reduce the potential for soil, groundwater, and surface water contamination during agrichemical storage, mixing, loading, unloading, rinsing, and recycling operations.

POLLUTANT CONTROLLED
Agrichemicals – (e.g., pesticides, fertilizers).

WHERE USED
On farms where current methods of storing, mixing, loading, and unloading of agrichemicals; and the rinsing of equipment or agrichemical containers are polluting or have the potential to pollute ground or surface waters; and a resource concern has been identified.

SYSTEM DESCRIPTION
An agrichemical mixing facility consists of a watertight containment structure comprised of a concrete pad and all necessary equipment for pumping, transferring, and storing water used in agrichemical mixing, loading, unloading, and rinsing operations. The size of the pad and storage capacity is related to the volume and size of the largest spray tank on the pad. Containment storage vessels incorporated into the facility design allow for the recovery of agrichemical, rinsate storage, plus handling/mixing/recovery/disposal. Surface runoff from a 25-year, 24-hour duration storm event is diverted away from the facility. A roof and sidewalls may be used to shelter the facility from rain, snow, and ice, preventing precipitation from accumulating on the pad and contaminating runoff.

SYSTEM EFFECTIVENESS
Little or no information exists on the documented effectiveness of agrichemical handling facilities on water quality improvement. Much is known about water quality impacts when these facilities are not available for agrichemical handling and rinsing operations. A recent study of commercial pesticide mixing and loading sites in Wisconsin, without pesticide handling facilities, found that two-thirds of the sites had significant groundwater contamination.

Pesticides were detected in groundwater at more than half of these sites, with concentrations exceeding groundwater standards at one-third of the sites surveyed. Officials and the pesticide industry in Wisconsin recognized that use of agrichemical mixing facilities minimize the potential for surface and groundwater contamination.

IMPACTS ON SURFACE WATER
Beneficial.

IMPACTS ON GROUND WATER
Beneficial.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial as it greatly reduces the risk of soil contamination due to leaks and spills.
Air: Beneficial as it greatly reduces the risk of air contamination resulting from leaks and spills.
Plants: Neutral.
Animals: Neutral.
Human: Beneficial as it improves environmental safety.
Energy: Neutral.

ADVANTAGES TO FARM

- Improves environmental safety by preventing contamination of ground and surface water from routine use and accidental spills.
- Allows compliance with federal and state regulations.
- Enhances owner / operator management.
- Promotes recycling of rinse water as tank make up water.
- Reduces liability risk.

DISADVANTAGES TO FARM

- Can be very expensive.
- Must perform maintenance frequently and diligently to ensure proper facility operation and water source protection.
- Expansive cropland acreage makes it difficult to pick one central location to protect and utilize exclusively.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the System:

- An Emergency Action Plan should be a part of the written O&M plan, in case of an accidental agrichemical spill, exposure, fire or other incident that could adversely affect environmental health. The plan should include a record-keeping component to accurately log spills, exposure, fire, or other incidents.
- Safe agrichemical handling procedures and frequent maintenance are critical to the performance of any agrichemical mixing facility.
- The proper disposal/utilization of rinsate, exterior wash water, accumulated sediment and spilled wastewater must be accomplished in accordance with the pesticide labeling requirements and federal, state and local laws and codes.
- Operator must perform periodic checks of any backflow prevention devices, inspect the pad and sump for cracks and leaks, clean the sump and pad between different chemical mixing operations and remove sediment accumulation from the sump.
- Personal protective equipment must be used during O&M procedures.
- Accurate records indicating maintenance, cleaning, and inspection of equipment are necessary.
- Pesticide containers are to be triple rinsed and properly recycled.

See the documents in Section 4 of the NRCS field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS
Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

NYSDEC recommends that all pesticide rinsates, including wash waters from cleaning of spray equipment, should be collected and stored aboveground. Stored rinsates should be recycled for future mixing with the same concentrates.

An agrichemical storage facility should have good air ventilation and an impervious floor and sides to contain spills and leaks. The building should be locked at all times and be located adjacent to the pad.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*
For the most current information on each NRCS Conservation Practice Standard, please go to the NY Field Office Technical Guide (FOTG) at https://efotg.sc.egov.usda.gov/#/state/NY/documents.
Use the drop box in the left side to reach Section 4 – Practice Standards and Supporting Documents, click on the folder for Conservation Practice Standards & Support Documents and locate the appropriate practice. Under each practice, you will find, at the minimum, the practice standard. You may also find: a Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Agrichemical Handling Facility	309	Number	October 2022	15
Access Road	560	Feet	March 2021	10
Access Control	472	Acre	April 2019	10
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Diversion	362	Feet	May 2017	10
Pumping Plant	533	Number	October 2022	15
Underground Outlet	620	Feet	September 2021	20
Grassed Waterway	412	Acre	September 2021	10

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Pesticide Storage, Mixing and Loading AEM Tier 2 Worksheet and Information Sheet

Composting System – Animal

DEFINITION
An on-farm System to safely facilitate the treatment or disposal through controlled aerobic decomposition of livestock and poultry carcasses, by micro-organisms into a biologically stable, soil-enriching material useful for soil amendment. This System is especially useful when rendering services are not available or too costly.

WATER QUALITY PURPOSE
To have a System for the safe decomposition and ultimate utilization of nutrients from animal composting in a safe environmental manner.

POLLUTANT CONTROLLED
Pathogens, nutrients.

WHERE USED
On farms where safe disposal of livestock carcasses is needed.

SYSTEM DESCRIPTION
A facility to safely compost animal carcasses. To protect surface and groundwater and allow for proper composting of animal carcasses, the facility may be located on lower permeability soils, an improved pad, or be a building with a roof and concrete floor, depending on the operation and need. Clean surface water will be diverted from the site and all contaminated run-off will be contained and treated.

Composting on the farm is accomplished by mixing an energy source (carbonaceous material: wood chips, sawdust, straw, corn cobs, or well-bedded horse manure) with a nutrient source (nitrogenous material: animal carcasses,) in a prescribed manner under aerobic conditions. Microorganisms (primarily bacteria and fungi) break down the raw organic waste under controlled conditions. Air, water, nutrients, surface area, temperature and pH are all important factors in the composting process.

Two types of carcass composting operations are common for on-farm use and either can be managed outside or in a controlled environment or building:

- The most common - Static Piles – carcasses are placed on bulky, high carbon organic material (such as wood chips) and then covered with more organic material and not turned during the composting process. Correct moisture content and bulk density facilitate air movement throughout the pile.
- Aerated Windrows - organic materials are formed into long narrow piles, called windrows, and turned periodically with power equipment to aerate the piles and promote the composting process. This method is the most suitable for smaller carcasses, such as poultry and but has been done on larger scales in the Midwest.

SYSTEM EFFECTIVENESS
Unsafe disposal of animal carcasses can be a large source of pathogens and nutrients. Proper composting, including the collection and treatment of any leachate from the process, greatly reduces the issues with pathogens and when the final product is land applied in accordance with a Nutrient Management Plan, the loss of nutrients is negligible.

IMPACTS ON SURFACE WATER
Beneficial - Improper disposal of carcasses can cause surface water contamination and a proper composting facility can eliminate the potential.

IMPACTS ON GROUND WATER
Beneficial - Improper burial or improper composting on well drained soils, shallow to fractured rock or near high groundwater tables can have negative effects on ground water quality. Proper composting facility will be installed in proper soils or lined and will not affect ground water quality.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial. Nutrients and organic matter will be incorporated in the soil and approve the soil health and nutrient values.
Air: Beneficial. Improper disposal or improperly operated composting facilities can cause major air quality issues on a farm. Properly operated and maintained composting facilities will create little to no odor.
Plants: Beneficial. Plants will benefit from increased nutrients in the soil.
Animals: Beneficial. Properly operated composting facilities will not be an attractant to wild animals or vectors.
Human: Beneficial. Protection of ground and surface water, odor control and vector control will all benefit humans.
Energy**:** Negative. Increased energy will be needed to properly run a composting system which requires increased equipment time over some forms of disposal (dragging carcass into woodlot), but energy use can be less than needed for proper burial.

ADVANTAGES TO FARM

- Can be done simply, at low cost and may not require engineering assistance (for non-structural composting facilities).
- Can utilize on-farm waste products for cover material, such as refusals, spoiled feed, etc.
- Compost can be used as a soil amendment increasing soil tilth and water-holding capacity.

DISADVANTAGES TO FARM

- Requires input (and possible purchase) of materials for composting, such as wood chips.
- Increased cost of initial investment (can be expensive, especially if a building or roofed structure).
- Higher degree of management by farm.
- Requires monitoring for run-off, temperature, proper covering with suitable materials.
- Some practices may require a SPDES permit for site disturbance.

SYSTEM LIFESPAN
Ten (10) years.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Costs can range from little to no out of pocket cost when there is a readily available supply of high carbon material for a base or can be very expensive for a building where large volumes of material are composted – range $0 to $150,000.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the System:

- Maintain correct operating temperatures, proper aeration, carbon to nitrogen (C: N) ratio, and perform periodic testing of compost.
- Check for run-off, kill zones or other signs of nutrient loss after storm events.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

Testing of compost for nutrients or heavy metals can be arranged through the local Cornell Cooperative Extension or through the Cornell Nutrient Analysis Laboratory.

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Animal Mortality Facility	316	Number	April 2016	15
Composting Facility	317	Number	September 2021	15
Access Road	560	Feet	March 2021	10
Diversion	362	Feet	May 2017	10
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Roofs and Covers	367	Number	October 2016	10
Vegetative Treatment Area	635	Acre	February 2017	10
Waste Storage Facility	313	Number	March 2018	15

Waste Transfer	634	Number	October 2022	15

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- National Engineering Handbook Part 637, Chapter 2 – Composting (NEH 637.0213, Dead Animal Composting)
- National Engineering Handbook Part 651
- Agricultural Waste Management Field Handbook, Chapter 10 Mortality Management (NEH 651.1007), NRCS or comparable extension publication
- Bonhotal, J., L Telega, J. Petzen. Natural Rendering: Composting Livestock Mortality and Butcher Waste. 2002. Cornell Waste Management Institute: http://compost.css.cornell.edu/naturalrenderingFS.pdf
- Northeast Regional Agricultural Engineering Service publication No. 54, On Farm Composting Handbook, Cornell Cooperative Extension, Ithaca, NY
- Waste Disposal AEM Tier 2 Worksheet and Information Sheet

Erosion Control System - Structural

DEFINITION
The construction of an Erosion Control System to control the loss of soil from sheet, ephemeral, rill or gully erosion on agricultural lands, farmsteads, and production areas. This includes Systems utilizing terraces, diversions, water and sediment control basins (WASCoBs), waterways (both grassed and lined), roof runoff practices, access roads, and associated earthmoving practices.

WATER QUALITY PURPOSE
To reduce all forms of erosion and thereby reducing sediment delivery to waterbodies. This includes shortening slope lengths, cutting off sheet and concentrated flows from adjacent land uses, stabilizing gullies and providing safe outlets for flowing waters.

POLLUTANT CONTROLLED
Sediment, nutrients, or pathogens.

WHERE USED
On erodible land, in both crop fields and pastures, where soil erosion and runoff must be controlled and the use of crop rotation, minimum tillage, or seeding does not or cannot limit the erosion to acceptable levels.

Within and adjacent farmsteads where excessive volumes of clean water concentrate and result in soil erosion and un-controlled runoff. This system would not be appropriate as a treatment method of concentrated nutrient-laden runoff (e.g., livestock heavy use area runoff, feed storage area runoff, waste storage and transfer sites); other practice systems within this Catalogue may apply to forementioned resource concern areas.

SYSTEM DESCRIPTION
This System may be one practice or several; terraces, diversion and WASCoB's are generally constructed across the slope, usually on the contour to intercept and conduct surface runoff at a non-erosive velocity to stable outlets, reducing ephemeral and gully erosion. These practices control erosion by shortening slope length and regulating surface runoff. They can outlet into established grassed waterways, flat vegetated areas or other stabilized outlets. They also can be total storage structures that release the flow through underground outlets within 24 to 48 hours, depending on crops grown. These Systems also act as sediment traps and help to reduce sediment-bound pollutants in surface run-off.

This System will also be used for the construction of waterways; grassed, lined or stone-centered, which are used to convey concentrated flows down slope to protected outlets to prevent gully erosion or to act as outlets for other erosion control practices. On slopes of less than 1% where out-of-bank flow will not cause erosion or property damage, the confinement of flow is not a design requirement.

Structures can be cropped, seeded to grasses and legumes to stabilize the slopes or lined with another material, such as rock, when velocities require.

Soil and water resources are often further conserved when structural erosion control practices are paired with cultural soil health practices (e.g., crop rotation, strip cropping, cover crop, conservation tillage) and nutrient management practices to further reduce pollutant transport and loss.

Within and adjacent farmsteads, Component BMPs may be compiled to collect, store, convey, and safely outlet clean water sources, thus protecting nearby management areas and infrastructure from possible damage or potential runoff.

SYSTEM EFFECTIVENESS

Structural erosion control practices are effective at reducing soil loss significantly as well as limiting nutrient losses and runoff.

IMPACTS ON SURFACE WATER

Beneficial – Terraces, diversions, waterways and WASCoB's reduce erosion by controlling surface runoff and gully erosion which lessen loads delivered to the receiving waterbody. Terraces, diversions, and WASCoBs can also reduce nutrient loading through settling in areas of water retention.

IMPACTS ON GROUND WATER

Slight to Moderate – Can be beneficial in areas where the groundwater is recharged from surface waterbodies. In the absence of a Nutrient Management Plan, terraces and diversions may increase nutrient leaching to groundwater. Impacts on groundwater may be reduced by increasing terrace or diversion release rates, thereby decreasing runoff storage time and potential soil saturation. Diversions decrease the amount of surface runoff infiltrating into the soil, reducing the risk of transporting nutrients and pesticides to groundwater. Waterways generally have little to no impact on ground water.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial to soil resources as soil loss will be diminished.

Air: Slightly beneficial and can have beneficial effects as erosion rates are reduced and the possibility that fines in the air will also be reduced.

Plants: Neutral.

Animals: Slightly beneficial improvement to wildlife as cross field practices could provide pathways for wildlife movement. Slight to moderate for fisheries as erosion rates will be lessened and delivery of sediment to waterbodies controlled.

Human: Slight to no effect on humans unless sediment reduction in waterbodies for public use are impacted.

Energy: Energy use may be slightly higher due to increased tractor use to go around conservation practices instead of normal plowing.

ADVANTAGES TO FARM

- Are relatively easy to design and install.
- Can be cheap to install for simple practices.
- May allow timelier planting and potential yield increases by removing surface runoff.
- Controls surface runoff and gully and ephemeral erosion.
- Can provides flood protection for crop fields.
- Stores runoff up to 48 hours, allowing sediment and sediment-bound pollutants to settle out.
- Protects management areas and farmstead infrastructure.
- Collects surface flows during storm events and provides safe clean water outlets.

DISADVANTAGES TO FARM

- Can take land out of crop production.
- Systems may need to be in conjunction with other conservation practices such as conservation tillage, crop rotations, and contour or strip cropping to bring soil loss to acceptable levels.

- Some systems can be very expensive and usually are not considered cost-effective management practices in relation to cultural control measures.
- Require increased maintenance as trapped sediment accumulates in the structure and removal of sediment or reconstruction is required to maintain capacity.
- Grassed waterways may be unsuitable for areas where a base flow exists (sustained wetness prevents adequate vegetative cover) unless a stone-center lining and a subsurface drain and surface inlet are installed.
- Use may be precluded or have an increased cost if a stable outlet is lacking.

SYSTEM LIFESPAN
Ten (10) years.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Costs can range from $1.00 per foot for a cross slope ditch to $10 a foot for storage structures with outlets.

OPERATION AND MAINTENANCE
Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system that need to be performed annually and after large storm events:

- Maintain capacity, storage, ridge height and outlets.
- Clean out inlets for underground outlets.
- Remove sediment build-up and redistribute.
- Inspect channel cross-section for stable side slopes, points of scour, rodent holes, and breaches.
- Check channel bottom for erosion or excessive scour, deposition of sediment or other obstructions.
- Outlets should be checked to ensure that they remain adequate, show no sign of erosion or loss of structural integrity.
- Vegetated structures will need to be periodically mowed.
- Periodic inspection and repair of roof runoff structures, outlets, access roads, etc.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS
Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

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Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Water and Sediment Control Basin	638	Number	March 2019	10
Sediment Basin	350	Number	May 2017	20
Diversion	362	Feet	May 2017	10
Grassed Waterway	412	Acre	September 2021	10
Filter Strips	393	Acre	October 2017	10
Grade Stabilization Structure	410	Number	March 2021	15
Critical Area Planting	342	Acre	October 2017	10
Lined Waterway or Outlet	468	Feet	September 2021	15
Conservation Cover	327	Acre	July 2019	5
Terrace	600	Feet	September 2021	10
Subsurface Drain	606	Feet	May 2020	20
Underground Outlet	620	Feet	September 2021	20
Obstruction Removal	500	Number	September 2021	10
Fence	382	Feet	October 2022	20
Access Road	560	Feet	March 2021	10
Roof Runoff Structure	558	Number	October 2022	15
Trails and Walkways	575	Feet	September 2021	10

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Soil Management AEM Tier 2 Worksheet and Information Sheet

Feed Management System

DEFINITION
The continual process of providing adequate, not excess, nutrients to dairy animals through the integration of feeding and crop management to reduce nutrient excretion in manure and nutrient accumulation in soil, lower potential pollution risks to water and air resources, and improve farm profitability.

WATER QUALITY PURPOSE
Reduces the accumulation and potential loss of nitrogen and phosphorus in manure from dairy farms.

POLLUTANT CONTROLLED
Nutrients, pathogens, biochemical oxygen demand (BOD), or ammonia.

WHERE USED
Dairy farms.

SYSTEM DESCRIPTION
Feed management is a continuous improvement process involving benchmarking, planning, implementation, and monitoring. It is facilitated by a feed management specialist and adopted and directed by farm management to meet goals in three areas:

1. improved nutrient use efficiency, homegrown feed utilization, and income-over-feed cost;
2. crop production and purchased feeds are optimized for the feeding system; and
3. reduced nutrient overfeeding, excretion, and accumulation.

Dairy farms using the feed management process pursue those goals often by improving the digestible nutrient content of homegrown feeds produced and fed; accurately estimating feed nutrient intakes by animals and tracking feed inventories; employing scientific standards to determine nutrient requirements and ration levels; and increasing the level of homegrown feeds (forages or grains) in the diet.

Feed management recommendations should be based on the best available research information. The USDA-NRCS Feed Management Standard (NY-592) provides specific technical details and references about planning, implementation, and operation and maintenance. The Cornell Precision Feed Management guidelines and Precision Feed Management Benchmarking tools provide further information for effective feed management with dairy cows. Management of feed rations and forages should be consistent with Cornell recommendations, where available; otherwise, National Research Council recommendations should be utilized.

SYSTEM EFFECTIVENESS
Improving a farm's nutrient mass balance (the amount of nutrients imported compared to the amount of nutrients exported) will reduce the amount of nutrients that have the potential to be lost to the environment. Changes in the feeding program can have a significant influence on farm nutrient management and its mass nutrient balance. While it varies widely by farm size and management, a substantial portion of the nutrients imported to dairy farms in the form of purchased (imported) feeds, and to a lesser degree fertilizers, often remains on the farm where they may accumulate in farm soils and may be lost to air and water resources. Farms that intensively manage their feeding program reduce

nutrient excretion in the manure, increase feed nutrient utilization, and subsequently improve the farm's mass nutrient balance.

A 60% reduction in nitrogen and phosphorus mass nutrient balances has been documented by Cornell University and Cornell Cooperative Extension research on over 40 dairy farms that adopted feed management practices between 2004 and 2008. Those dairy farms also realized lower operating costs ($1.33/CWT) and 11% higher milk production that similar sized farms not participating in the feed management process in the region.

IMPACTS ON SURFACE WATER
Beneficial, including nutrients and pathogens.

IMPACTS ON GROUND WATER
Beneficial, including nutrients and pathogens.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial, the soil health/conservation often must improve in order to optimize homegrown crop production for herd forage or grain needs.
Air: Beneficial, as it has the potential to reduce particulate matter from ammonia volatilization and nitrous oxide emissions.
Plants: Beneficial, as it can reduce nutrient losses and subsequent impacts on neighboring plant communities.
Animals: Beneficial, as it can reduce nutrient losses and subsequent impacts on terrestrial and aquatic habitat.
Human: Beneficial, as it can further safeguard drinking water sources, improve land and water resources for recreation, and provide economic growth.
Energy: Beneficial, as it can reduce use of transportation fuels for imported feed and fertilizer and improve livestock output per energy input.

ADVANTAGES TO FARM

- Potential to reduce nutrient losses and improve animal and crop production.
- Potential to improve herd/flock health.
- Often a positive impact on farm profitability.

DISADVANTAGES TO FARM

- Higher level of farm management is required may result in increased labor and equipment costs.
- Requires additional time and training to adjust to new management strategies.
- Cost to change management may be prohibitive for some farms.

SYSTEM LIFESPAN
One (1) year.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Costs for feed management depend on several factors, including the size and type of farm, existing level of farm management, feeding and feed storage facilities, history of herd, feed, and other farm records, available equipment, and familiarity with custom operators. Consultation fees for developing and maintaining a feed management plan should be considered in addition to the costs for feed and forage analyses.

OPERATION AND MAINTENANCE
Each Agricultural BMP System is unique and must be customized for every situation. Feed management is a continuous improvement process, involving regular monitoring through benchmarking, planning to address opportunities, implementing those plans, and evaluating the plans via benchmarking.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS
Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

See Cornell Feed Management guidelines and Precision Feed Management Benchmarking tools as well as the USDA-NRCS Feed Management Standard (NY-592) for specific technical details about planning, implementation, and operation and maintenance.

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Feed Management	592	Animals Units Affected	October 2022	1

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Cornell Precision Feed Management: https://cnydfc.cce.cornell.edu/topic.php?id=19
- Management of Dairy Feed Nutrients AEM Tier 2 Worksheet and Information Sheet

Integrated Pest Management System

DEFINITION
An ecologically based, site-specific integrated pest control strategy utilizing a combination of pest prevention, pest avoidance, pest monitoring, and pest suppression strategies coupled with precision application techniques and Best Management Practices when pesticide application is warranted.

WATER QUALITY PURPOSE
To reduce pesticide use, availability, and losses to the environment in crop and livestock production.

POLLUTANT CONTROLLED
Pesticides.

WHERE USED
On all agricultural lands where pests will be managed, and a resource concern has been identified.

SYSTEM DESCRIPTION
Integrated Pest Management (IPM) strategies that keep pest populations below economically damaging levels and minimize pest resistance are used to reduce pest management risks to water quality and the environment. Specific IPM techniques include:

Prevention – activities such as cleaning equipment when leaving an infested area, using pest free seeds and transplants, and irrigation scheduling to limit situations that are conducive to disease development,

Avoidance – activities such as using pest resistant varieties, crop rotation, refuge management, and maintaining healthy and diverse plant communities,

Monitoring – activities such as crop scouting, establishing trap crops, degree-day modeling and weather forecasting to help target suppression strategies and avoid routine preventative treatments,

Suppression – activities such as the judicious use of cultural, mechanical, biological, and chemical control methods that reduce or eliminate a pest population or its impacts while minimizing risks to non-target organisms. As part of a suppression system, precision application techniques in an IPM system can further minimize pesticide risks to natural resources and humans. Examples of such techniques include: appropriate equipment calibration to include the correct rate, boom height, appropriate nozzle type, nozzle spacing, operating speed and pressure; computer-controlled application technologies; and advanced technology equipment.

SYSTEM EFFECTIVENESS
Overall, IPM is effective, profitable, and relatively safe. Few if any studies have established a solid link between IPM usage and reduction of pesticide levels in receiving waters. However, IPM has been credited with the reduction in chemical usage. IPM is an effective management practice for consideration in vegetables, fruit, ornamentals, or field crops especially where large amounts of pesticides are applied, waterbodies are adjacent to crop fields, and soils are highly permeable. Numerous studies have shown pesticide use can be reduced up to 45% in fields employing IPM strategies verses conventional fields. Pesticide use for the control of house flies in dairy barns can be reduced 50 to 80% if manure is removed on a timely basis and fly biological control agent populations are enhanced.

When a pesticide is used its effectiveness depends upon the proper application and placement of the chemical. It is estimated that 60% of sprayers have a calibration error rate greater than plus or minus 10%. Frequent calibration checks or computerized precision application greatly reduce this problem.

Associated conservation practices that provide for adequate plant nutrients and soil moisture, including a favorable pH and soil quality, can reduce plant stress, improve plant vigor and increase the plant's overall ability to tolerate pests thereby reducing the need for pesticide use.

IMPACTS ON SURFACE WATER

Beneficial – In most management options the availability of pesticides as a nonpoint source pollutant is reduced.

IMPACTS ON GROUND WATER

Beneficial – In most management options the availability of pesticides as a nonpoint source pollutant is reduced.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial as the use of pesticides generally declines reducing risk of carry over and accumulation in the soil.
Air: Beneficial as IPM strategies generally result in less pesticide drift.
Plants: Beneficial as overall less use of pesticide and more precise application is a benefit to non-target plants.
Animals: Beneficial as IPM strategies and precision application techniques reduce the impact of pesticides on non-target organisms such as pollinators.
Human: Beneficial as it is an economically and environmentally defensible practice which realizes a higher net return per acre due to improved commodity quality.
Energy: Neutral.

ADVANTAGES TO FARM

- Use of pesticides usually declines with the use of IPM strategies.
- Usually requires fewer pesticides on a per acre basis.
- IPM generally results in higher average per acre crop yield.

DISADVANTAGES TO FARM

- May result in more pesticide applications per growing season as scouting may find pest populations over threshold.
- Higher level of grower management is required which may result in increased labor and equipment costs.
- Requires additional time and training to adjust to new management strategies.
- May have control costs higher than conventional control techniques.
- Cost of some advanced technology equipment may not be economical for small pesticide applicators.

SYSTEM LIFESPAN

One (1) year for IPM plan and may vary up to 10 years for various application equipment.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. The cost of this system will be highly variable depending on the control strategies employed.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- Scouting and monitoring is an on-going activity.
- O&M is specific for each prevention, avoidance, monitoring, and suppression technique used. Record keeping is an essential component of all these practices.
- Follow label directions when pesticides are used.
- Follow equipment manufacturer's directions.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

For the most current information on each NRCS Conservation Practice Standard, please go to the NY Field Office Technical Guide (FOTG) at https://efotg.sc.egov.usda.gov/#/state/NY/documents.
Use the drop box in the left side to reach Section 4 – Practice Standards and Supporting Documents, click on the folder for Conservation Practice Standards & Support Documents and locate the appropriate practice. Under each practice, you will find, at the minimum, the practice standard. You may also find: a Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Pest Management Conservation System	595	Acre	September 2020	1
Conservation Cover	327	Acre	July 2019	5
Herbaceous Weed Treatment	315	Acre	April 2021	5
Conservation Crop Rotation	328	Acre	October 2015	1
Field Border	386	Acre	October 2017	10

Filter Strip	393	Acre	October 2017	10
Forage Harvest Management	511	Acre	September 2021	1
Irrigation Water Management	449	Acre	October 2022	1

*This is a listing of the primary Component BMPs to use but is not all inclusive and other NRCS Conservation Practice Standards may be utilized. Please check with a SWCC representative for approval.

**NYS Program Lifespans (listed above in Table III) refers to the minimum time period that a program participant must perform Operation and Maintenance of an Agricultural BMP System and the Component BMPs. Alternatively, NRCS CPS Lifespans (as found in the Standards) refer to specific design criteria and defines how long a conservation practice should function under an appropriate level of Operation and Maintenance. To meet NRCS Standards, a conservation practice must be designed to meet the CPS Lifespan, and all materials and installation methods must meet or exceed the NRCS defined Lifespan criteria.

REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Pesticide Use AEM Tier 2 Worksheet and Information Sheet

Irrigation Water Management System

DEFINITION
A planned System that determines and controls the rate, amount, placement, and timing of irrigation water.

WATER QUALITY PURPOSE
To reduce surface water runoff, including any associated erosion or leaching of nutrients and pesticides by applying irrigation water based upon the capacity of the soil to hold water and the needs of the crop.

POLLUTANT CONTROLLED
Sediment, nutrients, or pesticides.

WHERE USED
On agricultural fields requiring irrigation where the potential for surface water runoff or groundwater contamination exists, and a resource concern has been identified.

SYSTEM DESCRIPTION
Irrigation water management is utilized on cropland to supplement rainfall, and to apply fertilizer and pesticides to target crops. Several irrigation methods exist. Selection of the irrigation system to be used is based on the needs of the crop to be grown, soil type, topography, climate, distance to streams or other water bodies, and the source of water to be used for irrigation. To decrease non-point source pollution of surface and groundwater resources, water application must be at rates that minimize the transport of sediments, nutrients and chemicals to surface waters and that minimize the transport of nutrients and chemicals to groundwater.

The development of an "Irrigation Water Management Plan" that addresses the irrigation scheduling, in both timing and amount, control of runoff, minimizing deep percolation, and the uniform application of water is an essential component of this practice.

SYSTEM EFFECTIVENESS
This System can help prevent over irrigation and the resulting loss of sediment, nutrients, and pesticides by surface runoff and leaching.

IMPACTS ON SURFACE WATER
Beneficial.

IMPACTS ON GROUND WATER
Beneficial- Leaching losses of nutrients and pesticides are minimized when scheduling is a part of an irrigation water management system. However, other associated practices that promote infiltration may have adverse impacts on groundwater.

IMPACTS ON OTHER RESOURCES (OFF-SITE)
- Soil: Beneficial by minimizing irrigation induced soil erosion and sedimentation.
- Water: Beneficial by reducing water waste – applies what the crop needs.
- Air: Beneficial by managing soil moisture to reduce particulate matter movement.
- Plants: Neutral.
- Animals: Neutral.

Human: Beneficial due to positive impacts on soil, water, air and energy.
Energy: Beneficial as it can reduce energy use.

ADVANTAGES TO FARM

- Manages air, soil, or plant micro-climate.
- Provides the medium and guidance for proper and safe chemigation and fertigation.
- Avoids crop stress due to under-irrigation and may increase crop yields.
- May reduce operating and labor costs.
- May reduce energy costs.

DISADVANTAGES TO FARM

- May require additional training, or an increase in irrigation management skills.
- Requires additional time and equipment to collect data.
- Changes in irrigation methods may require changes in equipment which can be costly.

SYSTEM LIFESPAN

One (1) year.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Some factors impacting cost include additional labor and equipment expenses to collect data and automated irrigation scheduling software may need to be purchased.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- Accurate and timely records of rate, amount, timing and maintenance of equipment is a necessary component of this practice.
- A record keeping system and O&M plan must be prepared for the system.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

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Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Irrigation Water Management	449	Acre	October 2022	1
Irrigation Pipeline	430	Feet	September 2021	20
Irrigation Reservoir	436	Number	October 2022	15
Irrigation System, Microirrigation	441	Acre	October 2022	15
Sprinkler System	442	Acre	October 2022	15
Irrigation System, Surface and Subsurface	443	Acre	October 2017	15
Pumping Plant	533	Number	October 2022	15
Water Well	642	Number	March 2021	20
Nutrient Management	590	Acre	September 2020	1
Pest Management Conservation System	595	Acre	September 2020	1

*This is a listing of the primary Component BMPs to use but is not all inclusive and other NRCS Conservation Practice Standards may be utilized. Please check with a SWCC representative for approval.

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Irrigation Water Management AEM Tier 2 Worksheet and Information Sheet

Livestock Heavy Use Area Runoff Management System

DEFINITION
A System for the interception, collection, and safe treatment of runoff water from a barnyard or concentrated livestock area.

WATER QUALITY PURPOSE
To exclude clean water from the concentrated livestock areas and to reduce the transport of pollutants from barnyards and concentrated livestock areas into surface or groundwaters.

POLLUTANT CONTROLLED
Nutrients, sediments, pathogens, or biochemical oxygen demand (BOD).

WHERE USED
Barns, barnyards, loafing areas, paddocks, feedlots, calf hutch areas or any area where livestock concentrate, and a resource concern has been identified.

SYSTEM DESCRIPTION
The System is composed of one or more component practices. Structural practices may be employed to exclude clean water from areas of livestock concentrations (for example, diversions that intercept and transport upslope surface water away from barnyards and roof runoff systems that collect rainwater from barn roofs). Heavy Use Areas are used to facilitate clean up and direct polluted runoff where a variety of structural, vegetative and operational practices are used to treat polluted runoff and seepage from barnyards, loafing areas and other areas with concentrated waste. Examples include settling tanks, collection or vegetative treatment areas.

Alternatives also include elimination, utilizing gates and laneways to move livestock to barns or managed pastures, or as a last resort, installation of roofs to isolate the barnyard from precipitation.

SYSTEM EFFECTIVENESS
Because Livestock Heavy Use Area Management Systems are site-specific and are composed of one or more Component BMPs, System effectiveness varies. Key factors for effectiveness include success of cutting off clean water before it reaches pollutants, reducing the size of the affected area, and collecting and treating polluted run-off.

IMPACTS ON SURFACE WATER
Beneficial.

IMPACTS ON GROUND WATER
Beneficial - Can be negative if the abandoned heavy use areas are not remediated and nutrient laden soil and manure is not removed allowing nutrient losses to the groundwater.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

<u>Soil</u>: Neutral.
<u>Air</u>: Beneficial. Clean barnyards, where manure and organics are collected more frequently, tend to have less odor issues.
<u>Plants</u>: Neutral.
<u>Animals</u>: Beneficial. Controlling or treating run-off leads to cleaner streams.

Human: Beneficial. Barnyard areas that are kept clean are more aesthetically pleasing and produce less odors, flies or vectors.
Energy: Negative. Increased fuel use.

ADVANTAGES TO FARM

- Dries up barnyard and loafing area.
- Improves ease of daily operating procedures.
- Less clean-up time during milking.
- Decreases the chance of milk production reduction during wet periods.
- Increased milk value due to lower somatic cell counts.
- Can include herd health benefits (less risk of mastitis and hoof rot in cattle).
- Depends on the system. Improved barnyards require more energy to clean up on a regular basis (more each day instead of a massive amount every few years) but are more efficient and can save energy required for cow-clean up, milking center clean-up (from less sediment and manure to treat).
- More manure collected to utilize for crop fertility.

DISADVANTAGES TO FARM

- Requires a higher level of producer management skill to achieve positive pollution control.
- May be expensive initial investment and operating costs.
- Increased fuel consumption.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Range: $3,000 to $150,000 or more, depending upon system design, complexity, and number of animals treated and total area to be treated.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- Daily to weekly scraping of concrete pads.
- Maintain fences and gates.
- Re-grade barnyards as needed to control water.
- Maintain vegetation.
- Check roof gutters after heavy storm events and remove debris and ice.
- Maintain gravel/stone heavy use areas, if applicable.
- Ensure dosing on VTA to not overload system. Harvest and remove filter area vegetation.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities

Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

For an ANSACP grant application, it is required to utilize the Roof Screening Tool if a covered facility is included in the grant.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Access Control	472	Acres	April 2019	10
Trails and Walkways	575	Feet	September 2021	10
Fence	382	Feet	October 2022	20
Access Road	560	Feet	March 2021	10
Roof Runoff Structure	558	Number	October 2022	15
Roofs and Covers	367	Number	October 2016	10
Conservation Cover	327	Acre	July 2019	5
Critical Area Planting	342	Acre	October 2017	10
Vegetated Treatment Area	635	Acre	February 2017	10
Diversion	362	Feet	May 2017	10
Grassed Waterway	412	Acre	September 2021	10
Lined Waterway or Outlet	468	Feet	September 2021	15
Pumping Plant	533	Number	October 2022	15
Sediment Basin	350	Number	May 2017	20
Subsurface Drain	606	Feet	May 2020	20

Underground Outlet	620	Feet	September 2021	20
Waste Separation Facility	632	Number	October 2022	15
Waste Storage Facility	313	Number	March 2018	15
Waste Transfer	634	Number	October 2022	15
Water and Sediment Control Basin	638	Number	March 2019	10
Watering Facility	614	Number	March 2021	10

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Livestock Heavy Use Area AEM Tier 2 Worksheet and Information Sheet

Manure and Agricultural Waste Treatment System

DEFINITION
A System for the mechanical, chemical or biological treatment of agricultural wastes.

WATER QUALITY PURPOSE
Treating manure and other agricultural wastes in order to improve nutrient and pathogen management and reduce losses to surface water and groundwater.

POLLUTANT CONTROLLED
Nutrients, pathogens, biochemical oxygen demand (BOD), or ammonia.

WHERE USED
Any farm with agricultural wastes, such as manure, process wastewaters, crop residues, or other organic residues, where nutrient, pathogen, or odor management could be improved through treatment of the wastes.

SYSTEM DESCRIPTION
Manure and Agricultural Waste Treatment Systems encompass a broad set of technologies used to process wastes for the purposes of:

- improving ground and surface water quality by reducing the nutrient content, biochemical oxygen demand (BOD), or pathogen levels of agricultural waste;
- improving air quality by reducing odors and gaseous emissions;
- producing value added byproducts; or
- facilitating desirable waste handling, storage, or land application alternatives.

This Agricultural BMP System applies where the form and characteristics of agricultural waste make it difficult to manage, where changing the form or composition provides additional utilization alternatives, and where conventional waste management alternatives are deemed not as effective.

Systems may be comprised of one or more of the following established treatment practices:

- anaerobic digestion;
- liquid solid separation;
- biological or chemical amendments;
- manure or agricultural waste composting facility (other than animal carcass);
- waste facility cover (and flare, where applicable).

Manure and Agricultural Waste Treatment Systems are often also combined with other Agricultural BMP Systems and Component BMPs, such as waste storage and transfer, composting, vegetated treatment areas, Nutrient Management Plans, etc.

SYSTEM EFFECTIVENESS
Manure and Agricultural Waste Treatment Systems must be planned, designed, implemented, and maintained to address the unique set of resource concerns for each farm, so Systems will be comprised of different components and achieve varying levels of effectiveness. In general, any System that utilizes high temperatures (such as anaerobic digestion) for prolonged periods will achieve significant pathogen control and odor control, allowing for improved nutrient management, water quality protection and neighbor relations. If such a System is anaerobic, it will also result in enhanced methane

production/capture which, if flared or used for heat or electricity production, could have positive greenhouse gas and renewable energy benefits. Systems that cover manure and other wastes reduce total volume by eliminating additions from precipitation and reduce ammonia, methane, and odor compound emissions. Systems that separate the waste into liquid and solid pools allow for more precise and efficient nutrient management (pumping, drag line application, incorporation, etc.) as well as the potential for value added products (solids re-used as bedding, compost for sale off farm, lower-risk solid manure for nutrient applications in sensitive areas, etc.). Most of these Systems do not make nutrients disappear, but they concentrate, separate, etc. nutrients into forms that facilitate more efficient for re-use by crops or sale/export from the farm.

IMPACTS ON SURFACE WATER
Beneficial - including reduced losses of nutrients, biochemical oxygen demand (BOD), ammonia, and pathogens.

IMPACTS ON GROUND WATER
Beneficial - including nutrients and pathogens.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial if system allows more precise application of nutrients with less soil compaction. Could be neutral or negative if the system results in significant manure/waste organic matter to be sold/exported from farm and not returned to cropland.
Air: Beneficial, as it has the potential to reduce emissions of ammonia, greenhouse gas, and odor compounds. May be negative if the treatment system is not operated correctly.
Plants: Beneficial, as it can reduce nutrient losses and subsequent impacts on neighboring plant communities.
Animals: Beneficial, as it can reduce pathogen losses as well as nutrient losses and subsequent impacts on terrestrial and aquatic habitat.
Human: Beneficial, as it can further safeguard drinking water sources, improve land and water resources for recreation, reduce odor, and provide economic growth.
Energy: Beneficial, as such systems often improve the use of on-farm nutrients, thereby reducing energy for fertilizer production and transport. Some treatment systems also allow for on-farm energy production.

ADVANTAGES TO FARM
- Reduced nutrient losses.
- Improved productivity of crops and livestock as well as greater management flexibility.
- Can have a positive impact on farm profitability and diversify income streams.
- Improved neighbor relations.

DISADVANTAGES TO FARM
- High capital costs, early stage of technology, sometimes inadequate infrastructure to deliver energy to market, competition with much larger energy entities, etc. may present significant barriers to entry.
- Soil organic matter may decline if systems involve significant exports/sales of manure solids.
- Higher level of farm management required may result in increased labor and equipment costs.
- Requires significant additional time and training to adjust to new management strategies.

SYSTEM LIFESPAN
Variable depending on Component BMPs of the System but generally 10 years.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. The cost is variable depending on the type of manure and agricultural waste treatment system. More complex systems, such as anaerobic digestion, coupled with liquid solid separation, electricity generation, solids composting, effluent storage, and drag hose land application, can be very expensive to design, build, and operate, but allow farms to realize other economic, community, and environmental goals.

OPERATION AND MAINTENANCE
Each Agricultural BMP System is unique and must be customized for every situation. Very regular monitoring and maintenance are required with these systems, according to the O&M associated with the various system components.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS
Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Waste Separation Facility	632	Number	October 2022	15
Waste Storage Facility	313	Number	March 2018	15
Waste Transfer	634	Number	October 2022	15
Waste Treatment	629	Number	October 2013	10
Anaerobic Digester	366	Number	March 2019	25

Composting Facility	317	Number	September 2021	15
Pumping Plant	533	Number	October 2022	15
Roofs and Covers	367	Number	October 2016	10
Heavy Use Area Protection	561	Sq. Feet	September 2021	10

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Cornell University Dairy Environmental Systems: https://cals.cornell.edu/pro-dairy/our-expertise/environmental-systems
- Greenhouse Gas Mitigation Opportunities AEM Tier 2 Worksheet
- IS#2 Dairy Manure Storage & & Greenhouse Gas Mitigation Opportunities
- IS#3 Planning for Quantitative Methane Capture & Destruction from Liquid Dairy Manure Storage

Nutrient Management System - Cultural

DEFINITION
Managing the amount (rate), source, placement (method of application), and timing of plant nutrient and soil amendment applications for efficient use by crops and reduced losses to the environment. If applicable, this can include addressing the issues from farmstead areas as it relates to non-point sources of pollutants.

WATER QUALITY PURPOSE
To reduce or prevent nutrient losses from runoff, erosion, and leaching to surface and groundwater resources.

POLLUTANT CONTROLLED
Sediment, nutrients, pathogens, biochemical oxygen demand (BOD), or ammonia.

WHERE USED
Cropland, hayland, pasture, vegetable and fruit production, orchards, vineyards, turf, biomass production, and ornamental production, including greenhouses.

SYSTEM DESCRIPTION
Nutrients are managed for the economic production of crops, forages, pasture, ornamentals, and biomass, and the protection of natural resources. Cultural nutrient management consists of applying nutrients and soil amendments to crops in the right amount, right source, right method, and right timing ("the 4Rs") according to several, integrated factors:

- farm management and goals including realistic crop yields;
- an accurate estimate of crop nutrient needs;
- nutrients credits in soil and manure;
- nutrient credits from crop residues;
- risk assessments for runoff, leaching, and erosion;
- setbacks from hydrologically active areas;
- weather and soil conditions; and
- adaptive management over time.

A well-integrated Nutrient Management Plan provides recommendations for manure, fertilizer, process wastewaters, composts, or lime applications according to the factors, above. It promotes nutrient use efficiency and controls nutrient loss by focusing on the use of on-farm nutrient sources, emphasizing the 4Rs, and, in many cases, reducing nutrient imports onto farms. Nutrient Management Plan recommendations should be based on the best available research information for the soils and climate in New York State. Nutrient applications and their management should be consistent with Cornell Nutrient Guidelines.

SYSTEM EFFECTIVENESS
Proper nutrient management prevents excessive applications, can decrease nutrient imports on farms, and reduces the potential for nutrient loss. Long-term experimentation demonstrates that recommendations based on field research, conducted in New York, provide the best estimate of economic response and improved nutrient cycling for our conditions. Several studies from Cornell University demonstrate reductions in whole farm nutrient balances and nutrient purchases as well as nutrient losses via runoff and leaching through improved nutrient management.

Specifically, there are many management opportunities that advance conservation and crop productivity through nutrient applications made with the 4Rs, including:

- counting nitrogen credits from soil organic matter, past manure applications, and crop residues can significantly reduce the need for supplemental nitrogen fertilizer without sacrificing crop yield;
- regular soil and manure testing helps make the most of on-farm nutrient sources and better target purchased fertilizers, saving money and excess nutrient applications without sacrificing crop yield;
- on-farm tracking of soil tests, manure tests, and field records over time improves confidence in the nutrient management program and allows continual improvement through adaptive management;
- incorporating/injecting manure soon after application to a growing crop or just before planting in the spring can increase the nitrogen supply from the manure, reduce the need for supplemental nitrogen fertilizer, reduce the risk of over applying phosphorus relative to crop uptake, and reduce risk of surface runoff losses;
- considering hydrologically active areas, weather, field risk assessments, and timing of crop nutrient use to prioritize nutrient applications improves crop uptake and lowers risk of runoff or leaching;
- using cover crops scavenges nutrients remaining after the main crop, reducing losses from runoff, erosion, and leaching, as well as conserving nutrients and organic matter for the following crop;
- applying fertilizer with a method and timing to allow optimal plant uptake reduces losses and improves efficiency;
- etc.

IMPACTS ON SURFACE WATER
Beneficial - including nutrients, sediment, and pathogens.

IMPACTS ON GROUND WATER
Beneficial - including nitrogen and pathogens.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial, as it generally improves soil health and reduces erosion.
Air: Beneficial, as it has the potential to reduce particulate matter from ammonia volatilization and odors.
Plants: Beneficial, as it can reduce nutrient losses and subsequent impacts on neighboring plant communities.
Animals: Beneficial, as it can reduce pathogen losses as well as nutrient losses and subsequent impacts on terrestrial and aquatic habitat.
Human: Beneficial, as it can further safeguard drinking water sources, improve land and water resources for recreation, reduce odor, and provide economic growth.
Energy: Beneficial, as it can reduce use of farm fuels, energy for fertilizer manufacturing and transportation fuels for imported fertilizer and feed.

ADVANTAGES TO FARM

- Reduced nutrient losses and improved nutrient use efficiency.
- Improved crop yield and quality, often across the range of optimal and extreme weather conditions (improved soil health).

- Beneficial or neutral impact on farm profitability.
- Improved neighbor relations.

DISADVANTAGES TO FARM

- Higher level of farm management required may result in increased labor, equipment costs, and capital investment (e.g., manure storage).
- Requires additional time and training to adjust to new management strategies.
- Cost to change management may be prohibitive for some farms.

SYSTEM LIFESPAN

One (1) year.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Costs depend on several factors, including the size and type of farm, existing level of farm management, history of nutrient analyses and farm records, available equipment, familiarity with custom operators, and, on livestock farms, existing manure storage and transfer capacity. Consultation fees for developing and maintaining a nutrient management plan should be considered in addition to the costs for soil testing and manure nutrient analyses.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- annual updating of the nutrient management plan.
- soil testing every three years and manure analyses once per calendar year.
- records showing manure tests, date and conditions when applied, amount applied, application method, manure source, and location.
- crop management records are maintained.
- calibration of manure and fertilizer application equipment

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

See Cornell Nutrient Guidelines and the USDA-NRCS Nutrient Management Practice Standard (NY-590) for specific technical details about planning, implementation, and operation and maintenance.

Nutrient Management Plans are limited to the management of nutrients and soil health/conservation practices on fields, pastures, and in greenhouses. Comprehensive Nutrient Management Plans (CNMPs) address resource concerns across fields, pastures, and farmstead concentrated sources on livestock farms and should be given priority consideration where:

- excess nutrients are produced or imported;
- other farm related environmental concerns exist (e.g., silage leachate runoff, barnyard runoff, milkhouse wastewater, petroleum product storage, pesticide storage, mixing and loading, pesticide use and waste disposal);
- the farm has been determined to be a Concentrated Animal Feeding Operation (CAFO) by NYS Department of Environmental Conservation;
- etc.

Note: a Nutrient Management Plan (NRCS Standard 590), alone, does not meet the NYS requirements for CAFOs. A Comprehensive Nutrient Management Plan (NRCS Standard 312) must be developed for these farms.

Nutrient Management Plans, Comprehensive Nutrient Management Plans, and certain Component BMPs may be eligible for cost-sharing. Check with the local NRCS or SWCD office to determine practice eligibility and the availability of funds.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

For the most current information on each NRCS Conservation Practice Standard, please go to the NY Field Office Technical Guide (FOTG) at https://efotg.sc.egov.usda.gov/#/state/NY/documents.
Use the drop box in the left side to reach Section 4 – Practice Standards and Supporting Documents, click on the folder for Conservation Practice Standards & Support Documents and locate the appropriate practice. Under each practice, you will find, at the minimum, the practice standard. You may also find: a Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Nutrient Management	590	Acre	September 2020	1

*This is a listing of the primary Component BMPs to use but is not all inclusive and other NRCS Conservation Practice Standards may be utilized. Please check with a SWCC representative for approval.

**NYS Program Lifespans (listed above in Table III) refers to the minimum time period that a program participant must perform Operation and Maintenance of an Agricultural BMP System and the Component BMPs. Alternatively, NRCS CPS Lifespans (as found in the Standards) refer to specific design criteria and defines how long a conservation practice should function under an appropriate level of Operation and Maintenance. To meet NRCS Standards, a conservation practice must be designed to meet the CPS Lifespan, and all materials and installation methods must meet or exceed the NRCS defined Lifespan criteria.

REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Cornell Nutrient Guidelines for Field Crops: http://nmsp.cals.cornell.edu/guidelines/nutrientguide.html
- Cornell Nutrient Guidelines for Vegetable Crops: https://www.vegetables.cornell.edu/crops
- Cornell Nutrient Guidelines for Grapes: https://cals.cornell.edu/cornell-agritech/products-we-research/grapes
- Cornell Nutrient Guidelines for Berries: https://cals.cornell.edu/cornell-agritech/products-we-research/berries
- Cornell Nutrient Guidelines for Tree Fruits: https://cals.cornell.edu/cornell-agritech/products-we-research/tree-fruits
- Cornell Guidelines for Greenhouses: www.greenhouse.cornell.edu
- Cornell Guidelines for Turf: https://turf.cals.cornell.edu/
- Nutrient Management: Manure and Fertilizer AEM Tier 2 Worksheet and Information Sheet

Pathogen Management System

DEFINITION
Use of preventative measures, livestock management and conservation practices to provide multiple barriers to the introduction, replication, and survival of pathogens in domestic livestock and reducing the risk of pathogen contamination of surface and groundwater resources by treatment or controlling the movement of pathogens to water.

WATER QUALITY PURPOSE
To reduce the threat to surface and ground water from contamination by pathogenic organisms (e.g., Giardia and Cryptosporidium) found in farm animals.

POLLUTANT CONTROLLED
Pathogens or nutrients.

WHERE USED
Primarily on agricultural land (livestock and poultry operations) where a resource concern has been identified citing runoff from young stock housing or exercise lots or land receiving manure applications containing feces from infected animals which could enter a nearby watercourse.

SYSTEM DESCRIPTION
A Pathogen Management System Plan which incorporates a 4-barrier approach, as described below, shall be developed. The Pathogen Management Plan will address each of the four barriers. A veterinarian, or other qualified professional, utilizing the protocol from the New York State Cattle Health Assurance Program (NYSCHAP), or other similar protocols for appropriate species, shall develop the first two barriers.

The **FIRST** barrier is reducing the potential for pathogens to enter the farm. This shall be accomplished by carrying out actions such as the following:

- The testing of non-chlorinated water supplies that serve the herd or flock for fecal coliform bacteria
- Establishing appropriate biosecurity measures, including those controlling people, pets, pests and other animals, equipment or materials that may transport pathogens from other sources.
- Maintaining good hygiene and minimizing herd or flock contact with manure from other animal groups.
- Maintaining an accurate animal identification system and record of all health events

The **SECOND** barrier minimizes cross-contamination among animals and amplification of infection within a herd or flock. This shall be accomplished by actions such as:

- Keeping animal raising areas clean and dry,
- Proper worker hygiene when moving between facilities or animal groups,
- Ensuring that all feeds are stored and handled properly, and feeding utensils are clean, specifically avoiding manure contamination of feed.
- Implementing rodent and pest control programs,
- Separating pre-weaned animals to prevent direct contact with another young animal and with adult manure,
- Isolating infected animals until they are no longer infectious,

- Identifying the order in which animals should be fed (e.g., youngest to oldest, etc. depending upon the pathogen of concern).

The **THIRD** barrier provides for collection, handling, and treatment of manure and wastes appropriately to minimize the spread of the pathogens. This shall be accomplished by practices such as:

- Vegetated Treatment Areas (635) conservation practice standard to reducing runoff
- Composting (317) conservation practice standard for the composting of manures
- Animal Mortality (316) conservation practice standard for proper disposal of animal mortalities
- Waste Storage Structure (313) conservation practice standard to extension of waste storage time or isolation of waste storages to take advantage of pathogen die-off using:
  - Anaerobic Digester (366) conservation practice standard
  - Groundwater Testing (355) conservation practice standard

The **FORTH** barrier restricts movement of contaminated feces into watercourses or groundwater. This shall be accomplished by practices such as:

- Diversion (362) conservation practice standard to divert clean water away from livestock facilities
- Nutrient Management (590) conservation practice standard to spreading manure.
- Access Control (472) conservation practice standard for the exclusion of animals from waterbodies, such as streams, creeks, rivers and lakes
- Fence (382) conservation practice standard for isolating septic systems, leach fields and filter areas, and other septage disposal areas from grazing animals
- Protecting aquifer recharge areas and wellheads from manure runoff from fields
- Filter Strips (393), Riparian Forested Buffer (391) Riparian Herbaceous Cover (390) conservation practice standards

SYSTEM EFFECTIVENESS

Pollution prevention effectiveness increases if a multi-barrier approach is implemented that controls pathogens at the source (e.g., improved calf management) while also controlling pathogen transport on the farm (e.g., composting of infected manure) and controlling pollutants at the water course (e.g., vegetative filter strip).

IMPACTS ON SURFACE WATER

Potential for significant reduction in the risk of waterborne disease outbreaks from agricultural activities.

IMPACTS ON GROUND WATER

Actual risk of pathogens from agricultural activities polluting groundwater sources still needs to be determined. Avoiding spreading of infected manure on karst topography and within recharge areas of wells would reduce risk of well contamination.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Neutral.

Air: Neutral.

Plants: Beneficial, as it often also results in reduced nutrient losses which can lead to less fertilization of off-site plant communities.

Animals: Beneficial, as it can reduce pathogen losses, transmission of pathogens to wildlife, and nutrient losses all of which can impact wildlife and their habitat.

Human: Beneficial, as it can further safeguard drinking water sources and improve land and water resources for recreation.
Energy: Neutral.

ADVANTAGES TO FARM

- Practices to improve health and survivability of young stock can increase overall farm production, profitability, and, in some cases, labor efficiency.
- Further reduces risk of pathogen contamination of farm wells used for drinking water.

DISADVANTAGES TO FARM

- Some solutions may involve high costs of providing separate housing facilities for raising calves on farms.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost, from no cost to $1000 to 1500 per calf if separate housing and waste storage is needed.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- periodic plan review to determine if adjustments or modifications to the plan are needed.
- inspection and maintenance of animal exclusion.
- on-going monitoring of animal health is needed to determine practice effectiveness.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

For this System to be cost-shared, several criteria must be met. At a minimum, a Pathogen Management Plan (PMP) or a PMP included in a CNMP must be completed. All Four Tiers must be implemented for any one practice to be cost-shared. For example, to qualify for alternative calf housing (Tier 2), the farm must have implemented Tier I and agrees to implement Tier 3 and 4 during the Lifespan of the practice.

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Animal Mortality Facility	316	Number	April 2016	15
Composting Facility	317	Number	September 2021	15
Groundwater Testing	355	Number	March 2021	1
Access Control	472	Acres	April 2019	10
Anaerobic Digester	366	Number	March 2019	25
Fence	382	Feet	October 2022	20
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Waste Separation Facility	632	Number	October 2022	15
Waste Storage Facility	313	Number	March 2018	15
Waste Transfer	634	Number	October 2022	15
Waste Treatment	629	Number	October 2013	10
Vegetated Treatment Area	635	Acre	February 2017	10
Nutrient Management	590	Acre	September 2020	1
Roofs and Covers	367	Number	October 2016	10
Diversion	362	Feet	May 2017	10

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- NYS Cattle Health Assurance Program: http://nyschap.vet.cornell.edu
- Water Borne Pathogens AEM Tier 2 Worksheet and Information Sheet

Petroleum and Oil Products Storage System

DEFINITION
An oil and petroleum product storage tank is a stationary facility which may include one or more above ground tanks, underground tanks, or a combination of both, for the storage, transfer, and usage of liquid oil or oil products such as diesel fuel, gasoline, kerosene, fuel oil, lubrication oil, hydraulic oil, crop oil, vegetable oil, waste oils, or animal fat. A Petroleum and Oil Products Storage System involves planning, implementation of standard operating procedures, proper tank siting, design and installation, spill and overfill prevention, leak monitoring and inspection, secondary containment, operation and maintenance, and emergency action planning.

WATER QUALITY PURPOSE
To prevent contamination of surface and groundwater from oil product storage facility leaks and spills.

POLLUTANT CONTROLLED
Petroleum/oil products and biochemical oxygen demand (BOD) (for organic oil products).

WHERE USED
On agricultural operations where liquid oil products are stored or utilized, and a resource concern has been identified.

SYSTEM DESCRIPTION
This System consists of a combination of one or more of the following depending on the water quality risk posed by the storage facility as well as the regulatory requirements defined by NYS DEC and USEPA:

1. Proper storage tank siting – includes consideration of soil characteristics (corrosivity, permeability, bearing capacity, etc.), depth to groundwater, distance from a surface waterbody or drinking water well, location of floodplains, vehicular traffic patterns around the tank site, and distance from existing and planned farm buildings.

2. Proper tank design and installation – includes the use of corrosion resistant tanks and pipes (i.e., tank contains label that it conforms with 6 NYCRR Part 614), double wall tanks with wall thickness of at least 7/16th inch to protect against ballistics, steel posts to protect against vehicular traffic, anchoring or diking to avoid floatation in areas subject to flooding, a roof over tank to exclude rain water, etc., and utilizing an experienced tank installer who is familiar with state petroleum tank installation requirements.

3. Spill and overfill prevention equipment – includes color coding of fill ports, operating and shutoff valves, gauges and high-level alarms, automated shutoff devices, tank labels (showing design and working capacity), spill catchment basin for fill ports of underground storage tanks.

4. Leak monitoring and tank inspection – includes checking of aboveground tank for corrosion and leaks, installing underground piping access ports for leak testing, installing a concrete pad under aboveground tanks to detect levels and installation of a monitoring well (e.g., 4" slotted plastic pipe) between underground storage tank and secondary containment barrier.

5. Secondary containment barrier – includes aboveground engineered dikes, curbs, liners, or diversion system designed to contain spills from above-ground tank rupture, overfills, vandals and

equipment failure. Also included are drainage provisions for storm water that accumulates within the dike, curb or liner and installing double-wall tanks.

6. Spill emergency response plan – includes a written emergency plan at the storage facility location that shows action to be taken in case of a spill, leak, fire or explosion. Cleanup equipment should also be available at the site.

SYSTEM EFFECTIVENESS
When properly designed, installed, maintained, and managed this System may significantly reduce the risk of a contamination event occurring from the spill or leak of an oil product.

IMPACTS ON SURFACE WATER
Beneficial as a complete System should greatly reduce the risk of contaminants from reaching a surface water body.

IMPACTS ON GROUND WATER
Beneficial as a complete System should greatly reduce the risk of contaminants from reaching groundwater.

IMPACTS ON OTHER RESOURCES (OFF-SITE)
Soil**:** Beneficial by reducing the risk of leaks and spills that could contaminate soil.
Air**:** Neutral.
Plants**:** Beneficial as movement of product offsite following a major spill or leak could destroy vegetation.
Animals**:** Beneficial as movement of product offsite could have a detrimental effect on animal health and habitat.
Human**:** Beneficial by reducing the risk of health impacts through contamination of water and air resources.
Energy**:** Neutral.

ADVANTAGES TO FARM
- May provide direct protection to farmstead water supply if water source is a well.
- Can save product.
- May reduce farmer liability.

DISADVANTAGES TO FARM
- Requires continuous monitoring for potential leakage.

SYSTEM LIFESPAN
Ten (10) years.

COST
Each Agricultural BMP System is unique and must be customized for every situation in which it is employed resulting in a wide and variable range in cost. Factors impacting cost may include site characteristics, and the number of upgrades or add-ons to the system are required to reduce risk or comply with regulations.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- Daily inspection for leaks either visually or check of leak monitoring system.
- All applicable State and Federal regulations and manufacturers recommendations regarding operation and maintenance and record keeping will be followed.
- An emergency action plan should be developed and may be required for certain threshold volumes.

See documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

Leaks from underground petroleum storage are difficult to detect especially since most of the tanks installed on farms lack a leak monitoring system. Also, most landowners are unaware of the significant groundwater contamination risk to their own water supply posed by these storage tanks.

Farms with certain types and capacities of petroleum or oil product storages are required to comply with the NYS Department of Environmental Conservation (DEC) Petroleum Bulk Storage (PBS) regulation or the US EPA's Spill Prevention, Control, and Countermeasure (SPCC) regulation. To absolutely determine whether a farm is regulated under PBS or SPCC and the regulatory requirements for each, please visit these web sites: www.dec.ny.gov/chemical/287.html
www.epa.gov/ceppo/web/content/spcc/

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

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NRCS Name	Standard #	Reportable Item	Date	Life Span
On-Farm Secondary Containment Facility	319	Number	October 2022	15
Access Road	560	Feet	March 2021	10

Access Control	472	Acre	April 2019	10
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Conservation Cover	327	Acre	July 2019	5

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- NYS Department of Environmental Conservation (DEC) Petroleum Bulk Storage (PBS) regulation: www.dec.ny.gov/chemical/287.html
- US EPA's Spill Prevention, Control, and Countermeasure (SPCC) regulation: www.epa.gov/ceppo/web/content/spcc/
- Petroleum and Oil Products Storage AEM Tier 2 Worksheet and information Sheet

Prescribed Rotational Grazing System

DEFINITION
A Prescribed Rotational Grazing System using 5 or more paddocks for a grazing season, alternating paddocks to allow for forage vigor and re-growth. Livestock graze for no more than 7 days before they are rotated to another paddock.

WATER QUALITY PURPOSE
To prevent soil erosion; reduce water runoff that may transport nutrients, sediments, and pathogens; and allow for the management of animal manure and nutrients.

POLLUTANT CONTROLLED
Sediment, nutrients, pathogens, biochemical oxygen demand (BOD), or ammonia.

WHERE USED
On continuously grazed pastures, and fields including cropland that can be converted to pasture where a resource concern has been identified.

SYSTEM DESCRIPTION
A Prescribed Rotational Grazing System involves subdividing pastures and hayfields into grazing units called paddocks. The size and number of paddocks depend on the level of pasture productivity, stocking rate of livestock, and the residency period in the paddock. Individual paddocks are grazed for a period long enough to harvest available forage, and then rotated to allow optimal re-growth of the forage before livestock are returned to the paddock. Livestock may be moved as often as twice per day but at least once per week. The frequent rotation of livestock allows forage to recover from grazing, permitting plant re-growth and resulting in increased plant productivity.

SYSTEM EFFECTIVENESS
Many of the resource concerns associated with livestock on pasture are the result of overgrazing and allowing livestock direct access to surface waterbodies. When comparing Prescribed Rotational Grazing Systems to continuous grazing, forage quality is improved, and ground cover is increased reducing erosion and runoff potential. Prescribed Rotational Grazing Systems reduce the time livestock spend grazing on any single paddock and improve the uniformity of manure and urine deposition over the pasture allowing for improved plant utilization and reduced runoff of nutrients. Controlled grazing pressure increases the quality and quantity of forage, thereby reducing the fiber content in manure and increasing the speed of manure decomposition. Livestock manure from a prescribed rotational grazing system is less likely to cause surface water pollution compared to a continuous grazing system. Because Prescribed Rotational Grazing Systems improve overall pasture yields, farmers can fence out riparian areas, wetlands, and other areas adjacent to waterbodies and still meet or exceed their pasture requirements.

IMPACTS ON SURFACE WATER
Beneficial as the practices reduces erosion and water runoff that may transport nutrients, sediment, and pathogens to waterbodies.

IMPACTS ON GROUND WATER
Beneficial as the System can improve the distribution of nutrients across a farm, address areas of livestock concentration, and result in a conversion of row crop acres to perennial pasture seedings.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial by reducing erosion, sedimentation, and improving or maintaining soil quality.
Air: Beneficial as it has the potential to reduce motorized equipment use and sequester carbon.
Plants: Neutral.
Animals: Beneficial as it may provide or improve wildlife habitat.
Human: Beneficial as farmers have reported positive comments from their nonfarm neighbors who like seeing livestock out on lush green pasture.
Energy: Beneficial by allowing livestock to harvest their own feed and spread their own manure saving fossil fuels in the process.

ADVANTAGES TO FARM

- It allows for the recovery of the economic investment in 1 to 5 years.
- Promotes harvest efficiency thus maximizing animal production per acre.
- Has the potential to lower annual feed costs and reduce dependence on purchased feeds.
- Proper implementation can improve forage quality, species composition, and yield.
- Can reduce energy, labor and equipment requirements.
- Practice has the potential to improve livestock health.

DISADVANTAGES TO FARM

- Requires a high degree of management skills.
- May be necessary to install stabilized stream crossing and alternative water supplies to provide livestock access to all grazed forage resources while protecting riparian areas and waterbodies.
- Requires a fencing system to subdivide existing pastures.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Some factors which will influence cost include:

- the number and type of livestock;
- system design, including the number and size of paddocks;
- the need for and design of watering facilities;
- pasture improvement needs such as seeding, lime, fertilizer, and pest management; laneway and stream crossing needs; and
- the amount and condition of existing fence.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- Soil analysis on at least a 3-year rotation to determine pH and fertility needs.
- Periodic forage analyses from actual pasture samples should be done about 3 times throughout the growing season.
- Excess forage growth (spring flush) must be captured either by mechanically harvesting or allowing another livestock group to graze it.
- Paddocks must be rotated according to forage growth stage.
- Basic maintenance as needed to fences, laneways, crossings, and watering stations.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

Stream crossing or disturbance of stream banks may require a permit.

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Prescribed Grazing	528	Acre	May 2018	1
Pasture and Hay Planting	512	Acre	March 2022	5
Forage Harvest Management	511	Acre	September 2021	1
Fence	382	Feet	October 2022	20
Field Border	386	Acre	October 2017	10
Trails and Walkways	575	Feet	September 2021	10
Watering Facility	614	Number	March 2021	10
Livestock Pipeline	516	Feet	March 2021	20
Pumping Plant	533	Number	October 2022	15
Structure for Water Control	587	Number	March 2019	20
Water Well	642	Number	March 2021	20
Spring Development	574	Number	September 2021	20

Pond	378	Number	May 2018	20
Access Road	560	Feet	March 2021	10
Access Control	472	Acre	April 2019	10
Grazing Land Mechanical Treatment	548	Acre	May 2011	1
Brush Management	314	Acre	March 2018	10
Herbaceous Weed Treatment	315	Acre	April 2021	5
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Stream Crossing	578	Number	January 2023	10
Subsurface Drain	606	Feet	May 2020	20
Underground Outlet	620	Feet	September 2021	20

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Pasture Management AEM Tier 2 Worksheet and Information Sheet

Process Wash Water Management System

DEFINITION
A System designed for the collection, storage, treatment and disposal of effluents from processes on farms that include milking centers, horse washing, egg washing, vegetable washing and fruit washing. They may contain milk solids, nutrients, liniments, organic matter and soil along with detergents, acid rinses and sanitizer, all mixed with a quantity of water. This System is not applicable for wash water containing manure and other animal waste or for wash water from commercial processing like cheese production or vegetable or fruit processing (like vineyard waste).

WATER QUALITY PURPOSE
To reduce the organic and nutrient component of the liquid waste from regular processes on a farm, into receiving waters.

POLLUTANT CONTROLLED
Primarily biodegradable organics and soluble phosphorous. Secondary pollutants include ammonia, nitrates, or pathogens.

WHERE USED
On operations where water is used to assist in the on-farm processing or clean-up of organic materials in areas such as milking centers, horse barns, egg farms or produce washing facilities that are not part of a value-added operations (such as cheese or wine making, commercial processing, etc.) or that require a NYS SPEDES Permit or are deemed to be a point source of pollution.

SYSTEM DESCRIPTION
The System is composed of an area where water is used to either clean up the barn or facility or is used to clean the animals or products. The wastewater is collected and then treated by a combination of tanks for settling of materials, transfer to proper waste storage structures, daily or periodic spreading or treatment by the use of vegetative measures or a combination there of.

SYSTEM EFFECTIVENESS
These Systems can be very effective in the removal of organic material including milk solids, soil, nutrients and some chemicals when properly installed and maintained on a regular basis or incorporated into a waste management system and land applied in accordance with a Nutrient Management Plan.

IMPACTS ON SURFACE WATER
Beneficial - Reduces phosphorous, fecal coliform and organics loading.

IMPACTS ON GROUND WATER
Beneficial if sited properly and care is given to avoid areas of shallow bedrock or groundwater.

IMPACTS ON OTHER RESOURCES

Soil: Beneficial by adding nutrients when applied in accordance with a Nutrient Management Plan.
Air: Negative if system is not operated or managed properly.
Plants: Beneficial.
Animals: Neutral.
Human: Beneficial as system protect water quality.

Energy: Negative to Beneficial depending on the system designed and its additional energy use or energy saving.

ADVANTAGES TO FARM

- Can be treated separately and does not need to add additional water to manure system.
- Can be made to perform with gravity and be relatively management free.
- Can be relatively inexpensive.

DISADVANTAGES TO FARM

- Some systems need high level of management to perform correctly.
- May require additional pumps and tanks that require clean-out and maintenance on a regular basis.
- Can be expensive if major modification to the existing infrastructure is required.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Cost can run from $3,000 to $45,000 depending on the complexity of the system and the material to be treated.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- Tanks installed in the system for settling of solids, collection of milk fats, etc. need to be emptied on a regular basis.
- Pumps need to be monitored, maintained and or replaced.
- Vegetated treatments need to be mowed and material removed.
- Flocculation systems need to be emptied and maintained.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

For the most current information on each NRCS Conservation Practice Standard, please go to the NY Field Office Technical Guide (FOTG) at https://efotg.sc.egov.usda.gov/#/state/NY/documents.
Use the drop box in the left side to reach Section 4 – Practice Standards and Supporting Documents, click on the folder for Conservation Practice Standards & Support Documents and locate the appropriate practice. Under each practice, you will find, at the minimum, the practice standard. You may also find: a Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects

Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Vegetated Treatment Area	635	Acres	February 2017	10
Waste Separation Facility	632	Number	October 2022	15
Waste Transfer	634	Number	October 2022	15
Pumping Plant	533	Number	October 2022	15
Waste Storage Facility	313	Number	March 2018	15
Structure for Water Control	587	Number	March 2019	20
Subsurface Drain	606	Feet	May 2020	20
Heavy Use Area Protection	561	Sq. Feet	September 2021	10

*This is a listing of the primary Component BMPs to use but is not all inclusive and other NRCS Conservation Practice Standards may be utilized. Please check with a SWCC representative for approval.

**NYS Program Lifespans (listed above in Table III) refers to the minimum time period that a program participant must perform Operation and Maintenance of an Agricultural BMP System and the Component BMPs. Alternatively, NRCS CPS Lifespans (as found in the Standards) refer to specific design criteria and defines how long a conservation practice should function under an appropriate level of Operation and Maintenance. To meet NRCS Standards, a conservation practice must be designed to meet the CPS Lifespan, and all materials and installation methods must meet or exceed the NRCS defined Lifespan criteria.

REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Process Wash Water AEM Tier 2 Worksheet and Information Sheet

Riparian Buffer System

DEFINITION
An area of grasses, sedges, rushes, ferns, legumes, forbs, shrubs, or trees tolerant of intermittent flooding or saturated soils located adjacent to and up-gradient from waterbodies.

WATER QUALITY PURPOSE
To intercept surface runoff, subsurface flow and shallow groundwater flow from agricultural sources in order to reduce excess amounts of pollutants. Systems can be used to create shade to lower or maintain surface water temperature, and to reduce pesticide drift from entering a waterbody.

POLLUTANT CONTROLLED
Sediment, nutrients, pesticides, biochemical oxygen demand (BOD), or thermal modification.

WHERE USED
This System can be applied to agricultural lands adjacent to permanent or intermittent waterbodies where a resource concern has been identified. This System is not applied to stabilize stream banks or shorelines, as a standalone System; this System and Component BMPs may be used in conjunction with the Stream Corridor and Shoreline Management System to aid in the stabilization of stream banks or shorelines.

SYSTEM DESCRIPTION
A Riparian Buffer System consists of an area containing a variety of vegetation situated between agricultural lands and waterbodies that are designed to filter surface runoff and shallow groundwater by encouraging sheet flow and infiltration and impede concentrated flow. The type and extent of vegetation is suited to the soil and hydrology of the site and for the water quality purpose. Up to three distinct zones may be employed to achieve desired results. In all cases livestock must be excluded or controlled. Appropriate site preparation is essential to establishing desired vegetation, and practices that promote the vigor and reproduction of desired plant species, including pest management, may be employed. In addition, excessive sheet-rill and concentrated flow erosion may need to be controlled in the areas immediately adjacent and up-gradient of the buffer area.

SYSTEM EFFECTIVENESS
A Riparian Buffer System will be most effective when used as a component of an overall conservation system including nutrient management, pest management, and runoff, sediment and erosion control practices. The filtering effects of riparian buffers are most effective when used in conjunction with erosion reducing management practices. Riparian buffers can be very effective for sediment and sediment-bound pollutant removal with trapping efficiencies exceeding 50%. Riparian buffers are less effective at removing soluble phosphorous or nitrates.

IMPACTS ON SURFACE WATER
Beneficial – this System does not generally address pollutants at the source (thermal modification is an exception), but “polishes” surface runoff by removing additional amounts of pollutants such as sediment, soil attached nutrients, and organic matter.

IMPACTS ON GROUND WATER
Neutral – It may be beneficial in areas where groundwater is recharged directly from surface waterbodies or there is a direct surface connection to groundwater.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Neutral.
Air: Beneficial by increasing carbon storage in plant biomass and soils.
Plants: Neutral.
Animals: Beneficial by improving riparian habitat and potentially providing a source of detritus and large woody debris. Provides food and cover for fish, wildlife, and livestock. Establish and maintain habitat corridors. Enhance pollen, nectar, and nesting habitat for pollinators. Improves overall surface water quality.
Human: Increase water storage on flood plains potentially reducing flood impacts.
Energy: Neutral.

ADVANTAGES TO FARM

- Provides a low cost, cost-effective approach to treat agricultural runoff.
- Restore, improve, or maintain riparian plant communities.
- May provide a buffer for cropland and farm infrastructure from flood damage.

DISADVANTAGES TO FARM

- May take cropland and pasture out of production.
- Requires a large land area.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Factors impacting costs may include buffer length, width, types of vegetation, and the need for associated practices to exclude livestock or maintain sheet flow.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized to the situation. The following are generally key components to the operation and maintenance of the system:

- Inspections conducted annually and immediately following severe storms for evidence of sediment deposit, erosion, or concentrated flow channels.
- Avoid use of fertilizers, pesticides, other chemicals, vehicular traffic or disturbance of vegetation and litter inconsistent with erosion control and buffering objectives.
- Portions of the buffer may need to be periodically mowed and the clippings removed to promote dense vegetative growth and removal of nutrients.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

Some activities may require stream disturbance or wetlands permits.

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Riparian Forest Buffer	391	Acre	September 2021	15
Riparian Herbaceous Cover	390	Acre	May 2011	5
Tree/Shrub Establishment	612	Acre	April 2017	15
Tree/Shrub Site Preparation	490	Acre	September 2021	1
Conservation Cover	327	Acre	July 2019	5
Critical Area Planting	342	Acre	October 2017	10
Stream Crossing	578	Number	January 2023	10
Access Control	472	Acre	April 2019	10
Access Road	560	Feet	March 2021	10
Trails & Walkways	575	Feet	September 2021	10
Brush Management	314	Acre	March 2018	10
Fence	382	Feet	October 2022	20
Filter Strip	393	Acre	October 2017	10
Pasture and Hay Planting	512	Acre	March 22	5
Grassed Waterway	412	Acre	September 2021	10
Herbaceous Weed Treatment	315	Acre	April 2021	5
Pest Management Conservation System	595	Acre	September 2020	1
Structure for Water Control	587	Number	March 2019	20
Lined Waterway or Outlet	468	Feet	September 2021	15

Water & Sediment Control Basin	638	Number	March 2019	10

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Stream and Floodplain Management AEM Tier 2 Worksheet and Information Sheet

Short-Term Waste Collection and Transfer System

DEFINITION
A System designed for the collection, transfer, and short-term storage for up to 60 days of generated or imported agricultural materials, including manure, by-products, process wastewater, or organic material being utilized as a land applied nutrient source or amendment rather than animal feed or bedding.

Waste is a Natural Resources Conservation Service - Conservation Practice Standard term used in reference to manure, agricultural by-products, wastewater, and contaminated runoff from agricultural production or processing.

WATER QUALITY PURPOSE
To reduce surface and subsurface loss of nutrients from concentrated livestock areas, manure, or other agricultural materials.

POLLUTANT CONTROLLED
Nutrients, pathogens, or organics.

WHERE USED
This Agricultural BMP System is designed, aligned, and intended to serve both Animal Feeding Operations (AFOs), such as a smaller dairy, beef, horse, sheep, and goat farms, as well as crop farms. Concentrated Animal Feeding Operation (CAFO)-permitted farms are directed to plan and implement NRCS CPS Waste Transfer (634) or NRCS CPS Waste Storage Facility (313) using the Waste Storage and Transfer System.

The System, described above, is appropriate for all situations on farms where agricultural materials, such as manure, by-products, process wastewater, or organic material are currently managed such that a resource concern has been identified; and where the proper collection, transfer, and short-term storage of materials is recommended to address resource concerns and improve nutrient utilization.

The purpose of this System is to aid daily spread farms (or farms receiving imported agricultural materials) in addressing primarily farmstead nutrient management resource concerns, as well as improving application flexibility to fields and pastures, given factors such as weather, seasonal workload, crop management timing, or field conditions. Properly collecting, transferring, and storing agricultural materials around farmstead facilities will protect adjacent resources, as well as organize and efficiently support manure transfer and targeted field applications. Due to the short-term storage duration, the System requires regular monitoring of manure or material amounts in the storage and applications to fields based on the Farm’s Nutrient Management Plan.

This System is not used to contain and facilitate an aerobic microbial ecosystem for the decomposition of manure, other organic material, or both. Thus, NRCS CPS Composting Facility (317) is not an allowable BMP in a Short-Term Waste Collection and Transfer System, because the limited duration does not effectively support biological processes necessary for proper composting.

This System may be utilized to address resource concerns associated with <u>existing</u> barns, bedded pack facilities, and heavy use areas. The Waste Storage and Transfer System would be appropriate if a new or future bedded pack / composted bedded pack system is planned and necessary to treat the resource concerns.

SYSTEM DESCRIPTION
The System may be composed of multiple component practices that collect agricultural materials and effectively transfer materials to application equipment or to a structural NRCS CPS Waste Storage Facility (313). System design is dependent upon the farm, site location and management considerations.

Systems may address one or multiple manure sources or imported agricultural materials and their existing transfer areas; collection of multiple sources to one appropriately planned NRCS CPS Waste Storage Facility (313) or multiple Waste Storage Facilities per each source is allowed.

Depending on the existing agricultural material's consistency (i.e., solid, semi-solid, liquid), consider the implications of storing waste, environmental inputs (precipitation), or combining variable waste streams of different consistency. System design will depend upon the existing manure handling equipment or will include provisions for procuring alternative equipment (e.g., solid vs. liquid manure spreader).

NRCS CPS Roofs and Covers (367) is required to exclude clean water and maintain appropriate manure moisture content for solid / semi-solid NRCS CPS Waste Storage Facilities (313). Excessive moisture will increase the potential for air emissions of volatile organic compounds, ammonia, and nitrous oxide, and may lead to anaerobic conditions, which will increase the potential for emissions of methane and hydrogen sulfide.

NRCS CPS Roofs and Covers (367) is not required for liquid NRCS CPS Waste Storage Facilities (313).

Consider a minimum storage duration capacity of 30 days of agricultural materials. Systems designed to manage materials below the minimum storage duration capacity may become overwhelmed easily, possibly resulting in resource concerns at the transfer or storage areas.

Future planning considerations: compatibility with future, longer-duration Waste Storage and Transfer Systems should be considered when siting and sizing Short-Term Waste Collection and Transfer Systems.

To both address the farmstead resource concerns and properly recycle nutrients on fields and pastures, Short-Term Waste Collection and Transfer Systems proposed for NYS SWCC Funding Programs shall have one of the following plan types completed before submitting the project for program application and a complete system meeting all NRCS Standards must result:

- *AEM Tier 3A Farmstead + Nutrient Management-Core Plan combination or*
  - *Requires a Certified Crop Adviser*
  - *See details below regarding use of The NYS Soil and Water Conservation Committee Short-Term Waste Collection and Transfer System Modified NRCS CPS Waste Storage Facility (313) Policy*
- *AEM Tier 3A Farmstead + Full 590 Nutrient Management Plan combination or*
  - *Requires an AEM Certified Planner*
- *CNMP*
  - *Requires an AEM Certified Planner*

This Policy does not require a Comprehensive Nutrient Management Plan (CNMP) for the planning and implementation of NRCS CPS Waste Storage Facilities (313) included in this BMP System with a storage duration less than 60 days of farm generated or imported agricultural materials.

NRCS CPS Waste Storage Facilities (313) planned and designed without a Full NRCS CPS Nutrient Management Plan (590) or a Comprehensive Nutrient Management Plan would not meet all requirements of the (313) Standard and would not be eligible for Federal Cost-Share Programs.

SYSTEM EFFECTIVENESS

NRCS CPS Waste Transfer (634) is effective in reducing losses from agricultural materials (especially where runoff potential or leaching potential risk is high) by properly collecting, controlling, and conveying materials around farmstead facilities to either manure application equipment or a NRCS CPS Waste Storage Facility (313)

NRCS CPS Waste Transfer (634) paired with a short-term NRCS CPS Waste Storage Facilities (313) is also effective in reducing loss of nutrients and pathogens by safely storing agricultural materials during critical runoff periods and applying materials and nutrients under the guidelines of the Farm's Nutrient Management Plan.

IMPACTS ON SURFACE WATER

Beneficial when agricultural materials and nutrients are applied in accordance with a Nutrient Management Plan and NRCS CPS Waste Transfers (634) and NRCS CPS Waste Storage Facilities (313) are designed and operated according to the Plan.

IMPACTS ON GROUND WATER

Beneficial as agricultural materials will be better controlled at the farmstead.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial as agricultural materials can replenish organic material and matter in the soil and improve soil health.

Air: Negative or beneficial. When agricultural materials, such as manure and wastes, is stored and applied at certain times of the year, odor issues increase for that time period unless the material is applied and incorporated or injected. Conversely, by storing waste, odors are not created when spreading daily. Greenhouse gas emissions may be the same or a modest increase relative to the management without a Short-Term Waste Collection and Transfer System, but can be mitigated with practices that maintain manure in a dryer, largely aerobic state (methane); limit the time manure is in storage (methane), especially during months with higher ambient temperatures; and apply manure for improved nitrogen use by crops (nitrous oxide).

Plants: Beneficial as nutrients may be applied based on agronomic guidelines within the Nutrient Management Plan.

Animals: Beneficial as improved nutrient management on cropland can improve habitat (especially aquatic).

Human: Beneficial as system protects water quality while also improving farm aesthetics, management, and crop production.

Energy: Beneficial depending on the system designed and its additional energy use or energy saving.

ADVANTAGES TO FARM

- Allows the farm to effectively collect and transfer agricultural materials around the farmstead.
- Allows livestock manure and other waste to be treated as a valuable nutrient resource rather than a waste.
- May reduce cost for purchased commercial fertilizer.
- May avoid or eliminate the need for daily spreading and allow for strategic and efficient spreading activities and targeted manure applications based on the Nutrient Management Plan.

- Can improve aesthetics and relations with neighbors if managed properly.
- Helps to reduce nutrient loss when runoff and erosion potential is high.

DISADVANTAGES TO FARM

- Can be expensive to implement and operate the System based on site constraints and existing infrastructure.
- Requires increased level of management and labor especially during times of application.
- May require additional equipment or expensive operation and maintenance procedures.
- May result in significant nutrient loss if emptied when surface runoff and erosion potential is high.
- May cause damage to streams and fish if storage structure leaks or fails.

SYSTEM LIFESPAN

Ten (10) years.

COST

Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost.

OPERATION AND MAINTENANCE

Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the System:

- A written plan should be prepared for each system designed, including regular removal of manure or material from the System and application to fields or pastures according to a Nutrient Management Plan.
- Accurate records of timing of manure or material application and location need to be kept.
- Storages must be fenced or walled, and warning signs maintained.
- Pumps need to be regularly checked and maintained.
- Safety measures need to be kept up to date.
- Other items need to be addressed based on specific system requirements.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

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Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span**
Waste Storage Facility	313	Number	March 2018	15 years
NYS SWCC Short-Term Waste Collection and Transfer System Modified NRCS CPS Waste Storage Facility (313) Policy ***	313	Number	March 2018 (NRCS) – October 2022 NYS SWCC Program Policy	15 Years
Waste Transfer	634	Number	October 2022	15 Years
Waste Separation Facility	632	Number	October 2022	15 Years
Waste Treatment	629	Number	October 2013	10 Years
Waste Facility Closure	360	Number	May 2020	15 Year
Nutrient Management	590	Acre	September 2020	1 year
Pumping Plant	533	Number	October 2022	15 Years
Roofs and Covers	367	Number	October 2016	10 Years
Subsurface Drain	606	Feet	May 2020	20 Years
Access Control	472	Acre	April 2019	10 Years
Access Road	560	Feet	March 2021	10 Years
Diversion	362	Feet	May 2017	10 Years
Fence	382	Feet	October 2022	20 Years
Heavy Use Area Protection	561	Sq. Feet	October 2021	10 Years
Hedgerow Planting	422	Feet	May 2011	15 Years
Pond Sealing or Lining – Geomembrane or Geosynthetic Clay Liner	521	Sq. Feet	March 2019	20 Years

Pond Sealing or Lining – Compacted Soil Treatment	520	Sq. Feet	May 2017	15 Years
Pond Sealing or Lining – Concrete	522	Sq. Feet	May 2017	20 Years

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***The NYS Soil and Water Conservation Committee Short-Term Waste Collection and Transfer System Modified NRCS CPS Waste Storage Facility (313) Policy should be utilized by Professional Engineers when designing and certifying NRCS CPS Waste Storage Facilities (313) that are planned, supported, and operated as part of the Short-Term Waste Collection and Transfer System from a combination of NYS AEM Tier 3A Farmstead and Nutrient Management-Core Plans. These NRCS CPS Waste Storage Facilities (313) are eligible for funding from NYS SWCC Cost-Share Programs, but not Federal Cost-Share Programs.

REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Manure and Fertilizer Storage AEM Tier 2 Worksheet and Information Sheets
- Nutrient Management: Manure and Fertilizer AEM Tier 2 Worksheet and Information Sheets
- Greenhouse Gas Mitigation Opportunities AEM Tier 2 Worksheets and Information Sheets
- 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
- The NYS Soil and Water Conservation Committee Short-Term Waste Collection and Transfer System Modified NRCS CPS Waste Storage Facility (313) Policy

Silage Leachate Control and Treatment System

DEFINITION
A System designed to reduce the generation of silage leachate and for the collection, storage, treatment and disposal of effluents and runoff from the storage of silage crops from upright and bunk silos, as well as silage storage bags.

WATER QUALITY PURPOSE
To manage silage leachate to reduce surface and ground water biochemical oxygen demand (BOD) loading as well as nutrient loading.

POLLUTANT CONTROLLED
Nutrients, sediment, organic loading or biochemical oxygen demand (BOD).

WHERE USED
In situations where the storage of silage and haylage can yield effluent and runoff which can enter either a surface water body or ground water and a resource concern has been identified. This practice can be used in barnyards, farmsteads, fields, or other areas where upright silos, bunk silos and silage bagging systems are located.

SYSTEM DESCRIPTION
Silage effluent and runoff control would be composed of a combination of structural and non-structural management practices to control the source of the material or manage the collection and treatment or disposal of it. Source reduction can lessen the amount of low-flow high concentrate leachate produced and can be accomplished with several management techniques including growing the proper variety of corn for the area, harvesting when corn or haylage are at the proper maturity and at the correct moisture content along with proper operation and maintenance of the structure. When source reduction does not eliminate leachate, a system to collect, store or treat the silo effluent and runoff can be installed. If a suitable waste storage is available, the silage leachate can be transferred there. Otherwise, a system to separate low and high flows, collection of low flows and a treatment system such as a Vegetated Treatment Area is required. Relocation of silage storage to an area that is not a resource concern is another option. The System should also include an area for the storage of waste or spoiled feed for later application to crop fields in accordance with a Nutrient Management Plan. Use of covered storage and exclusion of surface water runoff from the storage area will also reduce the overall amount of liquid requiring treatment.

SYSTEM EFFECTIVENESS
Silage leachate exerts a high organic loading on the receiving water and produces a high biochemical oxygen demand (BOD) which will deplete available dissolved oxygen resulting in fish kills, tastes and odors, and a general unaesthetic appearance. The proper management of leachate from silos and other types of storage facilities can significantly reduce these problems. In addition, Silage Leachate Control and Treatment Systems may provide Component BMPs which may greatly reduce or eliminate the degradation of clean water entering the site, stabilize the management area to reduce disturbed ground or access roads (reducing erosion, runoff, and sedimentation), allow better collection and management of waste or spoiled feed, and greatly influence the overall source of potential contaminates by incorporating proper feed harvesting and feed storage practices, as well as end use feed management practices.

IMPACTS ON SURFACE WATER
Beneficial - Reduces organic loading and resultant depletion of dissolved oxygen.

IMPACTS ON GROUND WATER
Beneficial - The oxygen depletion in ground water resulting from organic loading can cause bad odors and tastes which may be sustained for extended periods of time due to very low re-aeration rates.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial when leachate is applied in accordance with a Nutrient Management Plan.
Air: Negative is system is not operated or managed properly.
Plants: Beneficial by eliminating kill zones and correct application rates.
Animals: Beneficial – protects fish from high BOD.
Human: Beneficial as system protects water quality but can be negative if not operated or maintained effectively.
Energy: Negative to Beneficial depending on the system design and its additional energy use or energy saving.

ADVANTAGES TO FARM
- May be corrected by growing a different variety of corn and changing timing of harvest.
- Can be built as a gravity system.
- Can be plumbed into existing waste management system.
- The system design includes an area for waste feed storage for utilization as a nutrient source.

DISADVANTAGES TO FARM
- Can be expensive if separate collection and storage are required.
- Due to amino acid content of silage leachate, collection facilities should be made of corrosion resistant material and land application should be carefully managed to prevent kill-off.
- Require heightened level of management as run-off is precipitation driven and solid separation can require frequent maintenance.

SYSTEM LIFESPAN
Ten (10) years.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Cost can run from $3,000 to $70,000 or more depending on the complexity of the system.

OPERATION AND MAINTENANCE
Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:
- Low flow/high flow separation must be adjusted frequently to ensure capture of adequate low flow.
- Checking solid separation after each rainfall to remove debris.
- Keeping records of where silage leachate is applied to reduce potential over application.
- Periodic inspection and repair of storage facility to assure no leakage through floors and walls.
- Periodic inspection and repair of pipes and other connections to eliminate leakage opportunities.
- Tanks installed must be checked for need for emptying.

- Periodic inspection and repair of roads, heavy use areas, and waste feed management areas.
- Maintain clean water practices associated with the management areas.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Vegetated Treatment Area	635	Acre	February 2017	10
Waste Separation Facility	632	Number	October 2022	15
Waste Transfer	634	Number	October 2022	15
Pumping Plant	533	Number	October 2022	15
Dike	356	Feet	December 2012	20
Diversion	362	Feet	May 2017	10
Subsurface Drain	606	Feet	May 2020	20
Sediment Basin	350	Number	May 2017	20
Structure for Water Control	587	Number	March 2019	20
Heavy Use Area Protection	561	Sq. Feet	September 2021	10
Waste Storage Facility	313	Number	March 2018	15

Sprinkler System	442	Acre	October 2022	15
Irrigation Water Management	449	Acre	October 2022	1
Fence	382	Feet	October 2022	20
Conservation Crop Rotation	328	Acre	October 2015	1

*This is a listing of the primary Component BMPs to use but is not all inclusive and other NRCS Conservation Practice Standards may be utilized. Please check with a SWCC representative for approval.

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Silage Storage AEM Tier 2 Worksheet and Information Sheet

Soil Health System

DEFINITION
Soil Health Systems employ cultural (i.e., non-structural, cultural or management-based) measures such as crop rotation, tillage, mulching, cover cropping, or other practices according to a soil conservation plan to control soil erosion, reduce run-off, and enhance soil health.

WATER QUALITY PURPOSE
To reduce the detachment, transport, and loss of sediment and solid-phase nutrients as well as runoff volumes.

POLLUTANT CONTROLLED
Sediment, nutrients, pathogens, pesticides, or biochemical oxygen demand (BOD).

WHERE USED
Cropland, pasture, vegetable and fruit production, orchards, vineyards, or biomass production areas where a resource concern has been identified.

SYSTEM DESCRIPTION
Soil Health Systems consist of non-structural, management-based practices working in concert to control soil erosion, reduce runoff volumes, enhance soil health, and improve productivity of the land. Such systems advance soil health, water quality, and productivity through a few general approaches, including:

- reducing the intensity of tillage and oxidization of soil organic matter;
- maintaining greater soil cover throughout the year, by living crops or crop residues;
- preventing or slowing sheet and rill flows;
- increasing the diversity of crops grown throughout the rotation; and
- increasing organic matter additions to the soil, by crop residues or amendments.

Individual practices often utilized in soil health systems include:

- residue and tillage management, such as no-till, zone-till, mulch-till, etc.;
- cover crops;
- strip cropping;
- contour planting;
- long term perennial forage or biomass planting on cropland acres;
- mulching;
- etc.

The Soil Health System is based on a well-integrated, Cropland Soil Conservation Plan (or a Soil Conservation Plan within a broader Nutrient Management Plan or Comprehensive Nutrient Management Plan). The Plan is utilized to assess risk of water and wind erosion and other soil health resource concerns and make specific recommendations for how various practices will work together to address those concerns. These recommendations may extend beyond the cultural practices addressed with this System to dovetail with other Agricultural BMP Systems on the farm, including Erosion Control System - Structural, Nutrient Management System - Cultural, Prescribed Rotational Grazing System, etc.

SYSTEM EFFECTIVENESS
A systems approach to soil health provides multiple barriers against soil erosion and water quality degradation while improving soil function. Crop rotation, conservation tillage, cover cropping, strip cropping, organic matter amendments (manure, compost, green manures, mulch, etc.) and other cultural conservation practices help protect soil from erosion by wind and water and help maintain or increase soil organic matter. Soil organic matter improves soil tilth, reduces susceptibility to compaction, increases nutrient and water holding capacity, slows the movement of pesticides through the soil, reduces runoff losses, and protects against erosion. Several tons of soil loss per acre can be avoided annually with these practices, as well as significant improvements in nutrient use efficiency and crop production. Soil and water resources are often further conserved when cultural soil health practices are paired with structural soil conservation systems and nutrient management, per the multiple barrier approach.

IMPACTS ON SURFACE WATER
Beneficial - including reduced losses of sediment, nutrients, pathogens, pesticides, and biochemical oxygen demand (BOD).

IMPACTS ON GROUND WATER
Beneficial in most cases, but may be negative in some soil types with annual crops in long-term no-till because significant macropores may establish and aid the loss of nutrients and pathogens to groundwater or tile drainage systems.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial, as it generally improves soil health and reduces erosion.
Air: Beneficial, as it can reduce dust and fossil fuel combustion used in crop production.
Plants: Beneficial, as it can reduce sediment and nutrient losses and subsequent impacts on neighboring plant communities.
Animals: Beneficial, as it can reduce off-site impacts from sediment, nutrients, pathogens, pesticides, and biochemical oxygen demand (BOD) on terrestrial and aquatic habitats.
Human: Beneficial, as it can further safeguard drinking water sources, improve land and water resources for recreation, reduce maintenance costs on public infrastructure (e.g., road ditches, culverts, reservoirs), and provide economic growth.
Energy: Beneficial, as it can reduce use of farm fuels, energy for fertilizer manufacturing, and transportation fuels for imported fertilizer and feed.

ADVANTAGES TO FARM
- Potential to reduce soil loss, reduce negative effects of extreme weather years on crop production, and improve crop yield and quality.
- Improved labor efficiency and timing for crop management.
- Often a neutral or positive impact on farm profitability.
- Improved neighbor relations.

DISADVANTAGES TO FARM
- Higher level of farm management required may result in increased labor and equipment costs.
- Requires additional time and training to adjust to new management strategies.

SYSTEM LIFESPAN
1 to 5 years depending on components in the soil health system.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Costs depend on several factors, including the size and type of farm, existing level of farm management, availability of equipment, familiarity/availability of custom operators, etc.

OPERATION AND MAINTENANCE
Each Agricultural BMP System is unique and must be customized for every situation. Often annual evaluation and fine tuning of cultural conservation system is required because many component practices are annual practices and can be refined based on prior years' experiences and the current year's conditions.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS
Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

NOTE: a soil conservation plan, alone, does not meet the NYS requirements for CAFOs. A Comprehensive Nutrient Management Plan must be developed for these farms. Compliance with USDA Food Security Act program requirements should be considered.

See the USDA-NRCS Field Office Technical Guide for specific technical details about planning, implementation, and operation and maintenance. Guidance for the AEM Base Program provides details on developing Tier 3A cropland conservation plans. Also, the Cornell Soil Health Program offers technical resources for advancing soil health and productivity.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*
For the most current information on each NRCS Conservation Practice Standard, please go to the NY Field Office Technical Guide (FOTG) at https://efotg.sc.egov.usda.gov/#/state/NY/documents.
Use the drop box in the left side to reach Section 4 – Practice Standards and Supporting Documents, click on the folder for Conservation Practice Standards & Support Documents and locate the appropriate practice. Under each practice, you will find, at the minimum, the practice standard. You may also find: a Statement of Work; Practice Overview; Implementation Requirement; Conservation Practice Effects Network Diagram; and other document that will assist in the planning, installation, or operation of the practice.

NRCS Name	Standard #	Reportable Item	Date	Life Span
Conservation Crop Rotation	328	Acre	October 2015	1
Conservation Cover	327	Acre	July 2019	5
Contour Farming	330	Acre	March 2019	5
Cover Crop	340	Acre	October 2015	1

Pasture and Hay Planting	512	Acre	March 2022	5
Mulching	484	Acre	March 2019	1
Residue and Tillage Management, No-Till	329	Acre	October 2017	1
Residue and Tillage Management, Reduced Till	345	Acre	October 2017	1
Strip Cropping	585	Acre	March 2019	5

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Cornell Soil Health Program: http://soilhealth.cals.cornell.edu/
- Soil Management AEM Tier 2 Worksheet and Information Sheet

Stream Corridor and Shoreline Management System

DEFINITION
A planned System of vegetation, structures, bio-technology, or management techniques to stabilize or protect stream channels, streambanks and shorelines while also enhancing natural hydrologic processes and improving fish and wildlife habitat.

WATER QUALITY PURPOSE
To reduce sediment and nutrients entering waterbodies from eroding channels, streambanks, and shorelines. Systems can be used to maintain, improve, or restore the physical, chemical and biological functions of a stream, constructed channel, or shoreline while also protecting the designated use classification of the waterbody.

POLLUTANT CONTROLLED
Sediment, nutrients, or thermal modification.

WHERE USED
Streambanks, constructed channels, lake shores, estuaries and coastal shorelines on agricultural land.

SYSTEM DESCRIPTION
The System may be composed of a variety of operational, structural, and vegetative Agricultural BMP System and Component BMPs that may be aimed at one specific goal, such as controlling streambank erosion, or at a combination of goals. Component BMPs may be implemented within several areas of the stream corridor and shoreline area (i.e., within the channel, along the banks, or in the immediate riparian zones). Listed below are some of the components that may be utilized in a Stream Corridor and Shoreline Management System:

- Implement management techniques such as removing impeding vegetation along the banks (clearing) or selectively removing woody snags, sediment depositions/drifts, or other obstructions (snagging) that have negative impacts on stream flow and increase either bank or channel erosion.
- Establish vegetation to prevent or reduce erosion along the streambank toe, within adjacent riparian zones, and associated floodplains. Examples include shrubs, trees, grasses, rushes and sedges among other site-specific species; see Critical Area Planting practice as well.
- Install structural improvements such as slope stabilization, filter fabric, riprap, deflectors, sediment fencing, bulkheads, or groin systems.
- Employ biotechnical alternatives such as willow wattles, coir logs or direct seeding.
- Utilize fluvial geomorphology techniques.

SYSTEM EFFECTIVENESS
The effectiveness of a Streambank and Shoreline Management System should be evaluated based on the Component BMPs installed. In general, the System can attenuate the peak flow and bed load of the stream, reduce soil erosion, and decrease sediment and nutrient delivery to waterbodies. The System should not degrade the stream channel beyond tolerable limits, increase or promote new erosion concerns, increase sedimentation, induce gully formations, or disrupt stream habitat, the natural flow regime, and the interaction between the stream and the floodplain.

IMPACTS ON SURFACE WATER
Beneficial - Can control erosion rates and sediment delivery to receiving water bodies. Improving vegetation along a waterbody may decrease thermal modification, thus enhancing the freshwater biome and water quality.

IMPACTS ON GROUND WATER
Neutral - Vegetative cover and some structural practices may increase infiltration.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial by minimizing soil erosion.
Air: Neutral.
Plants: Beneficial by establishing streambank vegetation.
Animal: Beneficial for wildlife corridor establishment and fish habitat.
Human: Beneficial. Increased recreational opportunities, stable fish habitat. Reduction of flood impacts on agricultural lands and civil infrastructure.
Energy: Neutral.

ADVANTAGES TO FARM
- Stops loss of agricultural land.
- Improves fish and wildlife habitat.
- Restores water flow, capacity and direction.
- Improve landscape aesthetics.
- Protects best use of water bodies.
- Improved neighbor relations.

DISADVANTAGES TO FARM
- Cost of structural practices may be substantial.
- Can move problem areas downstream.
- Investment of practices may be lost by severe storm damage.
- Operation and Maintenance program has significant costs of time and money.

SYSTEM LIFESPAN
Ten (10) years.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Costs can vary greatly. For example, bio-technical components can cost as little as $5 per linear foot while structural components could cost in excess of $200 per foot.

OPERATION AND MAINTENANCE
Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:
- Debris should be removed from the stabilized streambank or shoreline.
- Structural practices should be inspected and repaired after storm events.
- Vegetation destroyed by bank failure must be replaced to maintain cover integrity.
- Subsequent planting or establishment of failed vegetation to practice integrity.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

Streambank and shoreline disturbance generally require a DEC and or Army Corp of Engineer permit. Other permits from various agencies may also be required.

NRCS CONSERVATION PRACTICE STANDARDS TO UTILIZE*

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Stream Habitat Improvement and Management	395	Acre	September 2020	5
Streambank and Shoreline Protection	580	Feet	September 2021	20
Clearing and Snagging	326	Feet	May 2017	5
Critical Area Planting	342	Acre	October 2017	10
Obstruction Removal	500	Number	September 2021	10
Open Channel	582	Feet	October 2016	15
Stream Crossing	578	Number	January 2023	10
Riparian Forest Buffer	391	Acre	September 2021	15
Riparian Herbaceous Cover	390	Acre	May 2011	5
Tree/Shrub Establishment	612	Acre	April 2017	15

Tree/Shrub Site Preparation	490	Acre	September 2021	1
Access Control	472	Acre	April 2019	10

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Stream and Floodplain Management AEM Tier 2 Worksheet and Information Sheet

Waste Storage and Transfer System

DEFINITION
A System designed for the collection, transfer, or storage of agricultural livestock and recognizable process waste.

WATER QUALITY PURPOSE
To reduce surface and subsurface loss of nutrients.

POLLUTANT CONTROLLED
Nutrients, pathogens, or organics.

WHERE USED
In situations where the collection, transfer, or storage of manure or other organic waste is recommended to address water quality concerns and improve a farm's ability to apply nutrients with the right timing, placement, method, and rate for recycling by crops. This includes scenarios where storage addresses seasonal limitations for manure application due to lack of suitable crop and hayland to safely apply during adverse weather or field conditions. It may also include Systems to better collect manure and other organic wastes for application to fields, without significant (if any) storage component. This System can be used whenever waste is transferred or stored and includes manure, milking center waste, process wastewater, silage leachate, barnyard run-off, etc. These Systems may also include the use of bedded pack or composting bedded pack barns.

SYSTEM DESCRIPTION
The System is composed of multiple Component BMPs that collect agricultural waste and transport it to a structural storage facility. System design is dependent upon agricultural operation, site location and management considerations. A Waste Storage and Transfer System controls the loss of nutrients and pathogens by safely storing waste during critical runoff and leaching periods. It can include the use of storage covers to trap greenhouse gases or to limit rainfall contribution to spreading volumes.

(NOTE: Prior to adoption of a Waste Storage and Transfer System, a Comprehensive Nutrient Management Plan needs to be developed.)

SYSTEM EFFECTIVENESS
Storing waste is effective in reducing losses of nitrogen and phosphorus when surface runoff and erosion potential is high. Storages can reduce pathogen loads through die-off during storage and when applied to soil and incorporated. Significant nutrient loss and water quality degradation may result if the storage is emptied when surface runoff, leaching or erosion potential is high, or waste is applied at non-agronomically recommended rates. A Comprehensive Nutrient Management Plan is an important component of this practice.

IMPACTS ON SURFACE WATER
Beneficial when waste is applied in accordance with a Comprehensive Nutrient Management Plan and transfers are designed and operated according to the Plan.

IMPACTS ON GROUND WATER
Beneficial as applications of waste can be timed to coincide with plant uptake and not during times of nutrient loss to groundwater. However, care must be taken in site selection and construction of storage facilities.

IMPACTS ON OTHER RESOURCES (OFF-SITE)

Soil: Beneficial as organic waste can replenish organic matter in the soil and improve soil health.
Air: Negative or beneficial. When waste is stored and applied at certain times of the year, odor issues increase for that time period unless incorporation of waste is utilized. But conversely, by storing waste, odors are not created when daily spread. Covers trap greenhouse gases and collect them for flaring or use.
Plants: Beneficial as nutrients can be applied during times of plant uptake.
Animals: Beneficial as improved nutrient management on cropland can improve habitat (especially aquatic).
Human: Beneficial as system protect water quality.
Energy: Beneficial depending on the system designed and its additional energy use or energy saving.

ADVANTAGES TO FARM

- Allows for spreading at certain times of the year and eliminated the need for daily spreading.
- Allows for semi-solid or liquid manure which lends itself to gravity systems.
- Can allow for irrigation of waste.
- Allows livestock manure and other waste to be treated as a resource rather than a waste.
- Reduces cost for purchased commercial fertilizer.
- Can improve aesthetics and relations with neighbors if managed properly.
- Helps to reduce nutrient loss when runoff and erosion potential is high.

DISADVANTAGES TO FARM

- Can be expensive if soils are not suitable and liners or other materials need to be utilized.
- Require increased level of management and manpower especially during times of application.
- Requires increased management and energy when sand is used for bedding.
- Requires frequent maintenance.
- May result in significant nutrient loss if emptied when surface runoff and erosion potential is high.
- May cause serious damage to streams and fish if storage structure leaks or fail.

SYSTEM LIFESPAN
Ten (10) years.

COST
Each Agricultural BMP System is unique and must be customized to the situation in which it is employed resulting in a wide and variable range in cost. Cost can run from $30,000 to $400,000 or more depending on the complexity of the system.

OPERATION AND MAINTENANCE
Each Agricultural BMP System is unique and must be customized for every situation. The following are generally key components to the operation and maintenance of the system:

- A written plan should be prepared for each system designed.
- Accurate records of timing of manure application and location need to be kept.
- Storages must be fenced, and warning signs maintained.

- Earthen storages require mowing several times a year to keep the growth of woody vegetation down and to be able to scout for rodent damage of the dike.
- Settled solids need to be removed on a regular basis increasing frequency with use of inorganics like sand bedding.
- Pumps need to be regularly checked and maintained.
- Safety measures need to be kept up to date.
- Other items need to be addressed based on specific system requirements.

See the documents in Section 4 of the NRCS Field Office Technical Guide (FOTG) under the specific conservation practice standard being utilized for additional information on operation and maintenance needs.

MISCELLANEOUS COMMENTS

Agricultural BMP Systems and associated component practices that will eliminate or provide effective treatment of one or more resource concerns may be eligible for cost-share funding. Compliance with Federal, State, and local laws should be adhered to including the potential need for construction stormwater permits, plans, and practices; other permits; as well as contacting Underground Utilities Protection before excavation, SHPO, and others as applicable. Livestock farms that have been designated as a CAFO are required to comply with CAFO regulations.

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NRCS Name	Standard #	Reportable Item	Date	Life Span
Waste Storage Facility	313	Number	March 2018	15 years
Waste Transfer	634	Number	October 2022	15 Years
Waste Separation Facility	632	Number	October 2022	15 Years
Waste Treatment	629	Number	October 2013	10 years
Waste Facility Closure	360	Number	May 2020	15 Year
Nutrient Management	590	Acre	September 2020	1 year
Pumping Plant	533	Number	October 2022	15 Years
Roofs and Covers	367	Number	October 2016	10 Years
Subsurface Drain	606	Feet	May 2020	20 Years

Access Control	472	Acre	April 2019	10 Years
Access Road	560	Feet	March 2021	10 Years
Composting Facility	317	Number	September 2021	15 Years
Diversion	362	Feet	May 2017	10 Years
Fence	382	Feet	October 2022	20 Years
Heavy Use Area Protection	561	Sq. Feet	September 2021	10 Years
Hedgerow Planting	422	Feet	May 2011	15 Years
Pond Sealing or Lining – Geomembrane or Geosynthetic Clay Liner	521	Sq. Feet	March 2019	20 Years
Pond Sealing or Lining – Compacted Soil Treatment	520	Sq. Feet	May 2017	15 Years
Pond Sealing or Lining – Concrete	522	Sq. Feet	May 2017	20 Years

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REFERENCES

- USDA NRCS FOTG for NY: https://efotg.sc.egov.usda.gov/#/state/NY/documents
- Manure and Fertilizer Storage AEM Tier 2 Worksheet and Information Sheet
- Nutrient Management: Manure and Fertilizer AEM Tier 2 Worksheet and Information Sheet

NEW YORK STATE | Department of Environmental Conservation

New York State
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Water

Deep-Ripping and Decompaction

April 2008

New York State
Department of Environmental Conservation

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Alternative Stormwater Management
Deep-Ripping and Decompaction

Description

The two-phase practice of 1) "Deep Ripping;" and 2) "Decompaction" (deep subsoiling), of the soil material as a step in the cleanup and restoration/landscaping of a construction site, helps mitigate the physically induced impacts of soil compression; i.e.: soil compaction or the substantial increase in the bulk density of the soil material.

Deep Ripping and Decompaction are key factors which help in restoring soil pore space and permeability for water infiltration. Conversely, the physical actions of cut-and-fill work, land grading, the ongoing movement of construction equipment and the transport of building materials throughout a site alter the architecture and structure of the soil, resulting in: the mixing of layers (horizons) of soil materials, compression of those materials and diminished soil porosity which, if left unchecked, severely impairs the soil's water holding capacity and vertical drainage (rainfall infiltration), from the surface downward.

In a humid climate region, compaction damage on a site is virtually guaranteed over the duration of a project. Soil in very moist to wet condition when compacted, will have severely reduced permeability. Figure 1 displays the early stage of the deep-ripping phase (Note that all topsoil was stripped prior to construction access, and it remains stockpiled until the next phase – decompaction – is complete). A heavy-duty tractor is pulling a three-shank ripper on the first of several series of incrementally deepening passes through the construction access corridor's densely compressed subsoil material. Figure 2 illustrates the approximate volumetric composition of a loam surface soil when conditions are good for plant growth, with adequate natural pore space for fluctuating moisture conditions.

Fig. 1. A typical deep ripping phase of this practice, during the first in a series of progressively deeper "rips" through severely compressed subsoil.

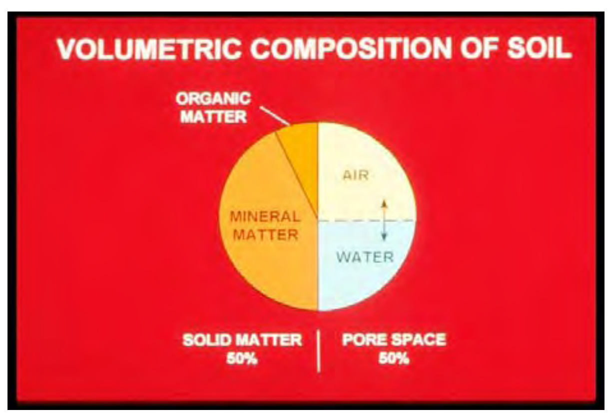

Fig. 2. About 50% of the volume of undisturbed loam surface soil is pore space, when soil is in good condition for plant growth. Brady, 2002.

Recommended Application of Practice

Fig. 3. Construction site with significant compaction of the deep basal till subsoil extends 24 inches below this exposed cut-and-fill work surface.

The objective of Deep Ripping and Decompaction is to effectively fracture (vertically and laterallly) through the thickness of the physically compressed subsoil material (see Figure 3), restoring soil porosity and permeability and aiding infiltration to help reduce runoff. Together with topsoil stripping, the "two-phase" practice of Deep Ripping and Decompaction first became established as a "best management practice" through ongoing success on commercial farmlands affected by heavy utility construction right-of-way projects (transmission pipelines and large power lines).

Soil permeability, soil drainage and cropland productivity were restored. For broader construction application, the two-phase practice of Deep Ripping and Decompaction is best adapted to areas impacted with significant soil compaction, on contiguous open portions of large construction sites and inside long, open construction corridors used as temporary access over the duration of construction. Each mitigation area should have minimal above-and-below-ground obstructions for the easy avoidance and maneuvering of a large tractor and ripping/decompacting implements. Conversely, the complete two-phase practice is not recommended in congested or obstructed areas due to the limitations on tractor and implement movement.

Benefits

Aggressive "deep ripping" through the compressed thickness of exposed subsoil before the replacement/respreading of the topsoil layer, followed by "decompaction," i.e.: "sub-soiling," through the restored topsoil layer down into the subsoil, offers the following benefits:

- Increases the project (larger size) area's direct surface infiltration of rainfall by providing the open site's mitigated soil condition and lowers the demand on concentrated runoff control structures

- Enhances direct groundwater recharge through greater dispersion across and through a broader surface than afforded by some runoff-control structural measures

- Decreases runoff volume generated and provides hydrologic source control

- May be planned for application in feasible open locations either alone or in conjunction with plans for structural practices (e.g., subsurface drain line or infiltration basin) serving the same or contiguous areas

- Promotes successful long-term revegetation by restoring soil permeability, drainage and water holding capacity for healthy (rather than restricted) root-system development of trees, shrubs and deep rooted ground cover, minimizing plant drowning during wet periods and burnout during dry periods.

Feasibility / Limitations

The effectiveness of Deep Ripping and Decompaction is governed mostly by site factors such as: the original (undisturbed) soil's hydrologic characteristics; the general slope; local weather/timing (soil moisture) for implementation; the space-related freedom of equipment/implement maneuverability (noted above in **Recommended Application of Practice**), and by the proper selection and operation of tractor and implements (explained below in **Design Guidance**). The more notable site-related factors include:

Soil

In the undisturbed condition, each identified soil type comprising a site is grouped into one of four categories of soil hydrology, Hydrologic Soil Group A, B, C or D, determined primarily by a range of characteristics including soil texture, drainage capability when thoroughly wet, and depth to water table. The natural rates of infiltration and transmission of soil-water through the undisturbed soil layers for Group A is "high" with a low runoff potential while soils in Group B are moderate in infiltration and the transmission of soil-water with a moderate runoff potential, depending somewhat on slope. Soils in Group C have slow rates of infiltration and transmission of soil-water and a moderately high runoff potential influenced by soil texture and slope; while soils in Group D have exceptionally slow rates of infiltration and transmission of soil-water, and high runoff potential.

In Figure 4, the profile displays the undisturbed horizons of a soil in Hydrologic Soil Group C and the naturally slow rate of infiltration through the subsoil. The slow rate of infiltration begins immediately below the topsoil horizon (30 cm), due to the limited amount of macro pores, e.g.: natural subsoil fractures, worm holes and root channels. Infiltration after the construction-induced mixing and compression of such subsoil material is virtually absent; but can be restored back to this natural level with the two-phase practice of deep ripping and decompaction, followed by the permanent establishment of an appropriate, deep taproot

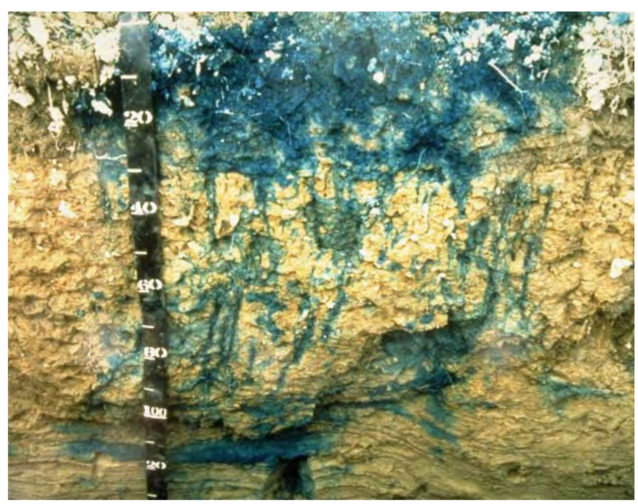

Fig. 4. Profile (in centimeters) displaying the infiltration test result of the natural undisturbed horizons of a soil in Hydrologic Soil Group C.

lawn/ground cover to help maintain the restored subsoil structure. Infiltration after construction-induced mixing and compression of such subsoil material can be notably rehabilitated with the Deep Ripping and Decompaction practice, which prepares the site for the appropriate long-term lawn/ground cover mix including deep taproot plants such as clover, fescue or trefoil, etc. needed for all rehabilitated soils.

Generally, soils in Hydrologic Soil Groups A and B, which respectively may include deep, well-drained, sandy-gravelly materials or deep, moderately well-drained basal till materials, are among the easier ones to restore permeability and infiltration, by deep ripping and decompaction. Among the many different soils in Hydrologic Soil Group C are those unique glacial tills having a natural fragipan zone, beginning about 12 to 18 inches (30 – 45cm), below surface. Although soils in Hydrologic Soil Group C do require a somewhat more carefully applied level of the Deep Ripping and Decompaction practice, it can greatly benefit such affected areas by reducing the runoff and fostering infiltration to a level equal to that of pre-disturbance.

Soils in Hydrologic Soil Group D typically have a permanent high water table close to the surface, influenced by a clay or other highly impervious layer of material. In many locations with clay subsoil material, the bulk density is so naturally high that heavy trafficking has little or no added impact on infiltration; and structural runoff control practices rather than Deep Ripping and Decompaction should be considered.

The information about Hydrologic Soil Groups is merely a general guideline. Site-specific data such as limited depths of cut-and-fill grading with minimal removal or translocation of the inherent subsoil materials (as analyzed in the county soil survey) or, conversely, the excavation and translocation of deeper, unconsolidated substratum or consolidated bedrock materials (unlike the analyzed subsoil horizons' materials referred to in the county soil survey) should always be taken into account.

Sites made up with significant quantities of large rocks, or having a very shallow depth to bedrock, are not conducive to deep ripping and decompation (subsoiling); and other measures may be more practical.

Slope

The two-phase application of 1) deep ripping and 2) decompaction (deep subsoiling), is most practical on flat, gentle and moderate slopes. In some situations, such as but not limited to temporary construction access corridors, inclusion areas that are moderately steep along a project's otherwise gentle or moderate slope may also be deep ripped and decompacted. For limited instances of moderate steepness on other projects, however, the post-construction land use and the relative alignment of the potential ripping and decompaction work in relation to the lay of the slope should be reviewed for safety and practicality. In broad construction areas predominated by moderately steep or steep slopes, the practice is generally not used.

Local Weather/Timing/Soil Moisture

Effective fracturing of compressed subsoil material from the exposed work surface, laterally and vertically down through the affected zone is achieved only when the soil material is moderately dry to moderately moist. Neither one of the two-phases, deep ripping nor decompaction (deep subsoiling), can be effectively conducted when the soil material (subsoil or replaced topsoil) is in either a "plastic" or "liquid" state of soil consistency. Pulling the respective implements legs through the soil when it is overly moist only results in the "slicing and smearing" of the material or added "squeezing and compression" instead of the necessary fracturing. Ample drying time is needed for a "rippable" soil condition not merely in the material close to the surface, but throughout the material located down to the bottom of the physically compressed zone of the subsoil.

The "poor man's Atterberg field test" for soil plasticity is a simple "hand-roll" method used for quick, on-site determination of whether or not the moisture level of the affected soil material is low enough for: effective deep ripping of subsoil; respreading of topsoil in a friable state; and final decompaction (deep subsoiling). Using a sample of soil material obtained from the planned bottom depth of ripping, e.g.: 20 - 24 inches below exposed subsoil surface, the sample is hand rolled between the palms down to a 1/8-inch diameter thread. (Use the same test for stored topsoil material before respreading on the site.) If the respective soil sample crumbles apart in segments no greater than 3/8 of an inch long, by the time it is rolled down to 1/8 inch diameter, it is low enough in moisture for deep ripping (or topsoil replacement), and decompaction. Conversely, as shown in Figure 5, if the rolled sample stretches out in increments greater than 3/8 of an inch long before crumbling, it is in a "plastic" state of soil consistency and is too wet for subsoil ripping (as well as topsoil replacement) and final decompaction.

Fig. 5. Augered from a depth of 19 inches below the surface of the replaced topsoil, this subsoil sample was hand rolled to a 1/8-inch diameter. The test shows the soil at this site stretches out too far without crumbling; it indicates the material is in a plastic state of consistence, too wet for final decompaction (deep subsoiling) at this time.

Design Guidance

Beyond the above-noted site factors, a vital requirement for the effective Deep Ripping and Decompaction (deep subsoiling), is implementing the practice in its distinct, two-phase process:

1) Deep rip the affected thickness of exposed subsoil material (see Figure 10 and 11), aggressively fracturing it before the protected topsoil is reapplied on the site (see Figure 12); and

2) Decompact (deep subsoil), simultaneously through the restored topsoil layer and the upper half of the affected subsoil (Figure 13). The second phase, "decompaction," mitigates the partial recompaction which occurs during the heavy process of topsoil spreading/grading. Prior to deep ripping and decompacting the site, all construction activity, including construction equipment and material storage, site cleanup and trafficking (Figure 14), should be finished; and the site closed off to further disturbance. Likewise, once the practice is underway and the area's soil permeability and

rainfall infiltration are being restored, a policy limiting all further traffic to permanent travel lanes is maintained.

The other critical elements, outlined below, are: using the proper implements (deep, heavy-duty rippers and subsoilers), and ample pulling-power equipment (tractors); and conducting the practice at the appropriate speed, depth and pattern(s) of movement.

Note that an appropriate plan for the separate practice of establishing a healthy perennial ground cover, with deep rooting to help maintain the restored soil structure, should be developed in advance. This may require the assistance of an agronomist or landscape horticulturist.

Implements
Avoid the use of all undersize implements. The small-to-medium, light-duty tool will, at best, only "scarify" the uppermost surface portion of the mass of compacted subsoil material. The term "chisel plow" is commonly but incorrectly applied to a broad range of implements. While a few may be adapted for the moderate subsoiling of non-impacted soils, the majority are less durable and used for only lighter land-fitting (see Figure 6).

Fig. 6. A light duty chisel implement, not adequate for either the deep ripping or decompaction (deep subsoiling) phase.

Fig. 7. One of several variations of an agricultural ripper. This unit has long, rugged shanks mounted on a steel V-frame for deep, aggressive fracturing through Phase 1.

Use a "heavy duty" agricultural-grade, deep ripper (see Figures 7,9,10 and 11) for the first phase: the lateral and vertical fracturing of the mass of exposed and compressed subsoil, down and through, to the bottom of impact, prior to the replacement of the topsoil layer. (Any oversize rocks which are uplifted to the subsoil surface during the deep ripping phase are picked and removed.) Like the heavy-duty class of implement for the first phase, the decompaction (deep subsoiling) of Phase 2 is conducted with the heavy-duty version of the deep subsoiler. More preferable is the angled-leg variety of deep subsoiler (shown in Figures 8 and 13). It minimizes the inversion of the subsoil and topsoil layers while laterally and vertically fracturing the upper half of the previously ripped subsoil layer and all of the topsoil layer by delivering a momentary, wave-like "lifting and shattering" action up through the soil layers as it is pulled.

Pulling-Power of Equipment
Use the following rule of thumb for tractor horsepower (hp) whenever deep ripping and decompacting a significantly impacted site: For both types of implement, have at least 40 hp of tractor pull available for each mounted shank/ leg.

Using the examples of a 3-shank and a 5-shank implement, the respective tractors should have 120 and 200 hp available for fracturing down to the final depth of 20-to-24 inches per phase. Final depth for the deep ripping in Phase 1 is achieved incrementally by a progressive series of passes (see Depth and Patterns of Movement, below); while for Phase 2, the full operating depth of the deep subsoiler is applied from the beginning.

The operating speed for pulling both types of implement should not exceed 2 to 3 mph. At this slow and managed rate of operating speed, maximum functional performance is sustained by the tractor and the implement performing the soil fracturing. Referring to Figure 8, the implement is the 6-leg version of the deep angled-leg subsoiler. Its two outside legs are "chained up" so that only four legs will be engaged (at the maximum depth), requiring no less than 160 hp, (rather than 240 hp) of pull. The 4-wheel drive, articulated-frame tractor in Figure 8 is 174 hp. It will be decompacting this unobstructed, former construction access area simultaneously through 11 inches of replaced topsoil and the upper 12 inches of the previously deep-ripped subsoil. In constricted areas of Phase 1) Deep Ripping, a medium-size tractor with adequate hp, such as the one in Figure 9 pulling a 3-shank deep ripper, may be more maneuverable.


Fig. 8. A deep, angled-leg subsoiler, ideal for Phase 2 decompaction of after the topsoil layer is graded on top of the ripped subsoil.


Fig. 9. This medium tractor is pulling a 3-shank deep ripper. The severely compacted construction access corridor is narrow, and the 120 hp tractor is more maneuverable for Phase 1 deep ripping (subsoil fracturing), here.

Some industrial-grade variations of ripping implements are attached to power graders and bulldozers. Although highly durable, they are generally not recommended. Typically, the shanks or "teeth" of these rippers are too short and stout; and they are mounted too far apart to achieve the well-distributed type of lateral and vertical fracturing of the soil materials necessary to restore soil permeability and infiltration. In addition, the power graders and bulldozers, as pullers, are far less maneuverable for turns and patterns than the tractor.

Depth and Patterns of Movement
As previously noted both Phase 1 Deep Ripping through significantly compressed, exposed subsoil and Phase 2 Decompaction (deep subsoiling) through the replaced topsoil and upper subsoil need to be performed at maximum capable depth of each implement. With an implement's guide wheels attached, some have a "normal" maximum operating depth of 18 inches, while others may go deeper. In many situations, however, the tractor/implement operator must first remove the guide wheels and other non essential elements from the implement. This adapts the ripper or the deep subsoiler for skillful pulling with its frame only a few inches above surface, while the shanks or legs, fracture the soil material 20-to-24 inches deep.

There may be construction sites where the depth of the exposed subsoil's compression is moderate, e.g.: 12 inches, rather than deep. This can be verified by using a ¾ inch cone penetrometer and a shovel to test the subsoil for its level of compaction, incrementally, every three inches of increasing depth. Once the full thickness of the subsoil's compacted zone is finally "pieced" and there is a significant drop in the psi measurements of the soil penetrometer, the depth/thickness of compaction is determined. This is repeated at several representative locations of the construction site. If the thickness of the site's subsoil compaction is verified as, for example, ten inches, then the Phase 1 Deep Ripping can be correspondingly reduced to the implement's minimum operable depth of 12 inches. However, the Phase 2 simultaneous Decompation (subsoiling) of an 11 inch thick layer of replaced topsoil and the upper subsoil should run at the subsoiling implements full operating depth.

Fig. 10. An early pass with a 3-shank deep ripper penetrating only 8 inches into this worksite's severely compressed subsoil.

Fig. 11. A repeat run of the 3-shank ripper along the same patterned pass area as Fig. 9; here, incrementally reaching 18 of the needed 22 inches of subsoil fracture.

Typically, three separate series (patterns) are used for both the Phase 1 Deep Ripping and the Phase 2 Decompaction on significantly compacted sites. For Phase 1, each series begins with a moderate depth of rip and, by repeat-pass, continues until full depth is reached. Phase 2 applies the full depth of Decompation (subsoiling), from the beginning.

Every separate series (pattern) consists of parallel, forward-and-return runs, with each progressive pass of the implement's legs or shanks evenly staggered between those from the previous pass. This compensates for the shank or leg-spacing on the implement, e.g., with 24-to-30 inches between each shank or leg. The staggered return pass ensures lateral and vertical fracturing actuated every 12 to 15 inches across the densely compressed soil mass.

Large, Unobstructed Areas

For larger easy areas, use the standard patterns of movement:

- The first series (pattern) of passes is applied lengthwise, parallel with the longest spread of the site; gradually progressing across the site's width, with each successive pass.

- The second series runs obliquely, crossing the first series at an angle of about 45 degrees.

- The third series runs at right angle (or 90 degrees), to the first series to complete the fracturing and shattering on severely compacted sites, and avoid leaving large unbroken blocks of compressed soil material. (In certain instances, the third series may be optional, depending on how thoroughly the first two series loosen the material and eliminate large chunks/blocks of material as verified by tests with a ¾-inch cone penetrometer.)

Fig. 12. Moderately dry topsoil is being replaced on the affected site now that Phase 1 deep ripping of the compressed subsoil is complete.

Fig. 13. The same deep, angled-leg subsoiler shown in Fig. 7 is engaged at maximum depth for Phase 2, decompaction (deep soiling), of the replaced topsoil and the upper subsoil materials.

Corridors

In long corridors of limited width and less maneuverability than larger sites, e.g.: along compacted areas used as temporary construction access, a modified series of pattern passes are used.

- First, apply the same initial lengthwise, parallel series of passes described above.

● A second series of passes makes a broad “S” shaped pattern of rips, continually and gradually alternating the “S” curves between opposite edges inside the compacted corridor.

● The third and final series again uses the broad, alternating S pattern, but it is “flip-flopped” to continually cross the previous S pattern along the corridor’s centerline. This final series of the S pattern curves back along the edge areas skipped by the second series.

Maintenance and Cost

Once the two-phase practice of Deep Ripping and Decompation is completed, two items are essential for maintaining a site’s soil porosity and permeability for infiltration. They are: planting and maintaining the appropriate ground cover with deep roots to maintain the soil structure (see Figure 15); and keeping the site free of traffic or other weight loads.

Note that site-specific choice of an appropriate vegetative ground-cover seed mix, including the proper seeding ratio of one or more perennial species with a deep taproot system and the proper amount of lime and soil nutrients (fertilizer mix) adapted to the soil-needs, are basic to the final practice of landscaping, i.e: surface tillage, seeding/planting/fertilizing and culti-packing or mulching is applied. The "maintenance" of an effectively deep-ripped and decompacted area is generally limited to the successful perennial (long-term) landscape ground cover; as long as no weight-bearing force of soil compaction is applied.

Fig. 14. The severely compacted soil of a temporary construction yard used daily by heavy equipment for four months; shown before deep ripping, topsoil replacement, and decompaction.

Fig. 15. The same site as Fig. 14 after deep ripping of the exposed subsoil, topsoil replacement, decompaction through the topsoil and upper subsoil and final surface tillage and revegetation to maintain soil permeability and infiltration.

The Deep Ripping and Decompaction practice is, by necessity, more extensive than periodic subsoiling of farmland.The cost of deep ripping and decompacting (deep subsoiling), will vary according to the depth and severity of soil-material compression and the relative amount of tractor and implement time that is required. In some instances, depending on open maneuverability, two-to-three acres of compacted project area may be deep-ripped in one day. In other situations of more severe compaction and - or less maneuverability, as little as one acre may be fully ripped in a day. Generally, if the Phase 1) Deep Ripping is fully effective, the Phase 2) Decompaction should be completed in 2/3 to 3/4 of the time required for Phase 1.

Using the example of two acres of Phase 1) Deep Ripping in one day, at $1800 per day, the net cost is $900 per acre. If the Phase 2) Decompacting or deep subsoiling takes 3/4 the time as Phase 1, it costs $675 per acre for a combined total of $1575 per acre to complete the practice (these figures do not include the cost of the separate practice of topsoil stripping and replacement). Due to the many variables, it must be recognized that cost will be determined by the specific conditions or constraints of the site and the availability of proper equipment.

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- US Department of Agriculture in cooperation with Cornell University Agricultural Experiment Station. Various years. *Soil Survey of (various names) County, New York.* USDA.

Internet Access:

- Examples of implements:

V-Rippers. Access by internet search of *John Deere Ag -New Equipment for 915* (larger-frame model) *V-Rippe*; and, *for 913* (smaller-frame model) *V-Ripper*. Deep, angled-leg subsoiler. Access by internet search of: B*igham Brothers Shear Bolt Paratill-Subsoiler*. http://salesmanual.deere.com/sales/salesmanual/en_NA/primary_tillage/2008/feature/rippers/915v_pattern_frame.html?sbu=ag&link=prodcat Last visited March 08.

- Soils data of USDA Natural Resources Conservation Service. *NRCS Web Soil Survey.* http://websoilsurvey.nrcs.usda.gov/app/ and *USDA-NRCS Official Soil Series Descriptions; View by Name.* http://ortho.ftw.nrcs.usda.gov/cgi-bin/osd/osdname.cgi . *Last visited Jan. 08.*

- Soil penetrometer information. Access by internet searches of: *Diagnosing Soil Compaction using a Penetrometer (soil compaction tester), PSU Extension;* as well as *Dickey-john Soil Compaction Tester.* http://www.dickey-johnproducts.com/pdf/SoilCompactionTest.pdf and http://cropsoil.psu.edu/Extension/Facts/uc178pdf Last visited Sept. 07

STANDARD AND SPECIFICATIONS FOR CHECK DAM

Definition & Scope

Small barriers or dams constructed of stone, bagged sand or gravel, or other durable materials across a drainageway to reduce erosion in a drainage channel by reducing the velocity of flow in the channel.

Conditions Where Practice Applies

This practice is used as a **temporary** and, in some cases, a **permanent** measure to limit erosion by reducing velocities in open channels that are degrading or subject to erosion or where permanent stabilization is impractical due to short period of usefulness and time constraints of construction.

Design Criteria

Drainage Area: Maximum drainage area above the check dam shall not exceed two (2) acres.

Height: Not greater than 2 feet. Center shall be maintained 9 inches lower than abutments at natural ground elevation.

Side Slopes: Shall be 2:1 or flatter.

Spacing: The check dams shall be spaced as necessary in the channel so that the crest of the downstream dam is at the elevation of the toe of the upstream dam. This spacing is equal to the height of the check dam divided by the channel slope.

Therefore:

$$S = \frac{h}{s}$$

Where: S = spacing interval (ft.)
h = height of check dam (ft.)
s = channel slope (ft./ft.)

Example:

For a channel with a 4% slope and 2 ft. high stone check dams, they are spaced as follows:

$$S = \frac{2\ \text{ft}}{0.04\ \frac{\text{ft}}{\text{ft}}} = 50\ \text{ft}$$

For stone check dams: Use a well graded stone matrix 2 to 9 inches in size (NYS – DOT Light Stone Fill meets these requirements).

The overflow of the check dams will be stabilized to resist erosion that might be caused by the check dam. See Figure 3.1 on page 3.3 for details.

Check dams should be anchored in the channel by a cutoff trench 1.5 ft. wide and 0.5 ft. deep and lined with filter fabric to prevent soil migration.

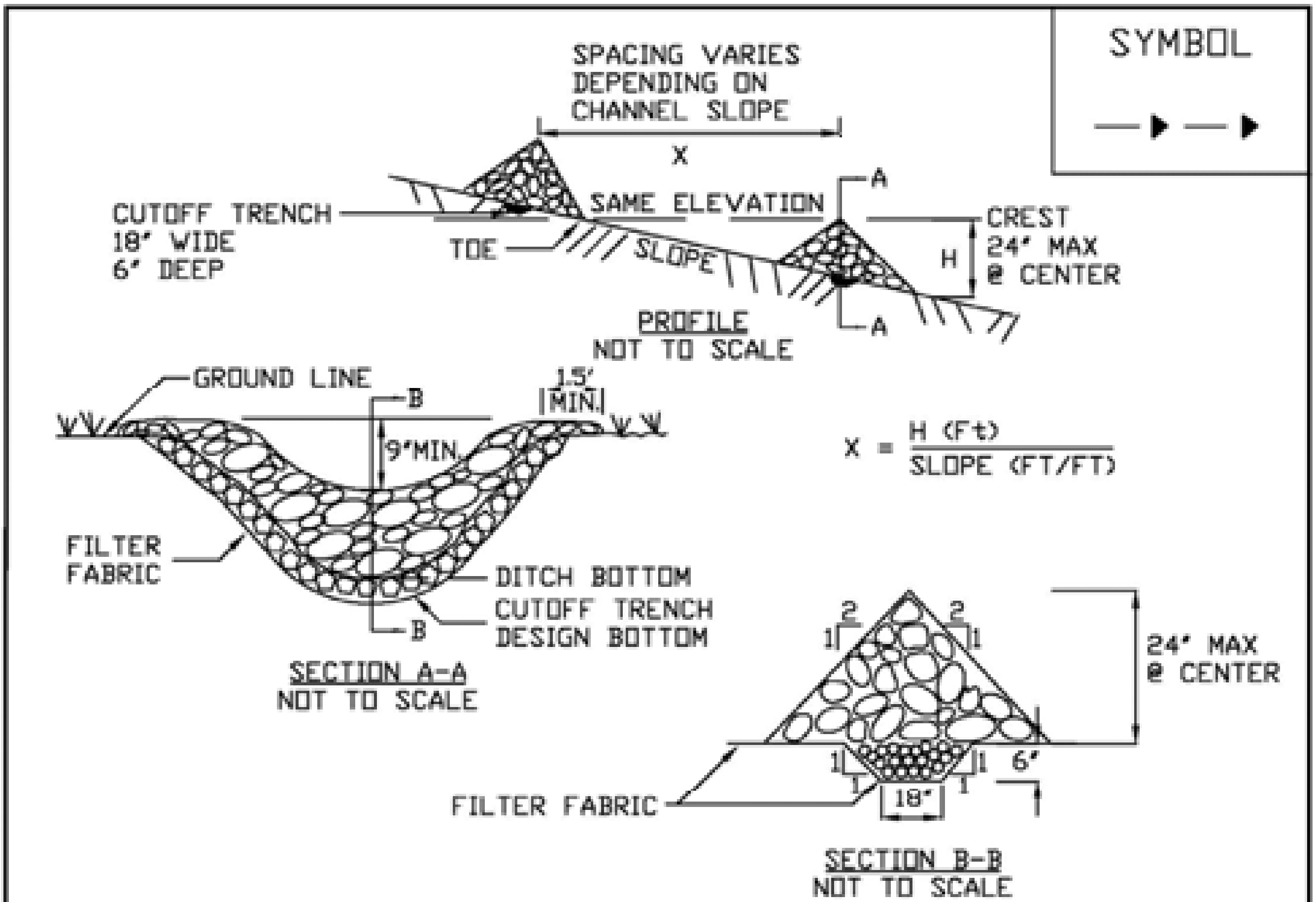
For filter sock or fiber roll check dams: The check dams will be anchored by staking the dam to the earth contact surface. The dam will extend to the top of the bank. The check dam will have a splash apron of NYS DOT #2 crushed stone extending a minimum 3 feet downstream from the dam and 1 foot up the sides of the channel. The compost and materials for a filter sock check dam shall meet the requirements shown in the standard for Compost Filter Sock on page 5.7.

Maintenance

The check dams should be inspected after each runoff event. Correct all damage immediately. If significant erosion has occurred between structures, a liner of stone or other suitable material should be installed in that portion of the channel or additional check dams added.

Remove sediment accumulated behind the dam as needed to allow channel to drain through the stone check dam and prevent large flows from carrying sediment over the dam.

Figure 3.1
Stone Check Dam Detail



CONSTRUCTION SPECIFICATIONS

1. STONE WILL BE PLACED ON A FILTER FABRIC FOUNDATION TO THE LINES, GRADES AND LOCATIONS SHOWN IN THE PLAN.
2. SET SPACING OF CHECK DAMS TO ASSUME THAT THE ELEVATIONS OF THE CREST OF THE DOWNSTREAM DAM IS AT THE SAME ELEVATION OF THE TOE OF THE UPSTREAM DAM.
3. EXTEND THE STONE A MINIMUM OF 1.5 FEET BEYOND THE DITCH BANKS TO PREVENT CUTTING AROUND THE DAM.
4. PROTECT THE CHANNEL DOWNSTREAM OF THE LOWEST CHECK DAM FROM SCOUR AND EROSION WITH STONE OR LINER AS APPROPRIATE.
5. ENSURE THAT CHANNEL APPURTENANCES SUCH AS CULVERT ENTRANCES BELOW CHECK DAMS ARE NOT SUBJECT TO DAMAGE OR BLOCKAGE FROM DISPLACED STONE.

MAXIMUM DRAINAGE AREA 2 ACRES.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	STONE CHECK DAM

STANDARD AND SPECIFICATIONS FOR CONCRETE TRUCK WASHOUT

Definition & Scope

A temporary excavated or above ground lined constructed pit where concrete truck mixers and equipment can be washed after their loads have been discharged, to prevent highly alkaline runoff from entering storm drainage systems or leaching into soil.

Conditions Where Practice Applies

Washout facilities shall be provided for every project where concrete will be poured or otherwise formed on the site. This facility will receive highly alkaline wash water from the cleaning of chutes, mixers, hoppers, vibrators, placing equipment, trowels, and screeds. Under no circumstances will wash water from these operations be allowed to infiltrate into the soil or enter surface waters.

Design Criteria

Capacity: The washout facility should be sized to contain solids, wash water, and rainfall and sized to allow for the evaporation of the wash water and rainfall. Wash water shall be estimated at 7 gallons per chute and 50 gallons per hopper of the concrete pump truck and/or discharging drum. The minimum size shall be 8 feet by 8 feet at the bottom and 2 feet deep. If excavated, the side slopes shall be 2 horizontal to 1 vertical.

Location: Locate the facility a minimum of 100 feet from drainage swales, storm drain inlets, wetlands, streams and other surface waters. Prevent surface water from entering the structure except for the access road. Provide appropriate access with a gravel access road sloped down to the structure. Signs shall be placed to direct drivers to the facility after their load is discharged.

Liner: All washout facilities will be lined to prevent leaching of liquids into the ground. The liner shall be plastic sheeting with a minimum thickness of 10 mils with no holes or tears, and anchored beyond the top of the pit with an earthen berm, sand bags, stone, or other structural appurtenance except at the access point.

If pre-fabricated washouts are used they must ensure the capture and containment of the concrete wash and be sized based on the expected frequency of concrete pours. They shall be sited as noted in the location criteria.

Maintenance

- All concrete washout facilities shall be inspected daily. Damaged or leaking facilities shall be deactivated and repaired or replaced immediately. Excess rainwater that has accumulated over hardened concrete should be pumped to a stabilized area, such as a grass filter strip.
- Accumulated hardened material shall be removed when 75% of the storage capacity of the structure is filled. Any excess wash water shall be pumped into a containment vessel and properly disposed of off site.
- Dispose of the hardened material off-site in a construction/demolition landfill. On-site disposal may be allowed if this has been approved and accepted as part of the projects SWPPP. In that case, the material should be recycled as specified, or buried and covered with a minimum of 2 feet of clean compacted earthfill that is permanently stabilized to prevent erosion.
- The plastic liner shall be replaced with each cleaning of the washout facility.
- Inspect the project site frequently to ensure that no concrete discharges are taking place in non-designated areas.

STANDARD AND SPECIFICATIONS FOR CONSTRUCTION DITCH

Definition & Scope

A **temporary** excavated drainage way to intercept sediment laden water and divert it to a sediment trapping device or to prevent runoff from entering disturbed areas by intercepting and diverting it to a stabilized outlet.

Conditions Where Practice Applies

Construction ditches are constructed:

1. to divert flows from entering a disturbed area.
2. intermittently across disturbed areas to shorten overland flow distances.
3. to direct sediment laden water along the base of slopes to a trapping device.
4. to transport offsite flows across disturbed areas such as rights-of-way.

Ditches collecting runoff from disturbed areas shall remain in place until the disturbed areas are permanently stabilized.

Design Criteria

See Figure 3.2 on page 3.6 for details.

General

	Ditch A	Ditch B
Drainage Area	<5 Ac	5-10 Ac
Bottom Width of Flow Channel	4 ft.	6 ft.
Depth of Flow Channel	1 ft.	1 ft.
Side Slopes	2:1 or flatter	2:1 or flatter
Grade	0.5% Min. 10% Max.	0.5% Min. 10% Max.

For drainage areas larger than 10 acres, refer to the Standard and Specification for Grassed Waterways on page 3.23 and 3.24.

Stabilization

Stabilization of the ditch shall be completed within 2 days of installation in accordance with the appropriate standard and specifications for vegetative stabilization or stabilization with mulch as determined by the time of year. The flow channel shall be stabilized as per the following criteria:

The seeding for vegetative stabilization shall be in accordance with the standard on Page 4.78. The seeded area will be mulched in accordance with the standard on Page 4.39.

Type of Treatment	Channel Grade[1]	Flow Channel	
		A (<5 Ac.)	B (5-10 Ac.)
1	0.5-3.0%	Seed & Straw Mulch	Seed & Straw Mulch
2	3.1-5.0%	Seed & Straw Mulch	Seed and cover with RECP[2], Sod, or lined with plastic or 2” stone
3	5.1-8.0%	Seed and cover with RECP[2], Sod, or line with plastic or 2 in. stone	Line with 4-8 in. rip-rap or, geotextile
4	8.1-10%	Line with 4-8 in. rip-rap or geotextile	Site Specific Design

1 In highly erodible soils, as defined by the local approving agency, refer to the next higher slope grade for type of stabilization.
2 Rolled Erosion Control Product.

Outlet

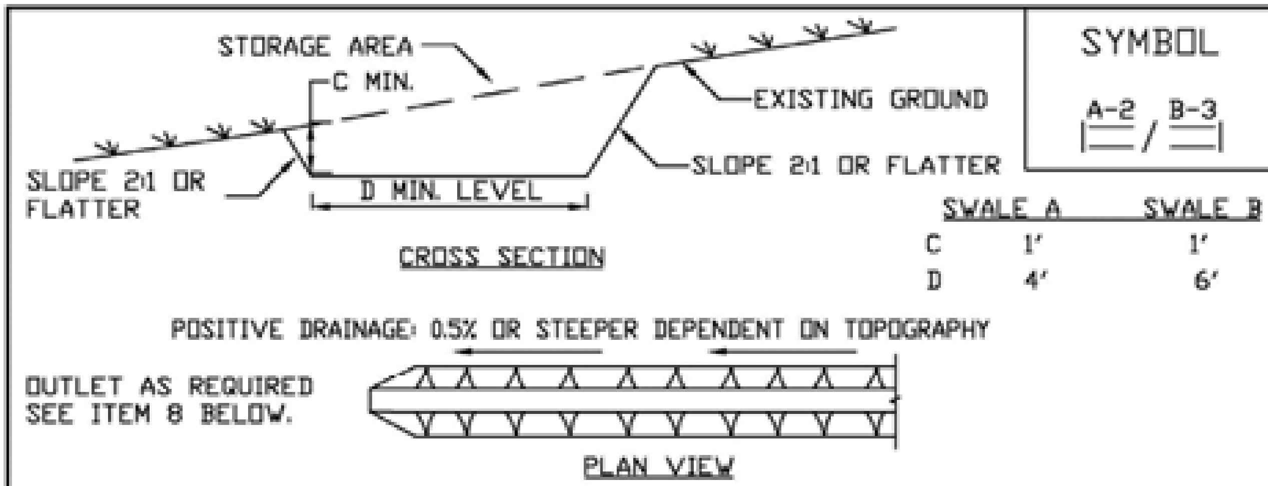
Ditch shall have an outlet that functions with a minimum of erosion, and dissipates runoff velocity prior to discharge off the site.

Runoff shall be conveyed to a sediment trapping device such as a sediment trap or sediment basin until the drainage area above the ditch is adequately stabilized.

The on-site location may need to be adusted to meet field conditions in order to utilize the most suitable outlet condition.

If a ditch is used to divert clean water flows from entering a disturbed area, a sediment trapping device may not be needed.

Figure 3.2
Construction Ditch Detail



CONSTRUCTION SPECIFICATIONS

1. ALL CONSTRUCTION DITCHES SHALL HAVE UNINTERUPTED POSITIVE GRADE TO AN OUTLET.
2. DIVERTED RUNOFF FROM A DISTURBED AREA SHALL BE CONVEYED TO A SEDIMENT TRAPPING DEVICE.
3. DIVERTED RUNOFF FROM AN UNDISTURBED AREA SHALL OUTLET DIRECTLY INTO AN UNDISTURBED STABILIZED AREA AT NON-EROSIVE VELOCITY.
4. ALL TREES, BRUSH, STUMPS, OBSTRUCTIONS, AND OTHER OBJECTIONABLE MATERIAL SHALL BE REMOVED AND DISPOSED OF SO AS NOT TO INTERFERE WITH THE PROPER FUNCTIONING OF THE SWALE.
5. THE DITCH SHALL BE EXCAVATED OR SHAPED TO LINE, GRADE, AND CROSS SECTION AS REQUIRED TO MEET THE CRITERIA SPECIFIED HEREIN AND BE FREE OF BANK PROJECTIONS OR OTHER IRREGULARITIES WHICH WILL IMPEDE NORMAL FLOW.
6. FILLS SHALL BE COMPACTED BY EARTH MOVING EQUIPMENT.
7. ALL EARTH REMOVED AND NOT NEEDED FOR CONSTRUCTION SHALL BE PLACED SO THAT IT WILL NOT INTERFERE WITH THE FUNCTIONING OF THE DITCH.
8. STABILIZATION SHALL BE AS PER THE FLOW CHANNEL STABILIZATION CHART BELOW:

TYPE OF TREATMENT	CHANNEL GRADE	A(5 AC. OR LESS)	B(5 AC. -10AC)
1	0.5-3.0%	SEED AND STRAW MULCH	SEED AND STRAW MULCH
2	3.1-5.0%	SEED AND STRAW MULCH	SEED AND COVER USING RECP
3	5.1-8.0%	SEED AND COVER WITH RECP	LINED WITH 4-8" RIP-RAP OR GEOTEXTILE
4	8.1-10.%	LINED WITH 4-8" RIP-RAP OR GEOTEXTILE	SITE SPECIFIC DESIGN

9. PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE

CONSTRUCTION DITCH

STANDARD AND SPECIFICATIONS FOR CONSTRUCTION ROAD STABILIZATION

Definition & Scope

The stabilization of temporary construction access routes, on-site vehicle transportation routes, and construction parking areas to control erosion on temporary construction routes and parking areas.

Conditions Where Practice Applies

All traffic routes and parking areas for temporary use by construction traffic.

Design Criteria

Construction roads should be located to reduce erosion potential, minimize impact on existing site resources, and maintain operations in a safe manner. Highly erosive soils, wet or rocky areas, and steep slopes should be avoided. Roads should be routed where seasonal water tables are deeper than 18 inches. Surface runoff and control should be in accordance with other standards.

Road Grade – A maximum grade of 12% is recommended, although grades up to 15% are possible for short distances.

Road Width – 12 foot minimum for one-way traffic or 24 foot minimum for two-way traffic.

Side Slope of Road Embankment – 2:1 or flatter.

Ditch Capacity – On-site roadside ditch and culvert capacities shall be the 10 yr. peak runoff.

Composition – Use a 6-inch layer of NYS DOT sub-base Types 1,2,3, 4 or equivalent as specified in NYSDOT Standard Specifications.

Construction Specifications

1. Clear and strip roadbed and parking areas of all vegetation, roots, and other objectionable material.

2. Locate parking areas on naturally flat areas as available. Keep grades sufficient for drainage, but not more than 2 to 3 percent.

3. Provide surface drainage and divert excess runoff to stabilized areas.

4. Maintain cut and fill slopes to 2:1 or flatter and stabilized with vegetation as soon as grading is accomplished.

5. Spread 6-inch layer of sub-base material evenly over the full width of the road and smooth to avoid depressions.

6. Provide appropriate sediment control measures to prevent offsite sedimentation.

Maintenance

Inspect construction roads and parking areas periodically for condition of surface. Top dress with new gravel as needed. Check ditches for erosion and sedimentation after rainfall events. Maintain vegetation in a healthy, vigorous condition. Areas producing sediment should be treated immediately.

STANDARD AND SPECIFICATIONS FOR DIVERSION

Definition & Scope

A drainage way of parabolic or trapezoidal cross-section with a supporting ridge on the lower side that is constructed across the slope to intercept and convey runoff to stable outlets at non-erosive velocities.

Conditions Where Practice Applies

Diversions are used where:

1. Runoff from higher areas has potential for damaging properties, causing erosion, or interfering with, or preventing the establishment of, vegetation on lower areas.

2. Surface and/or shallow subsurface flow is damaging sloping upland.

3. The length of slopes needs to be reduced so that soil loss will be kept to a minimum.

Diversions are only applicable below stabilized or protected areas. Avoid establishment on slopes greater than fifteen percent. Diversions should be used with caution on soils subject to slippage. Construction of diversions shall be in compliance with state and local drainage and water laws.

Design Criteria

Location

Diversion location shall be determined by considering outlet conditions, topography, land use, soil type, length of slope, seep planes (when seepage is a problem), and the development layout.

Capacity

Peak rates of runoff values used in determining the capacity requirements shall be calculated using the most current hydrologic data from the Northeast Regional Climate Center in an appropriate model.

The constructed diversion shall have capacity to carry, as a minimum, the peak discharge from a 10 year frequency rainfall event with freeboard of not less than 0.3 feet.

Diversions designed to protect homes, schools, industrial buildings, roads, parking lots, and comparable high-risk areas, and those designed to function in connection with other structures, shall have sufficient capacity to carry peak runoff expected from a storm frequency consistent with the hazard involved.

Cross Section

The diversion channel shall be parabolic or trapezoidal in shape. Parabolic Diversion design charts are provided in Tables 3.2, 3.3 and 3.4 on pages 3.10, 3.12 and 3.13**.** The diversion shall be designed to have stable side slopes. The side slopes shall not be steeper than 2:1 and shall be flat enough to ensure ease of maintenance of the diversion and its protective vegetative cover.

The ridge shall have a minimum width of four feet at the design water elevation; a minimum of 0.3 feet freeboard and a reasonable settlement factor shall be provided.

Velocity and Grade

The permissible velocity for the specified method of stabilization will determine the maximum grade. Maximum permissible velocities of flow for the stated conditions of stabilization shall be as shown in Table 3.1 on page 3.10 of this standard.

Diversions are not usually applicable below high sediment producing areas unless land treatment practices or structural measures, designed to prevent damaging accumulations of sediment in the channels, are installed with, or before, the diversions.

Outlets

Each diversion must have an adequate outlet. The outlet may be a grassed waterway, vegetated or paved area, grade stabilization structure, flow spreader, flow diffuser, stable watercourse, or subsurface drain outlet. In all cases, the outlet must convey runoff to a point where outflow will not cause damage. Vegetated outlets shall be installed before diversion construction, if needed, to ensure establishment of vegetative cover in the outlet channel.

The design elevation of the water surface in the diversion shall not be lower than the design elevation of the water surface in the outlet at their junction when both are operating at design flow.

Stabilization

Vegetated diversions shall be stabilized in accordance with the following tables.

Table 3.1
Diversion Maximum Permissible Design Velocities Table

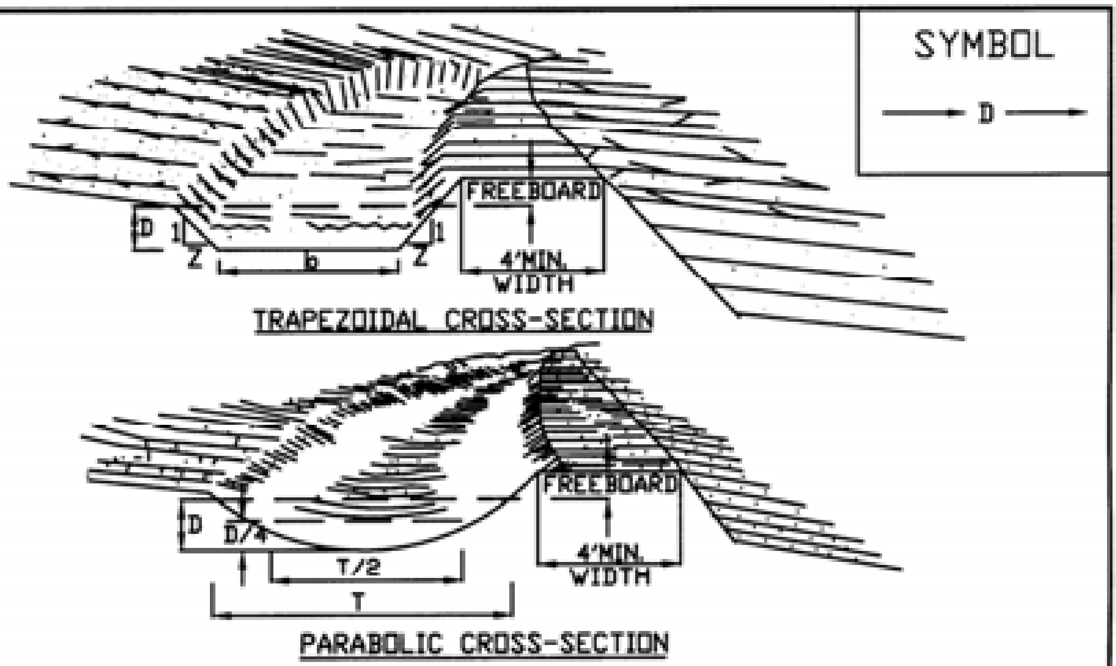
Soil Texture	Retardance and Cover	Permissible Velocity (ft / second) for Selected Channel Vegetation
Sand, Silt, Sandy loam, silty loam, loamy sand (ML, SM, SP, SW)	C-Kentucky 31 tall fescue and Kentucky bluegrass	3.0
	D-Annuals[1] Small grain (rye, oats, barley, millet) Ryegrass	2.5
Silty clay loam, Sandy clay loam (ML-CL, SC)	C-Kentucky 31 tall fescue and Kentucky bluegrass	4.0
	D-Annuals[1] Small grain (rye, oats, barley, millet) Ryegrass	3.5
Clay (CL)	C-Kentucky 31 tall fescue and Kentucky bluegrass	5.0
	D-Annuals[1] Small grain (rye, oats, barley, millet) Ryegrass	4.0

[1] Annuals—Use only as temporary protection until permanent vegetation is established.

Table 3.2 - Retardance Factors for Various Grasses and Legumes Table

Retardance	Cover	Condition
A	Reed canarygrass	Excellent stand, tall (average 36 inches)
B	Smooth bromegrass	Good stand, mowed (average 12 to 15 inches)
	Tall fescue	Good stand, unmowed (average 18 inches)
	Grass-legume mixture—Timothy, smooth bromegrass, or Orchard grass with birdsfoot trefoil	Good stand, uncut (average 20 inches)
	Reed canarygrass	Good stand, mowed (average 12 to 15 inches)
	Tall fescue, with birdsfoot trefoil or ladino clover	Good stand, uncut (average 18 inches)
C	Redtop	Good stand, headed (15 to 20 inches)
	Grass-legume mixture—summer (Orchard grass, redtop, Annual ryegrass, and ladino or white clover)	Good stand, uncut (6 to 8 inches)
	Kentucky bluegrass	Good stand, headed (6 to 12 inches)
D	Red fescue	Good stand, headed (12 to 18 inches)
	Grass-legume mixture—fall, spring (Orchard grass, redtop, Annual ryegrass, and white or ladino clover)	Good stand, uncut (4 to 5 inches)

Figure 3.4
Diversion Detail



CONSTRUCTION SPECIFICATIONS

1. ALL TREES, BRUSH, STUMPS, OBSTRUCTIONS, AND OTHER OBJECTIONABLE MATERIAL SHALL BE REMOVED AND DISPOSED OF SO AS NOT TO INTERFERE WITH THE PROPER FUNCTIONING OF THE DIVERSION.
2. THE DIVERSION SHALL BE EXCAVATED OR SHAPED TO LINE, GRADE, AND CROSS SECTION AS REQUIRED TO MEET THE CRITERIA SPECIFIED HEREIN, AND BE FREE OF BANK PROJECTIONS OR OTHER IRREGULARITIES WHICH WILL IMPEDE NORMAL FLOW.
3. FILLS SHALL BE COMPACTED AS NEEDED TO PREVENT UNEQUAL SETTLEMENT THAT WOULD CAUSE DAMAGE IN THE COMPLETE DIVERSION.
4. ALL EARTH REMOVED AND NOT NEEDED IN CONSTRUCTION SHALL BE SPREAD OR DISPOSED OF SO THAT IT WILL NOT INTERFERE WITH THE FUNCTIONING OF THE DIVERSION.
5. STABILIZATION SHALL BE DONE ACCORDING TO THE APPROPRIATE STANDARD AND SPECIFICATIONS FOR VEGETATIVE PRACTICES.
   A. FOR DESIGN VELOCITIES OF LESS THAN 3.5 FT. PER. SEC., SEEDING AND MULCHING MAY BE USED FOR THE ESTABLISHMENT OF THE VEGETATION. IT IS RECOMMENDED THAT, WHEN CONDITIONS PERMIT, TEMPORARY DIVERSIONS OR OTHER MEANS SHOULD BE USED TO PREVENT WATER FROM ENTERING THE DIVERSION DURING THE ESTABLISHMENT OF THE VEGETATION.
   B. FOR DESIGN VELOCITIES OF MORE THAN 3.5 FT. PER. SEC., THE DIVERSION SHALL BE STABILIZED WITH SOD, WITH SEEDING PROTECTED BY JUTE OR EXCELSIOR MATTING OR WITH SEEDING AND MULCHING INCLUDING TEMPORARY DIVERSION OF THE WATER UNTIL THE VEGETATION IS ESTABLISHED.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	DIVERSION

Table 3.3
Parabolic Diversion Design, Without Freeboard Tables - 1 (USDA– NRCS)

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD

RETARDANCE - D & C
GRADE, % - 0.50

V_1 Based on Permissible Velocity of the Soil With Retardance "D"
Top Width, Depth & V_2 Based on Retardance "C"

Q	V_1 = 2.0			V_1 = 2.5			V_1 = 3.0			V_1 = 3.5			V_1 = 4.0			V_1 = 4.5			V_1 = 5.0			V_1 = 5.5			V_1 = 6.0		
cfs	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2
15	9	1.6	1.6																								
20	11	1.6	1.7																								
25	14	1.6	1.7	9	1.9	2.1																					
30	17	1.6	1.7	11	1.9	2.2	8	2.2	2.5																		
35	20	1.6	1.7	12	1.9	2.3	9	2.1	2.6																		
40	22	1.6	1.7	14	1.8	2.3	11	2.1	2.7																		
45	25	1.5	1.7	16	1.8	2.3	12	2.0	2.8																		
50	28	1.5	1.7	18	1.8	2.4	13	2.0	2.8	10	2.4	3.2															
55	31	1.5	1.7	19	1.8	2.4	15	2.0	2.8	11	2.4	3.3															
60	33	1.5	1.7	21	1.8	2.4	16	2.0	2.8	11	2.4	3.3															
65	36	1.5	1.8	23	1.8	2.4	17	2.0	2.9	12	2.4	3.3															
70	39	1.5	1.7	24	1.8	2.4	18	2.0	2.9	13	2.3	3.4															
75	42	1.5	1.8	26	1.8	2.4	19	2.0	2.9	14	2.3	3.4	11	2.7	3.7												
80	44	1.5	1.8	28	1.8	2.4	21	2.0	2.9	15	2.3	3.4	12	2.7	3.8												
90	50	1.5	1.8	31	1.8	2.4	24	2.0	2.9	17	2.3	3.4	13	2.7	3.8												
100	55	1.5	1.8	35	1.8	2.4	26	2.0	2.9	19	2.3	3.5	15	2.6	3.9	12	3.0	4.1									

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD

RETARDANCE - D & C
GRADE, % - 1.0

V_1 based on Permissible Velocity of the Soil With Retardance "D"
Top Width, Depth & V_2 Based on Retardance "C"

Q	V_1 = 2.0			V_1 = 2.5			V_1 = 3.0			V_1 = 3.5			V_1 = 4.0			V_1 = 4.5			V_1 = 5.0			V_1 = 5.5			V_1 = 6.0		
cfs	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2
15	13	1.1	1.5	8	1.3	2.0																					
20	18	1.1	1.5	11	1.3	2.1	8	1.5	2.6																		
25	22	1.1	1.5	14	1.3	2.1	9	1.5	2.6	8	1.6	3.0															
30	27	1.1	1.5	17	1.3	2.1	11	1.5	2.7	9	1.6	3.0															
35	31	1.1	1.5	19	1.3	2.2	13	1.5	2.8	11	1.6	3.1	8	1.8	3.6												
40	35	1.1	1.5	22	1.3	2.1	15	1.4	2.8	12	1.5	3.1	9	1.8	3.7												
45	40	1.1	1.5	25	1.3	2.2	17	1.5	2.8	13	1.6	3.2	10	1.8	3.7												
50	44	1.1	1.5	28	1.3	2.2	19	1.4	2.8	15	1.6	3.2	11	1.8	3.7	9	2.0	4.2									
55	48	1.1	1.5	30	1.3	2.2	20	1.4	2.8	16	1.5	3.3	12	1.8	3.8	10	2.0	4.3									
60	53	1.1	1.5	33	1.3	2.2	22	1.4	2.8	18	1.5	3.3	14	1.7	3.8	10	2.0	4.3									
65	57	1.1	1.5	36	1.3	2.2	24	1.4	2.8	19	1.5	3.3	15	1.7	3.8	11	2.0	4.3	9	2.2	4.7						
70	61	1.1	1.5	38	1.3	2.2	26	1.4	2.8	21	1.5	3.3	16	1.7	3.9	12	2.0	4.4	10	2.2	4.7						
75	66	1.1	1.5	41	1.3	2.2	28	1.4	2.9	22	1.5	3.3	17	1.7	3.9	13	2.0	4.5	11	2.2	4.7						
80	70	1.1	1.5	44	1.3	2.2	29	1.4	2.9	24	1.5	3.3	18	1.7	3.9	14	2.0	4.4	11	2.2	4.9						
90	79	1.1	1.5	49	1.3	2.2	33	1.4	2.9	27	1.5	3.3	20	1.7	3.9	15	1.9	4.5	13	2.2	4.9	11	2.4	5.2			
100	87	1.1	1.5	55	1.3	2.2	37	1.4	2.9	29	1.5	3.3	22	1.7	3.9	17	1.9	4.5	14	2.2	4.9	12	2.4	5.3			

Table 3.4
Parabolic Diversion Design, Without Freeboard Tables - 2 (USDA– NRCS)

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD

RETARDANCE - D & C
GRADE, % - 1.5

V_1 Based on Permissible Velocity of the Soil With Retardance "D"
Top Width, Depth & V_2 Based on Retardance "C"

Q	V_1 = 2.0			V_1 = 2.5			V_1 = 3.0			V_1 = 3.5			V_1 = 4.0			V_1 = 4.5			V_1 = 5.0			V_1 = 5.5			V_1 = 6.0		
cfs	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2
15	17	0.9	1.4	11	1.1	1.9	8	1.2	2.4																		
20	23	0.9	1.4	15	1.0	1.9	10	1.2	2.5	7	1.4	3.0	6	1.5	3.4												
25	28	0.9	1.4	19	1.0	1.9	12	1.2	2.6	8	1.4	3.2	7	1.5	3.6												
30	34	0.9	1.4	22	1.0	1.9	15	1.2	2.6	10	1.3	3.2	8	1.5	3.6	7	1.6	4.0									
35	40	0.9	1.4	26	1.0	2.0	17	1.1	2.6	12	1.3	3.3	10	1.4	3.7	8	1.6	4.1									
40	45	0.9	1.4	30	1.0	1.9	20	1.2	2.6	14	1.3	3.3	11	1.4	3.7	9	1.6	4.2	7	1.8	4.6						
45	51	0.9	1.4	33	1.0	2.0	22	1.1	2.6	15	1.3	3.4	12	1.4	3.8	10	1.5	4.3	8	1.8	4.6						
50	56	0.9	1.4	37	1.0	2.0	25	1.1	2.7	17	1.3	3.4	14	1.4	3.9	11	1.5	4.3	9	1.8	4.8						
55	62	0.9	1.5	41	1.0	2.0	27	1.1	2.6	19	1.3	3.4	15	1.4	3.9	12	1.5	4.3	10	1.7	4.9	8	1.9	5.1			
60	67	0.9	1.5	44	1.0	2.0	30	1.1	2.7	20	1.3	3.4	16	1.4	3.9	14	1.5	4.4	11	1.7	4.9	9	1.9	5.2			
65	73	0.9	1.5	48	1.0	2.0	32	1.1	2.7	22	1.3	3.4	18	1.4	3.9	15	1.5	4.4	11	1.7	5.0	10	1.9	5.3			
70	78	0.9	1.5	51	1.0	2.0	34	1.1	2.7	24	1.3	3.4	19	1.4	3.9	16	1.5	4.4	12	1.7	4.9	10	1.9	5.4	9	2.1	5.6
75	83	0.9	1.5	55	1.0	2.0	37	1.1	2.7	25	1.3	3.4	21	1.4	3.9	17	1.5	4.4	13	1.7	5.0	11	1.9	5.4	9	2.1	5.6
80	89	0.9	1.5	59	1.0	2.0	39	1.1	2.7	27	1.3	3.4	22	1.4	3.9	18	1.5	4.4	14	1.7	5.0	12	1.9	5.5	10	2.1	5.8
90	100	0.9	1.5	66	1.0	2.0	44	1.1	2.7	30	1.3	3.5	25	1.4	3.9	20	1.5	4.4	15	1.7	5.0	13	1.9	5.4	11	2.0	5.9
100				73	1.0	2.0	49	1.1	2.7	33	1.3	3.5	27	1.4	3.9	22	1.5	4.5	17	1.7	5.1	15	1.9	5.5	12	2.0	6.0

PARABOLIC DIVERSION DESIGN, WITHOUT FREEBOARD

RETARDANCE - D & C
GRADE, % - 2.0

V_1 Based on Permissible Velocity of the Soil With Retardance "D"
Top Width, Depth & V_2 Based on Retardance "C"

Q	V_1 = 2.0			V_1 = 2.5			V_1 = 3.0			V_1 = 3.5			V_1 = 4.0			V_1 = 4.5			V_1 = 5.0			V_1 = 5.5			V_1 = 6.0		
cfs	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2	T	D	V_2
15	21	0.8	1.3	13	0.9	1.9	9	1.0	2.4	7	1.2	2.9															
20	28	0.8	1.3	17	0.9	1.9	12	1.0	2.4	9	1.1	3.0	7	1.3	3.5	5	1.4	3.8									
25	35	0.8	1.3	21	0.9	1.9	15	1.0	2.4	11	1.1	3.0	8	1.3	3.7	7	1.4	4.0									
30	41	0.8	1.3	26	0.9	1.9	18	1.0	2.5	13	1.1	3.0	10	1.2	3.7	8	1.3	4.2	7	1.5	4.5						
35	48	0.8	1.4	30	0.9	1.9	22	1.0	2.4	15	1.1	3.1	11	1.2	3.8	9	1.3	4.2	8	1.5	4.7						
40	55	0.8	1.3	34	0.9	1.9	25	1.0	2.5	18	1.1	3.1	13	1.2	3.8	11	1.3	4.3	9	1.5	4.7	7	1.7	5.0			
45	62	0.8	1.4	38	0.9	1.9	28	1.0	2.5	20	1.1	3.1	14	1.2	3.8	12	1.3	4.3	10	1.4	4.8	8	1.6	5.2			
50	68	0.8	1.4	42	0.9	1.9	31	1.0	2.5	22	1.1	3.1	16	1.2	3.9	13	1.3	4.3	11	1.4	4.8	9	1.6	5.3	8	1.7	5.6
55	75	0.8	1.4	46	0.9	1.9	34	1.0	2.5	24	1.1	3.1	17	1.2	3.8	14	1.3	4.3	12	1.4	4.9	10	1.6	5.3	8	1.7	5.8
60	82	0.8	1.4	51	0.9	1.9	37	1.0	2.5	26	1.1	3.1	19	1.2	3.9	16	1.3	4.4	13	1.4	4.8	11	1.6	5.3	9	1.7	5.7
65	88	0.8	1.4	55	0.9	1.9	40	1.0	2.5	28	1.1	3.1	21	1.2	3.9	17	1.3	4.4	14	1.4	4.9	11	1.6	5.4	10	1.7	5.7
70	95	0.8	1.4	59	0.9	1.9	43	1.0	2.5	30	1.1	3.1	22	1.2	3.9	18	1.3	4.4	15	1.4	4.9	12	1.6	5.4	10	1.7	5.8
75				63	0.9	1.9	46	1.0	2.5	32	1.1	3.2	24	1.2	3.9	20	1.3	4.4	16	1.4	5.0	13	1.6	5.5	11	1.7	5.9
80				67	0.9	2.0	48	1.0	2.5	35	1.1	3.1	25	1.2	3.9	21	1.3	4.4	17	1.4	4.9	14	1.6	5.4	12	1.7	6.0
90				75	0.9	2.0	54	1.0	2.5	39	1.1	3.2	28	1.2	3.9	23	1.3	4.4	19	1.4	4.9	16	1.6	5.5	13	1.7	5.9
100				83	0.9	2.0	60	1.0	2.5	43	1.1	3.2	31	1.2	3.9	26	1.3	4.4	21	1.4	5.0	17	1.6	5.5	15	1.7	6.0

STANDARD AND SPECIFICATIONS FOR DUST CONTROL

Definition & Scope

The control of dust resulting from land-disturbing activities, to prevent surface and air movement of dust from disturbed soil surfaces that may cause off-site damage, health hazards, and traffic safety problems.

Conditions Where Practice Applies

On construction roads, access points, and other disturbed areas subject to surface dust movement and dust blowing where off-site damage may occur if dust is not controlled.

Design Criteria

Construction operations should be scheduled to minimize the amount of area disturbed at one time. Buffer areas of vegetation should be left where practical. Temporary or permanent stabilization measures shall be installed. No specific design criteria is given; see construction specifications below for common methods of dust control.

Water quality must be considered when materials are selected for dust control. Where there is a potential for the material to wash off to a stream, ingredient information must be provided to the NYSDEC.

No polymer application shall take place without written approval from the NYSDEC.

Construction Specifications

A. **Non-driving Areas –** These areas use products and materials applied or placed on soil surfaces to prevent airborne migration of soil particles.

Vegetative Cover – For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control (see Section 3).

Mulch (including gravel mulch) – Mulch offers a fast effective means of controlling dust. This can also include rolled erosion control blankets.

Spray adhesives – These are products generally composed of polymers in a liquid or solid form that are mixed with water to form an emulsion that is sprayed on the soil surface with typical hydroseeding equipment. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations for the specific soils on the site. In no case should the application of these adhesives be made on wet soils or if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators and others working with the material.

B. **Driving Areas** – These areas utilize water, polymer emulsions, and barriers to prevent dust movement from the traffic surface into the air.

Sprinkling – The site may be sprayed with water until the surface is wet. This is especially effective on haul roads and access route to provide short term limited dust control.

Polymer Additives – These polymers are mixed with water and applied to the driving surface by a water truck with a gravity feed drip bar, spray bar or automated distributor truck. The mixing ratios and application rates will be in accordance with the manufacturer's recommendations. Incorporation of the emulsion into the soil will be done to the appropriate depth based on expected traffic. Compaction after incorporation will be by vibratory roller to a minimum of 95%. The prepared surface shall be moist and no application of the polymer will be made if there is a probability of precipitation within 48 hours of its proposed use. Material Safety Data Sheets will be provided to all applicators working with the material.

Barriers – Woven geo-textiles can be placed on the driving surface to effectively reduce dust throw and particle migration on haul roads. Stone can also be used for construction roads for effective dust control.

Windbreak – A silt fence or similar barrier can control air currents at intervals equal to ten times the barrier height. Preserve existing wind barrier vegetation as much as practical.

Maintenance

Maintain dust control measures through dry weather periods until all disturbed areas are stabilized.

STANDARD AND SPECIFICATIONS FOR FERTILIZER APPLICATION

Definition & Scope

The **permanent** incorporation of fertilizer into the planting zone of the soil profile to provide nutrient amendments to the soil for vigorous support to plant and vegetation growth.

Conditions Where Practice Applies

This standard applies to all areas where permanent seeding, sodding, and plant establishment is required. All application of fertilizer shall be in accordance with Nutrient Runoff Law - ECL Article 17, Title 21. Phosphorus runoff poses a threat to water quality. Therefore, under New York Law, fertilizer containing phosphorus may only be applied to lawn or non-agricultural turf when:

1. A soil test indicates that additional phosphorus is needed for growth of that lawn or non-agricultural turf, or

2. The fertilizer is used for newly established lawn or non -agricultural turf during the first growing season.

For projects located within watersheds where enhanced phosphorus removal standards are required as part of its post-construction stormwater management plan, use of any fertilizer containing more than 0.67 percent phosphate (P_20_5) content will be done only with a valid soil test demonstrating the need for that formulation.

Design Criteria

Fertilizer is sold with an analysis printed on the tag or bag shown as three numbers separated by a dash, such as 5-10-5. The first number is the percent of the total weight of the bag that is nitrogen (N), the second is the percent of phosphate (phosphorus, P), and the third is the percent of potash (potassium, K). Other elements are sometimes included and are listed with these three basic components.

For example a 40 lb bag of 5-10-5 fertilizer contains 5% of 40 lbs of Nitrogen which equals 2 lbs. There is 10% of 40 lbs of phosphate (phosphorus) which equals 4 lbs, and there is 5% of potash (potassium), another 2 lbs., for a total of 8 lbs of active fertilizer in the 40 lb bag. The rest is filler to aid in spreading the material over the area to be treated.

Specify the design fertilizer mix and application rates based on the results of the soil tests.

Specifications

1. In no case shall fertilizer be applied between December 1 and April 1 annually.

2. Fertilizer shall not be spread within 20 feet of a surface water.

3. Any fertilizer falling or spilled into impervious surface areas such as parking lots, roadways, and sidewalks should be immediately contained and legally applied or placed in an appropriate container.

4. Incorporate the fertilizer, and lime if specified, into the top 2-4 inches of the topsoil or soil profile.

5. When applying fertilizer by hydro seeding care should be taken to apply mix only to seed bed areas at an appropriate flow rate to prevent erosion and spraying onto impervious areas.

STANDARD AND SPECIFICATIONS FOR FIBER ROLL

Definition & Scope

A fiber roll is a coir (coconut fiber), straw, or excelsior roll encased in netting of jute, nylon, or burlap to dissipate energy along streambanks, channels, and bodies of water and to reduce sheet flow on slopes.

Conditions Where Practice Applies

Fiber rolls are used where the water surface levels are relatively constant. Artificially controlled streams for hydropower are not good candidates for this technique. The rolls provide a good medium for the introduction of herbaceous vegetation. Planting in the fiber roll is appropriate where the roll will remain continuously wet.

Design Criteria

1. The roll is placed in a shallow trench dug below baseflow or in a 4 inch trench on the slope contour and anchored by 2" x 2", 3-foot long posts driven on each side of the roll (see Figure 4.8).

2. The roll is contained by a 9-gauge non-galvanized wire placed over the roll from post to post. Braided nylon rope (1/8" thick) may be used.

3. The anchor posts shall be spaced laterally 4 feet on center on both sides of the roll and driven down to the top of the roll.

4. Soil is placed behind the roll and planted with suitable herbaceous or woody vegetation. If the roll will be continuously saturated, wetland plants may be planted into voids created in the upper surface of the roll.

5. Where water levels may fall below the bottom edge of the roll, a brush layer of willow should be installed so as to lay across the top edge of the roll.

6. Where fiber rolls are used to reduce sheet flow on slopes they should be at least 12" in diameter and spaced according to the straw bale dike standard for sediment control.

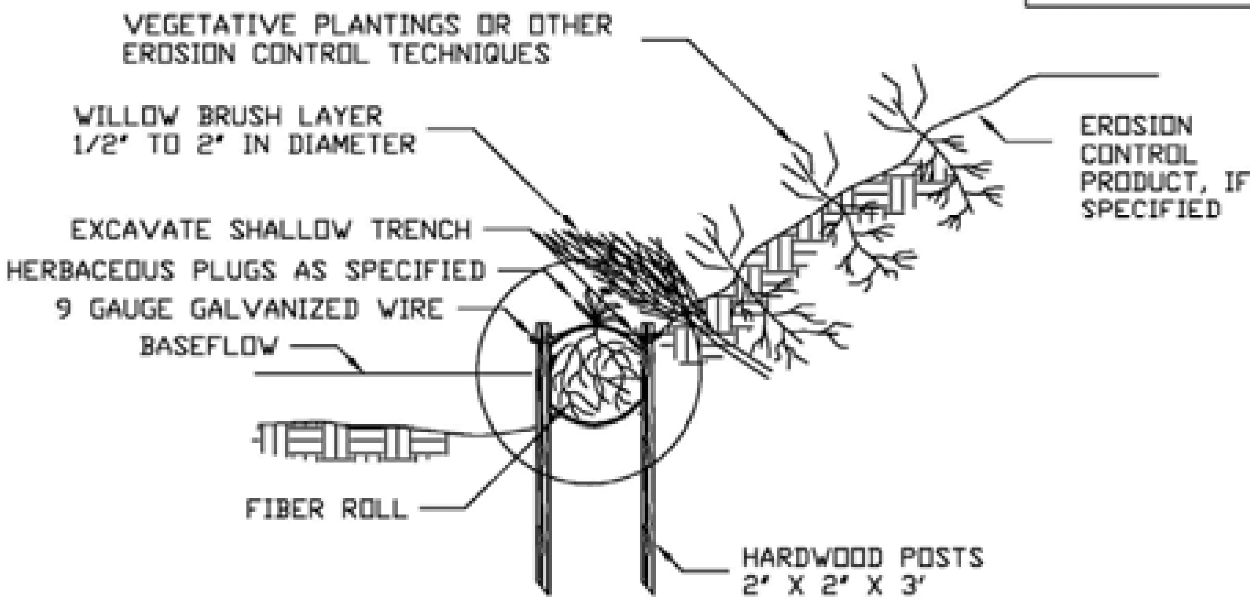
Maintenance

Due to the susceptibility of plant materials to the physical constraints of the site, climate conditions, and animal populations, it is necessary to inspect installations frequently. This is especially important during the first year or two of establishment. Plant materials missing or damaged should be replaced as soon as possible. Sloughs or breaks in drainage pattern should be reestablished for the site as quickly as possible to maintain stability.

Figure 4.8
Fiber Roll

SYMBOL

FR



CROSS SECTION
NOT TO SCALE

CONSTRUCTION SPECIFICATIONS

1. EXCAVATE A SHALLOW TRENCH SLIGHTLY BELOW BASEFLOW OR A 4" TRENCH ON SLOPE CONTOURS.
2. PLACE THE ROLL IN THE TRENCH AND ANCHOR WITH 2" x 2" POSTS PLACED ON BOTH SIDES OF THE ROLL AND SPACED LATERALLY ON 2' TO 4' CENTERS. TRIM THE TOP OF THE POSTS EVEN WITH THE EDGE OF THE ROLL, IF NECESSARY.
3. NOTCH THE POSTS AND TIE TOGETHER, ACROSS THE ROLL, WITH 9 GAUGE GALVANIZED WIRE OR 1/8" DIAMETER BRAIDED NYLON ROPE..
4. PLACE SOIL EXCAVATED FROM THE TRENCH BEHIND THE ROLL AND HAND TAMP. PLANT WITH SUITABLE HERBACEOUS OR WOODY VEGETATION AS SPECIFIED ELSEWHERE IN THE CONTRACT DOCUMENTS. VEGETATION SHALL BE PLACED IMMEDIATELY ADJACENT TO THE ROLL TO PROMOTE ROOT GROWTH INTO THE FIBER. HERBACEOUS VEGETATION, IF SPECIFIED, SHALL BE PLANTED INTO THE FIBER ROLL.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	FIBER ROLL

STANDARD AND SPECIFICATIONS FOR LANDGRADING

Definition & Scope

Permanent reshaping of the existing land surface by grading in accordance with an engineering topographic plan and specification to provide for erosion control and vegetative establishment on disturbed, reshaped areas.

Design Criteria

The grading plan should be based upon the incorporation of building designs and street layouts that fit and utilize existing topography and desirable natural surrounding to avoid extreme grade modifications. Information submitted must provide sufficient topographic surveys and soil investigations to determine limitations that must be imposed on the grading operation related to slope stability, effect on adjacent properties and drainage patterns, measures for drainage and water removal, and vegetative treatment, etc.

Many municipalities and counties have regulations and design procedures already established for land grading and cut and fill slopes. Where these requirements exist, they shall be followed.

The plan must show existing and proposed contours of the area(s) to be graded. The plan shall also include practices for erosion control, slope stabilization, safe disposal of runoff water and drainage, such as waterways, lined ditches, reverse slope benches (include grade and cross section), grade stabilization structures, retaining walls, and surface and subsurface drains. The plan shall also include phasing of these practices. The following shall be incorporated into the plan:

1. Provisions shall be made to safely convey surface runoff to storm drains, protected outlets, or to stable water courses to ensure that surface runoff will not damage slopes or other graded areas; see standards and specifications for Grassed Waterway, Diversion, or Grade Stabilization Structure.

2. Cut and fill slopes that are to be stabilized with grasses shall not be steeper than 2:1. When slopes exceed 2:1, special design and stabilization consideration are required and shall be adequately shown on the plans. (Note: Where the slope is to be mowed, the slope should be no steeper than 3:1, although 4:1 is preferred because of safety factors related to mowing steep slopes.)

3. Reverse slope benches or diversion shall be provided whenever the vertical interval (height) of any 2:1 slope exceeds 20 feet; for 3:1 slope it shall be increased to 30 feet and for 4:1 to 40 feet. Benches shall be located to divide the slope face as equally as possible and shall convey the water to a stable outlet. Soils, seeps, rock outcrops, etc., shall also be taken into consideration when designing benches.

   A. Benches shall be a minimum of six feet wide to provide for ease of maintenance.

   B. Benches shall be designed with a reverse slope of 6:1 or flatter to the toe of the upper slope and with a minimum of one foot in depth. Bench gradient to the outlet shall be between 2 percent and 3 percent, unless accompanied by appropriate design and computations.

   C. The flow length within a bench shall not exceed 800 feet unless accompanied by appropriate design and computations; see Standard and Specifications for Diversion on page 3.9

4. Surface water shall be diverted from the face of all cut and/or fill slopes by the use of diversions, ditches and swales or conveyed downslope by the use of a designed structure, except where:

   A. The face of the slope is or shall be stabilized and the face of all graded slopes shall be protected from surface runoff until they are stabilized.

   B. The face of the slope shall not be subject to any concentrated flows of surface water such as from natural drainage ways, graded ditches, downspouts, etc.

   C. The face of the slope will be protected by anchored stabilization matting, sod, gravel, riprap, or other stabilization method.

5. Cut slopes occurring in ripable rock shall be serrated as shown in Figure 4.9 on page 4.26. The serrations shall be made with conventional equipment as the excavation is made. Each step or serration shall be constructed on the contour and will have steps cut at nominal two-foot intervals with nominal three-foot horizontal shelves. These steps will vary depending on the slope ratio or the cut slope. The nominal slope line is 1 ½: 1. These steps will weather and act to hold moisture, lime, fertilizer, and seed thus producing a much quicker and longer-lived vegetative cover and better slope stabilization. Overland flow shall be diverted from the top of all serrated cut slopes and carried to a suitable outlet.

6. Subsurface drainage shall be provided where necessary to intercept seepage that would otherwise adversely affect slope stability or create excessively wet site conditions.

7. Slopes shall not be created so close to property lines as to endanger adjoining properties without adequately protecting such properties against sedimentation, erosion, slippage, settlement, subsidence, or other related damages.

8. Fill material shall be free of brush, rubbish, rocks, logs, stumps, building debris, and other objectionable material. It should be free of stones over two (2) inches in diameter where compacted by hand or mechanical tampers or over eight (8) inches in diameter where compacted by rollers or other equipment. Frozen material shall not be placed in the fill nor shall the fill material be placed on a frozen foundation.

9. Stockpiles, borrow areas, and spoil shall be shown on the plans and shall be subject to the provisions of this Standard and Specifications.

10. All disturbed areas shall be stabilized structurally or vegetatively in compliance with the Permanent Construction Area Planting Standard on page 4.42.

Construction Specifications

See Figures 4.9 and 4.10 for details.

1. All graded or disturbed areas, including slopes, shall be protected during clearing and construction in accordance with the erosion and sediment control plan until they are adequately stabilized.

2. All erosion and sediment control practices and measures shall be constructed, applied and maintained in accordance with the erosion and sediment control plan and these standards.

3. Topsoil required for the establishment of vegetation shall be stockpiled in amount necessary to complete finished grading of all exposed areas.

4. Areas to be filled shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, or other objectionable material.

5. Areas that are to be topsoiled shall be scarified to a minimum depth of four inches prior to placement of topsoil.

6. All fills shall be compacted as required to reduce erosion, slippage, settlement, subsidence, or other related problems. Fill intended to support buildings, structures, and conduits, etc., shall be compacted in accordance with local requirements or codes.

7. All fill shall be placed and compacted in layers not to exceed 9 inches in thickness.

8. Except for approved landfills or nonstructural fills, fill material shall be free of frozen particles, brush, roots, sod, or other foreign objectionable materials that would interfere with, or prevent, construction of satisfactory fills.

9. Frozen material or soft, mucky or highly compressible materials shall not be incorporated into fill slopes or structural fills.

10. Fill shall not be placed on saturated or frozen surfaces.

11. All benches shall be kept free of sediment during all phases of development.

12. Seeps or springs encountered during construction shall be handled in accordance with the Standard and Specification for Subsurface Drain on page 3.48 or other approved methods.

13. All graded areas shall be permanently stabilized immediately following finished grading.

14. Stockpiles, borrow areas, and spoil areas shall be shown on the plans and shall be subject to the provisions of this Standard and Specifications.

Figure 4.9
Typical Section of Serrated Cut Slope

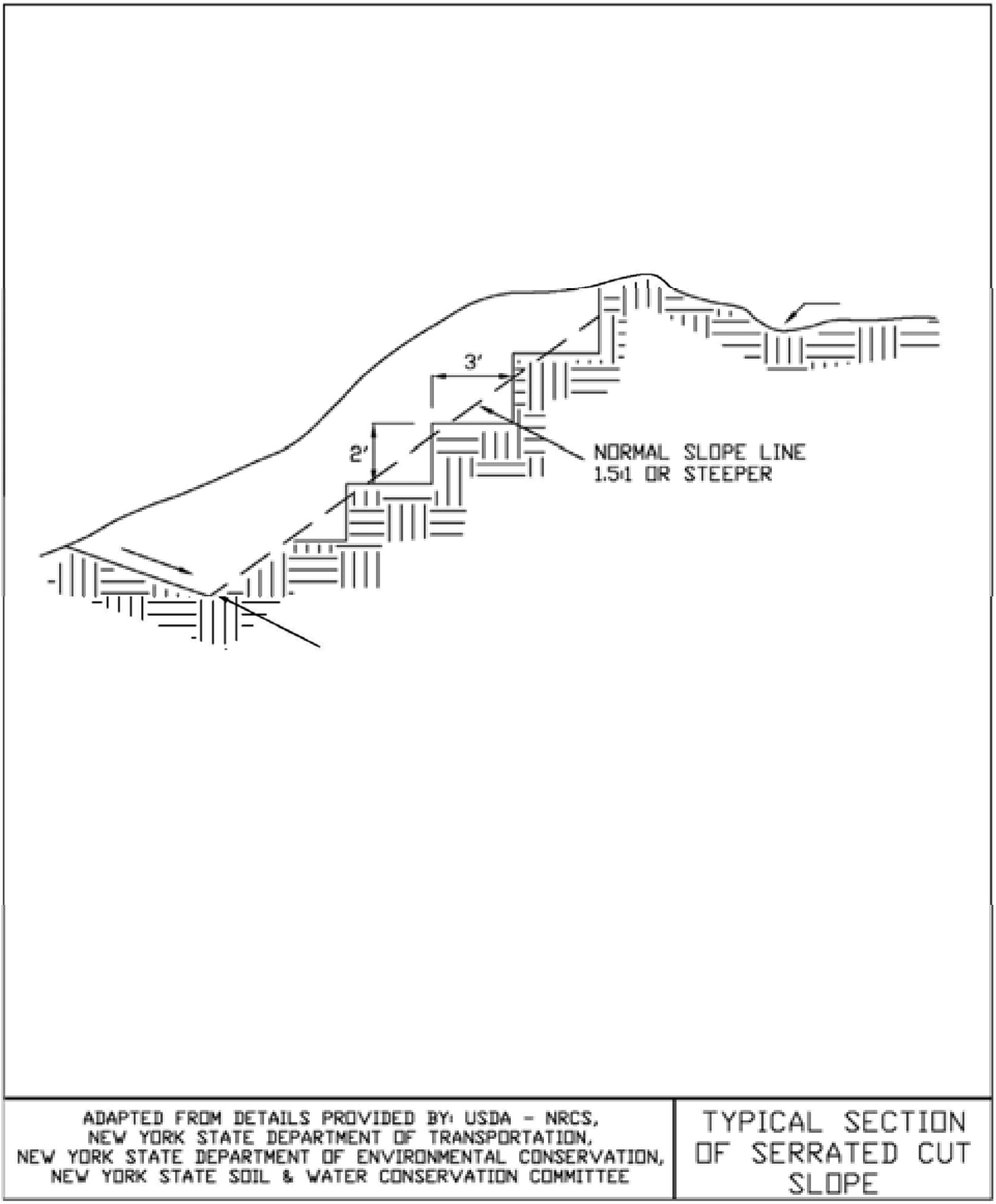


Figure 4.10
Landgrading

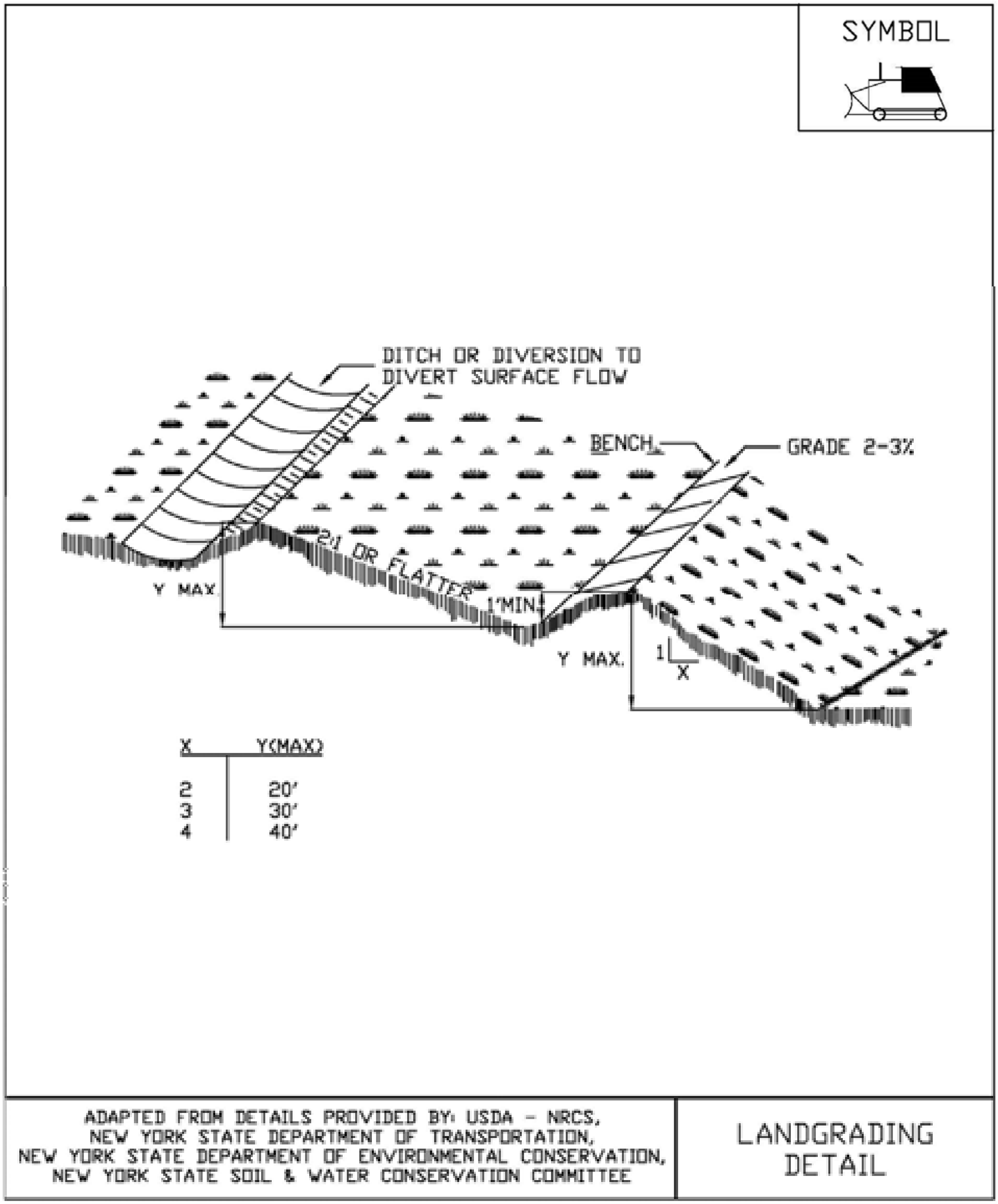


Figure 4.11
Landgrading - Construction Specifications

CONSTRUCTION SPECIFICATIONS

1. ALL GRADED OR DISTURBED AREAS INCLUDING SLOPES SHALL BE PROTECTED DURING CLEARING AND CONSTRUCTION IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENT CONTROL PLAN UNTIL THEY ARE PERMANENTLY STABILIZED.
2. ALL SEDIMENT CONTROL PRACTICES AND MEASURES SHALL BE CONSTRUCTED, APPLIED AND MAINTAINED IN ACCORDANCE WITH THE APPROVED EROSION AND SEDIMENT CONTROL PLAN.
3. TOPSOIL REQUIRED FOR THE ESTABLISHMENT OF VEGETATION SHALL BE STOCKPILED IN AMOUNT NECESSARY TO COMPLETE FINISHED GRADING OF ALL EXPOSED AREAS.
4. AREAS TO BE FILLED SHALL BE CLEARED, GRUBBED, AND STRIPPED OF TOPSOIL TO REMOVE TREES, VEGETATION, ROOTS OR OTHER OBJECTIONABLE MATERIAL.
5. AREAS WHICH ARE TO BE TOPSOILED SHALL BE SCARIFIED TO A MINIMUM DEPTH OF FOUR INCHES PRIOR TO PLACEMENT OF TOPSOIL.
6. ALL FILLS SHALL BE COMPACTED AS REQUIRED TO REDUCE EROSION, SLIPPAGE, SETTLEMENT, SUBSIDENCE OR OTHER RELATED PROBLEMS. FILL INTENDED TO SUPPORT BUILDINGS, STRUCTURES AND CONDUITS, ETC. SHALL BE COMPACTED IN ACCORDANCE WITH LOCAL REQUIREMENTS OR CODES.
7. ALL FILL SHALL BE PLACED AND COMPACTED IN LAYERS NOT TO EXCEED 9 INCHES IN THICKNESS.
8. EXCEPT FOR APPROVED LANDFILLS, FILL MATERIAL SHALL BE FREE OF FROZEN PARTICLES, BRUSH, ROOTS, SOD, OR OTHER FOREIGN OR OTHER OBJECTIONABLE MATERIALS THAT WOULD INTERFERE WITH OR PREVENT CONSTRUCTION OF SATISFACTORY FILLS.
9. FROZEN MATERIALS OR SOFT, MUCKY OR HIGHLY COMPRESSIBLE MATERIALS SHALL NOT BE INCORPORATED IN FILLS.
10. FILL SHALL NOT BE PLACED ON SATURATED OR FROZEN SURFACES.
11. ALL BENCHES SHALL BE KEPT FREE OF SEDIMENT DURING ALL PHASES OF DEVELOPMENT.
12. SEEPS OR SPRINGS ENCOUNTERED DURING CONSTRUCTION SHALL BE HANDLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATION FOR SUBSURFACE DRAIN OR OTHER APPROVED METHOD.
13. ALL GRADED AREAS SHALL BE PERMANENTLY STABILIZED IMMEDIATELY FOLLOWING FINISHED GRADING.
14. STOCKPILES, BORROW AREAS AND SPOIL AREAS SHALL BE SHOWN ON THE PLANS AND SHALL BE SUBJECT TO THE PROVISIONS OF THIS STANDARD AND SPECIFICATION.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	LANDGRADING SPECIFICATIONS

STANDARD AND SPECIFICATIONS FOR PROTECTING VEGETATION DURING CONSTRUCTION

Definition & Scope

The protection of trees, shrubs, ground cover and other vegetation from damage by construction equipment. In order to preserve existing vegetation determined to be important for soil erosion control, water quality protection, shade, screening, buffers, wildlife habitat, wetland protection, and other values.

Conditions Where Practices Applies

On planned construction sites where valued vegetation exists and needs to be preserved.

Design Criteria

1. Planning Considerations

   A. Inventory:

   1) Property boundaries, topography, vegetation and soils information should be gathered. Identify potentially high erosion areas, areas with tree windthrow potential, etc. A vegetative cover type map should be made on a copy of a topographic map which shows other natural and manmade features. Vegetation that is desirable to preserve because of its value for screening, shade, critical erosion control, endangered species, aesthetics, etc., should be identified and marked on the map.

   2) Based upon this data, general statements should be prepared about the present condition, potential problem areas, and unique features of the property.

   B. Planning:

   1) After engineering plans (plot maps) are prepared, another field review should take place and recommendations made for the vegetation to be saved. Minor adjustments in location of roads, dwellings, and utilities may be needed. Construction on steep slopes, erodible soils, wetlands, and streams should be avoided. Clearing limits should be delineated (See “Determine Limits of Clearing and Grading” on page 2.2).

   2) Areas to be seeded and planted should be identified. Remaining vegetation should blend with their surroundings and/or provide special function such as a filter strip, buffer zone, or screen.

   3) Trees and shrubs of special seasonal interest, such as flowering dogwood, red maple, striped maple, serviceberry, or shadbush, and valuable potential shade trees should be identified and marked for special protective treatment as appropriate.

   4) Trees to be cut should be marked on the plans. If timber can be removed for salable products, a forester should be consulted for marketing advice.

   5) Trees that may become a hazard to people, personal property, or utilities should be removed. These include trees that are weak-wooded, disease-prone, subject to windthrow, or those that have severely damaged root systems.

   6) The vigor of remaining trees may be improved by a selective thinning. A forester should be consulted for implementing this practice.

2. Measures to Protect Vegetation

   A. Limit soil placement over existing tree and shrub roots to a maximum of 3 inches. Soils with loamy texture and good structure should be used.

   B. Use retaining walls and terraces to protect roots of trees and shrubs when grades are lowered. Lowered grades should start no closer than the dripline of the tree. For narrow-canopied trees and shrubs, the stem diameter in inches is converted to feet and doubled, such that a 10 inch tree should be protected to 20 feet.

   C. Trenching across tree root systems should be the same minimum distance from the trunk, as in “B”. Tunnels under root systems for underground utilities should start 18 inches or deeper below the normal ground surface. Tree roots which must be severed should be cut clean. Backfill material that will be in contact with the roots should be topsoil or a prepared planting soil mixture.

   D. Construct sturdy fences, or barriers, of wood, steel, or other protective material around valuable vegetation for protection from construction equipment. Place barriers far enough away from trees, but not less than the specifications in "B", so that tall equipment such as backhoes and dump trucks do not contact tree branches.

E. Construction limits should be identified and clearly marked to exclude equipment.

F. Avoid spills of oil/gas and other contaminants.

G. Obstructive and broken branches should be pruned properly. The branch collar on all branches whether living or dead should not be damaged. The 3 or 4 cut method should be used on all branches larger than two inches at the cut. First cut about one-third the way through the underside of the limb (about 6-12 inches from the tree trunk). Then (approximately an inch further out) make a second cut through the limb from the upper side. When the branch is removed, there is no splintering of the main tree trunk. Remove the stub. If the branch is larger than 5-6 inches in diameter, use the four cut system. Cuts 1 and 2 remain the same and cut 3 should be from the underside of the limb, on the outside of the branch collar. Cut 4 should be from the top and in alignment with the 3rd cut. Cut 3 should be 1/4 to 1/3 the way through the limb. This will prevent the bark from peeling down the trunk. Do not paint the cut surface.

H. Penalties for damage to valuable trees, shrubs, and herbaceous plants should be clearly spelled out in the contract.

PROTECTING TREES IN HEAVY USE AREAS

The compaction of soil over the roots of trees and shrubs by the trampling of recreationists, vehicular traffic, etc., reduces oxygen, water, and nutrient uptake by feeder roots. This weakens and may eventually kill the plants. Table 2.6 rates the “Susceptibility of Tree Species to Compaction.”

Where heavy compaction is anticipated, apply and maintain a 3 to 4 inch layer of undecayed wood chips or 2 inches of No. 2 washed, crushed gravel. In addition, use of a wooden or plastic mat may be used to lessen compaction, if applicable.

STANDARD AND SPECIFICATIONS FOR ROCK OUTLET PROTECTION

Definition & Scope

A **permanent** section of rock protection placed at the outlet end of the culverts, conduits, or channels to reduce the depth, velocity, and energy of water, such that the flow will not erode the receiving downstream reach.

Conditions Where Practice Applies

This practice applies where discharge velocities and energies at the outlets of culverts, conduits, or channels are sufficient to erode the next downstream reach. This applies to:

1. Culvert outlets of all types.

2. Pipe conduits from all sediment basins, dry storm water ponds, and permanent type ponds.

3. New channels constructed as outlets for culverts and conduits.

Design Criteria

The design of rock outlet protection depends entirely on the location. Pipe outlet at the top of cuts or on slopes steeper than 10 percent, cannot be protected by rock aprons or riprap sections due to re-concentration of flows and high velocities encountered after the flow leaves the apron.

Many counties and state agencies have regulations and design procedures already established for dimensions, type and size of materials, and locations where outlet protection is required. Where these requirements exist, they shall be followed.

Tailwater Depth

The depth of tailwater immediately below the pipe outlet must be determined for the design capacity of the pipe. If the tailwater depth is less than half the diameter of the outlet pipe, and the receiving stream is wide enough to accept divergence of the flow, it shall be classified as a Minimum Tailwater Condition; see Figure 3.16 on page 3.42 as an example. If the tailwater depth is greater than half the pipe diameter and the receiving stream will continue to confine the flow, it shall be classified as a Maximum Tailwater Condition; see Figure 3.17 on page 3.43 as an example. Pipes which outlet onto flat areas with no defined channel may be assumed to have a Minimum Tailwater Condition; see Figure 3.16 on page 3.42 as an example.

Apron Size

The apron length and width shall be determined from the curves according to the tailwater conditions:

Minimum Tailwater – Use Figure 3.16 on page 3.42
Maximum Tailwater – Use Figure 3.17 on page 3.43

If the pipe discharges directly into a well defined channel, the apron shall extend across the channel bottom and up the channel banks to an elevation one foot above the maximum tailwater depth or to the top of the bank, whichever is less.

The upstream end of the apron, adjacent to the pipe, shall have a width two (2) times the diameter of the outlet pipe, or conform to pipe end section if used.

Bottom Grade

The outlet protection apron shall be constructed with no slope along its length. There shall be no overfall at the end of the apron. The elevation of the downstream end of the apron shall be equal to the elevation of the receiving channel or adjacent ground.

Alignment

The outlet protection apron shall be located so that there are no bends in the horizontal alignment.

Materials

The outlet protection may be done using rock riprap, grouted riprap, or gabions. Outlets constructed on the bank of a stream or wetland shall not use grouted rip-rap, gabions or concrete.

Riprap shall be composed of a well-graded mixture of rock size so that 50 percent of the pieces, by weight, shall be larger than the d_{50} size determined by using the charts. A well-graded mixture, as used herein, is defined as a mixture composed primarily of larger rock sizes, but with a sufficient mixture of other sizes to fill the smaller voids between the rocks. The diameter of the largest rock size in such a mixture shall be 1.5 times the d_{50} size.

Thickness

The minimum thickness of the riprap layer shall be 1.5 times the maximum rock diameter for d_{50} of 15 inches or less; and 1.2 times the maximum rock size for d_{50} greater than 15 inches. The following chart lists some examples:

D_{50} (inches)	d_{max} (inches)	Minimum Blanket Thickness (inches)
4	6	9
6	9	14
9	14	20
12	18	27
15	22	32
18	27	32
21	32	38
24	36	43

Rock Quality

Rock for riprap shall consist of field rock or rough unhewn quarry rock. The rock shall be hard and angular and of a quality that will not disintegrate on exposure to water or weathering. The specific gravity of the individual rocks shall be at least 2.5.

Filter

A filter is a layer of material placed between the riprap and the underlying soil surface to prevent soil movement into and through the riprap. Riprap shall have a filter placed under it in all cases.

A filter can be of two general forms: a gravel layer or a plastic filter cloth. The plastic filter cloth can be woven or non-woven monofilament yarns, and shall meet these base requirements: thickness 20-60 mils, grab strength 90-120 lbs; and shall conform to ASTM D-1777 and ASTM D-1682.

Gravel filter blanket, when used, shall be designed by comparing particle sizes of the overlying material and the base material. Design criteria are available in Standard and Specification for Anchored Slope and Channel Stabilization on page 4.7.

Gabions

Gabions shall be made of hexagonal triple twist mesh with heavily galvanized steel wire. The maximum linear dimension of the mesh opening shall not exceed 4 ½ inches and the area of the mesh opening shall not exceed 10 square inches.

Gabions shall be fabricated in such a manner that the sides, ends, and lid can be assembled at the construction site into a rectangular basket of the specified sizes. Gabions shall be of single unit construction and shall be installed according to manufacturer's recommendations.

The area on which the gabion is to be installed shall be graded as shown on the drawings. Foundation conditions shall be the same as for placing rock riprap, and filter cloth shall be placed under all gabions. Where necessary, key, or tie, the structure into the bank to prevent undermining of the main gabion structure.

Maintenance

Once a riprap outlet has been installed, the maintenance needs are very low. It should be inspected after high flows for evidence of scour beneath the riprap or for dislodged rocks. Repairs should be made immediately.

Design Procedure

1. Investigate the downstream channel to assure that nonerosive velocities can be maintained.
2. Determine the tailwater condition at the outlet to establish which curve to use.
3. Use the appropriate chart with the design discharge to determine the riprap size and apron length required. It is noted that references to pipe diameters in the charts are based on full flow. For other than full pipe flow, the parameters of depth of flow and velocity must be used to adjust the design discharges.
4. Calculate apron width at the downstream end if a flare section is to be employed.

Design Examples are demonstrated in Appendix B.

Construction Specifications

1. The subgrade for the filter, riprap, or gabion shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density of approximately that of the surrounding undisturbed material.
2. The rock or gravel shall conform to the specified grad-

ing limits when installed respectively in the riprap or filter.

3. Filter cloth shall be protected from punching, cutting, or tearing. Any damage other than an occasional small hole shall be repaired by placing another piece of cloth over the damaged part or by completely replacing the cloth. All overlaps, whether for repairs or for joining two pieces of cloth shall be a minimum of one foot.

4. Rock for the riprap or gabion outlets may be placed by equipment. Both shall each be constructed to the full course thickness in one operation and in such a manner as to avoid displacement of underlying materials. The rock for riprap or gabion outlets shall be delivered and placed in a manner that will ensure that it is reasonably homogenous with the smaller rocks and spalls filling the voids between the larger rocks. Riprap shall be placed in a manner to prevent damage to the filter blanket or filter cloth. Hand placement will be required to the extent necessary to prevent damage to the permanent works.

Figure 3.16
Outlet Protection Design—Minimum Tailwater Condition Chart
(Design of Outlet Protection from a Round Pipe Flowing Full, Minimum Tailwater Condition: $T_w < 0.5D_o$) (USDA - NRCS)

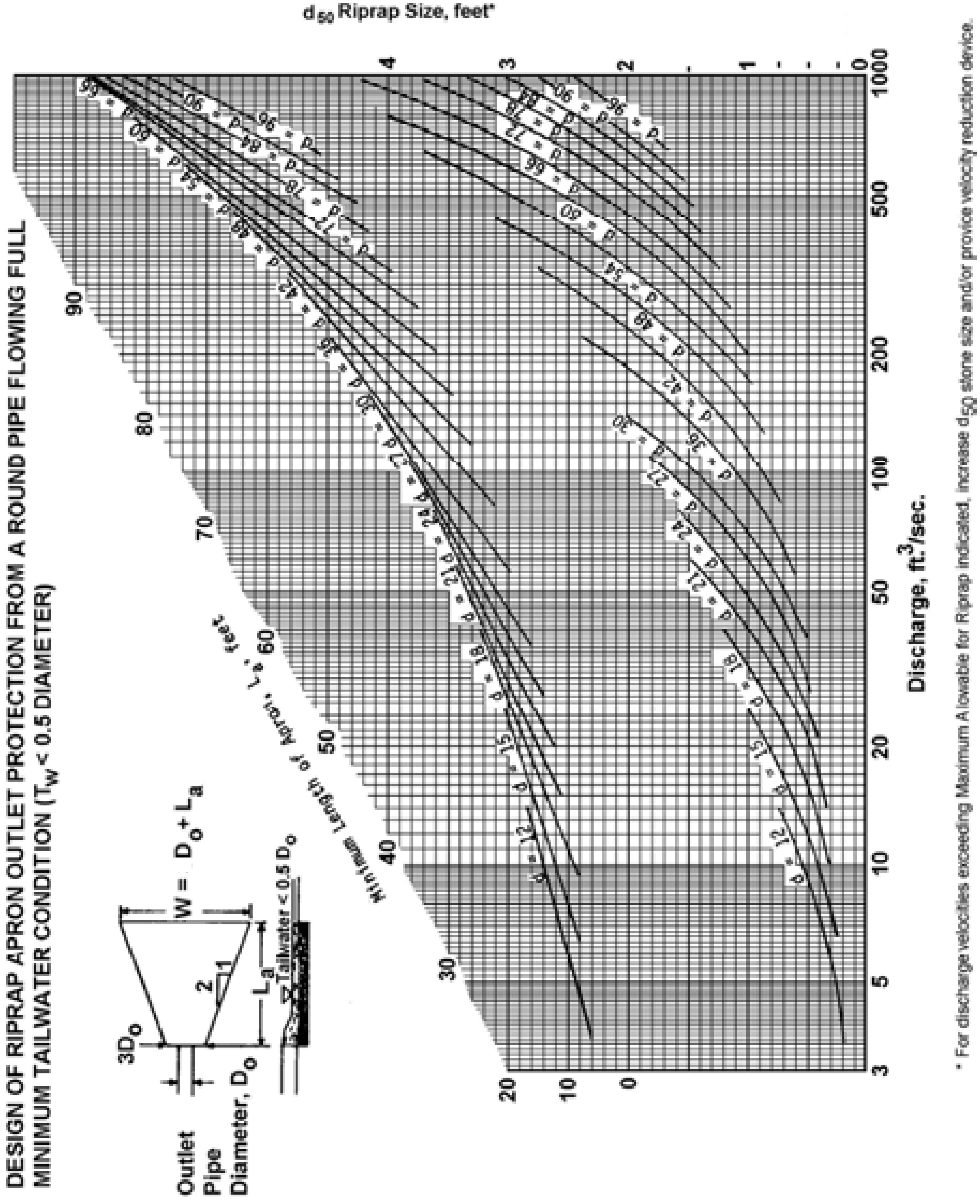


Figure 3.17
Outlet Protection Design—Maximum Tailwater Condition Chart
(Design of Outlet Protection from a Round Pipe Flowing Full, Maximum Tailwater Condition: $T_w \geq 0.5D_o$) (USDA - NRCS)

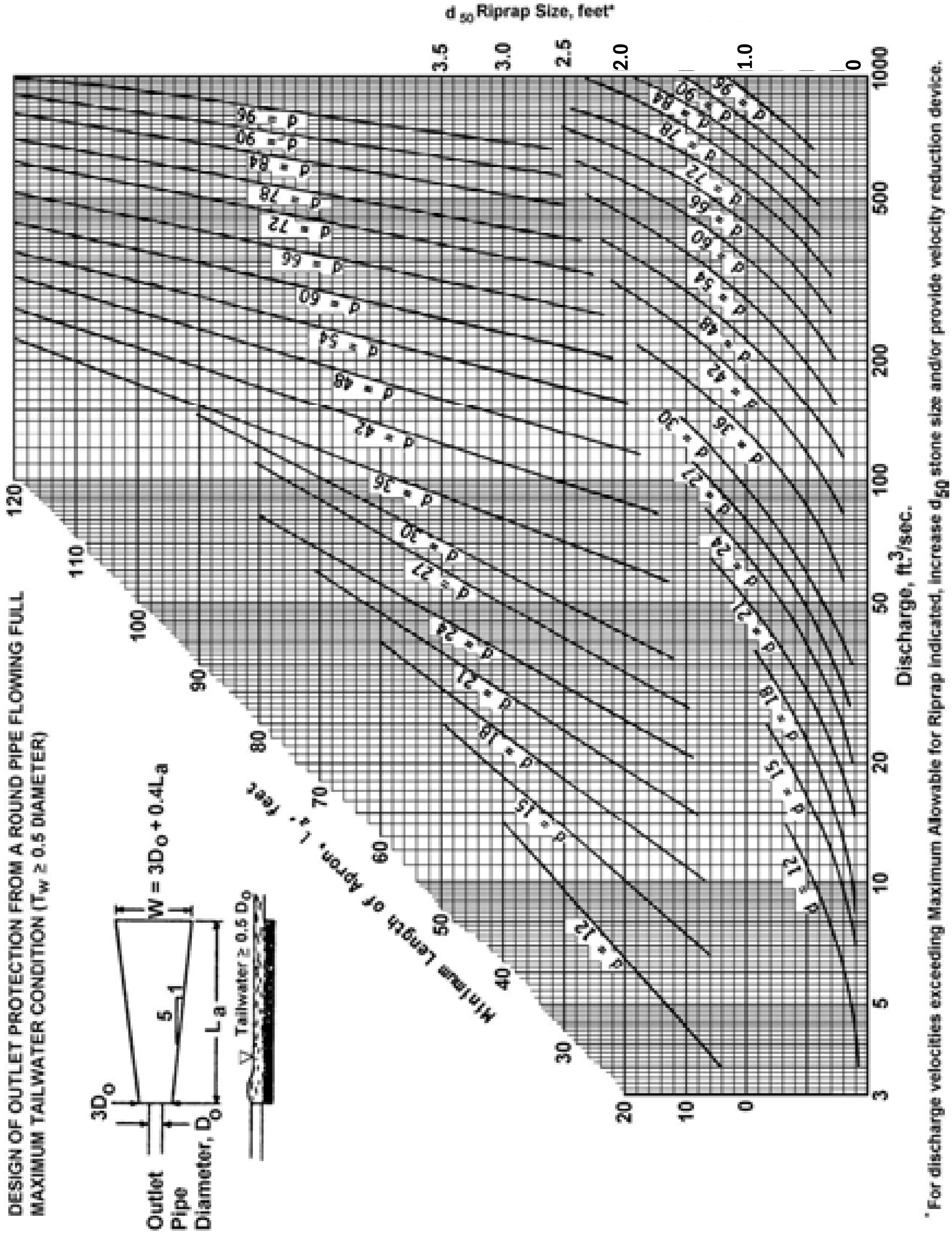


Figure 3.18
Riprap Outlet Protection Detail (1)

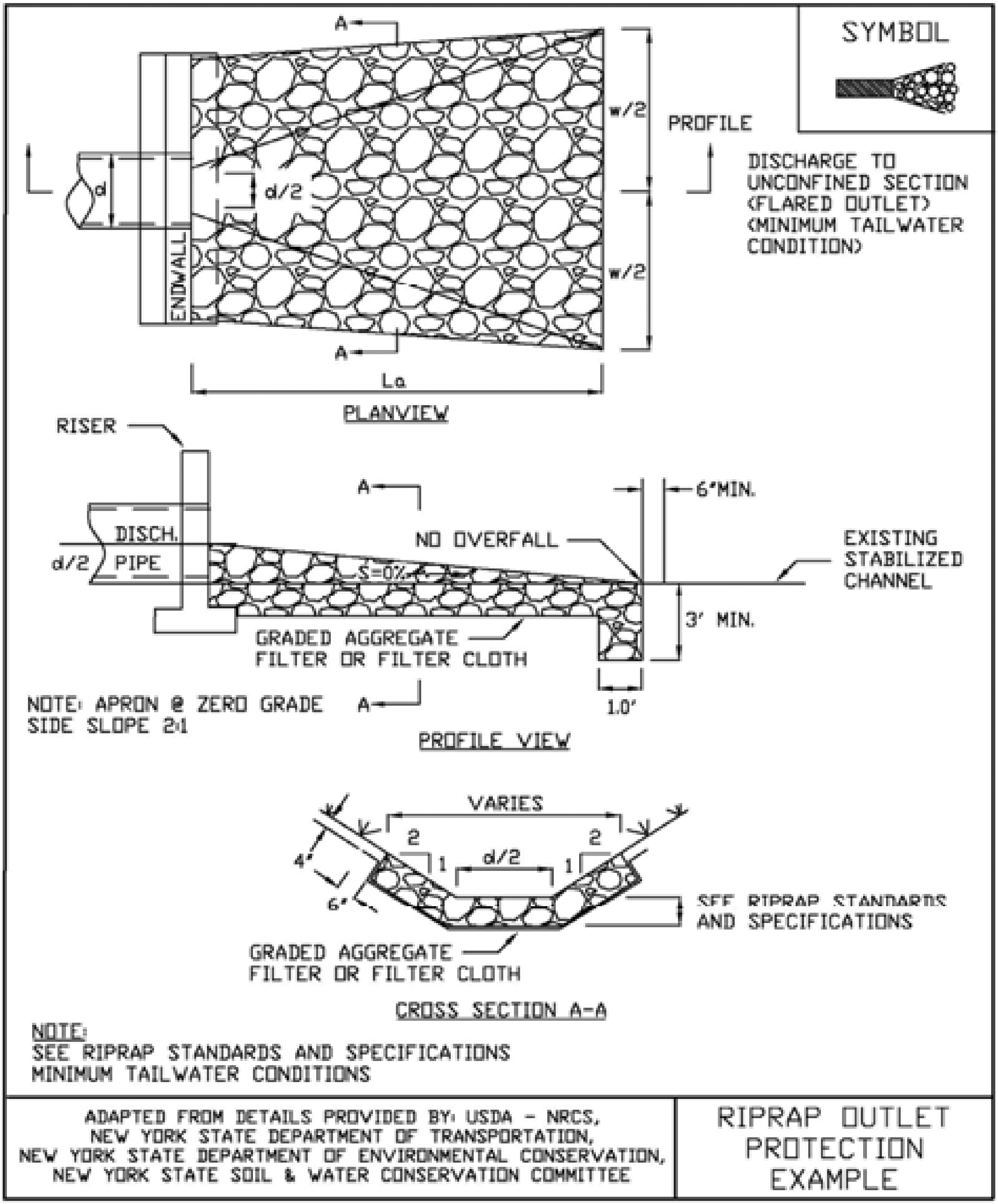


Figure 3.19
Riprap Outlet Protection Detail (2)

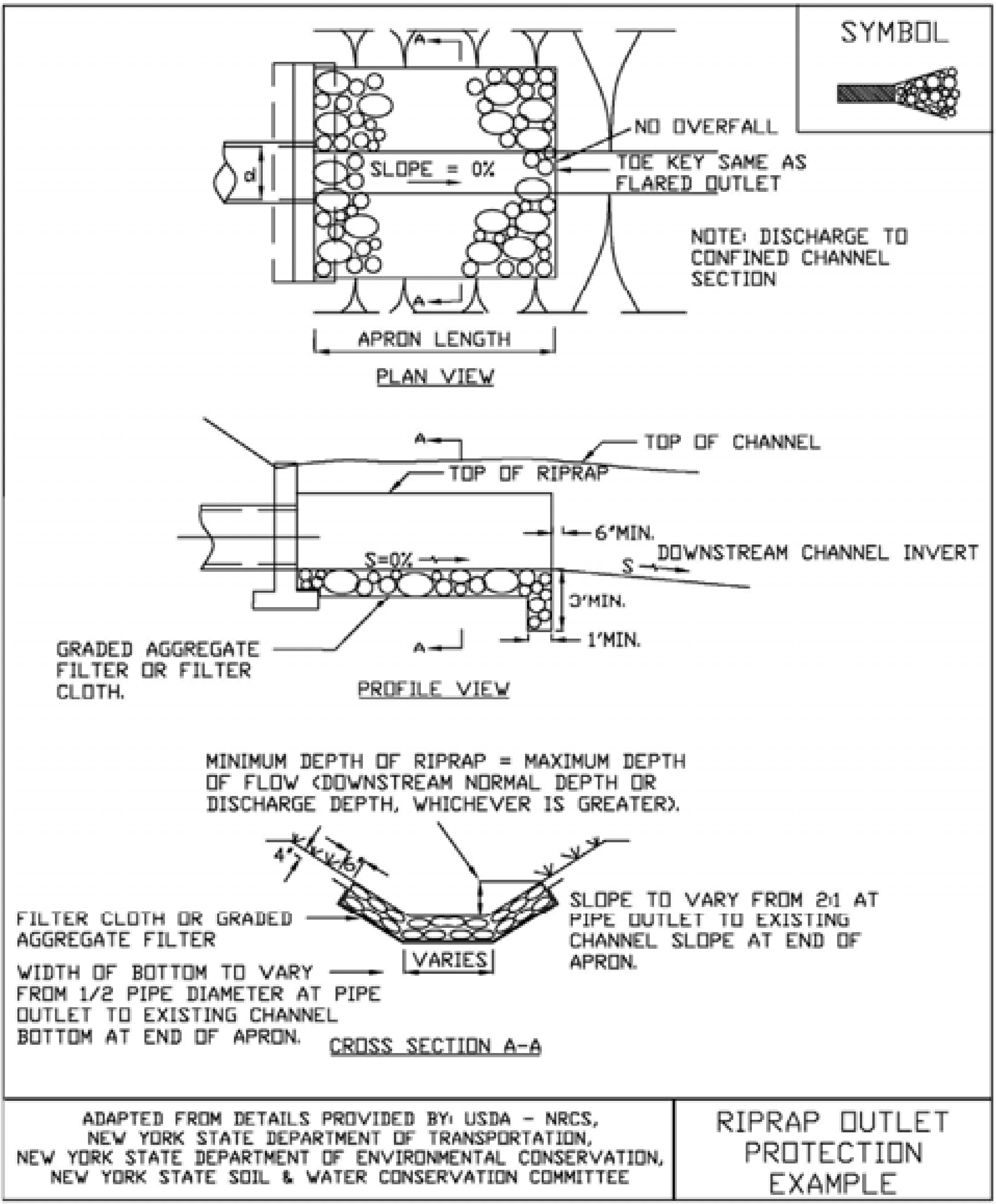
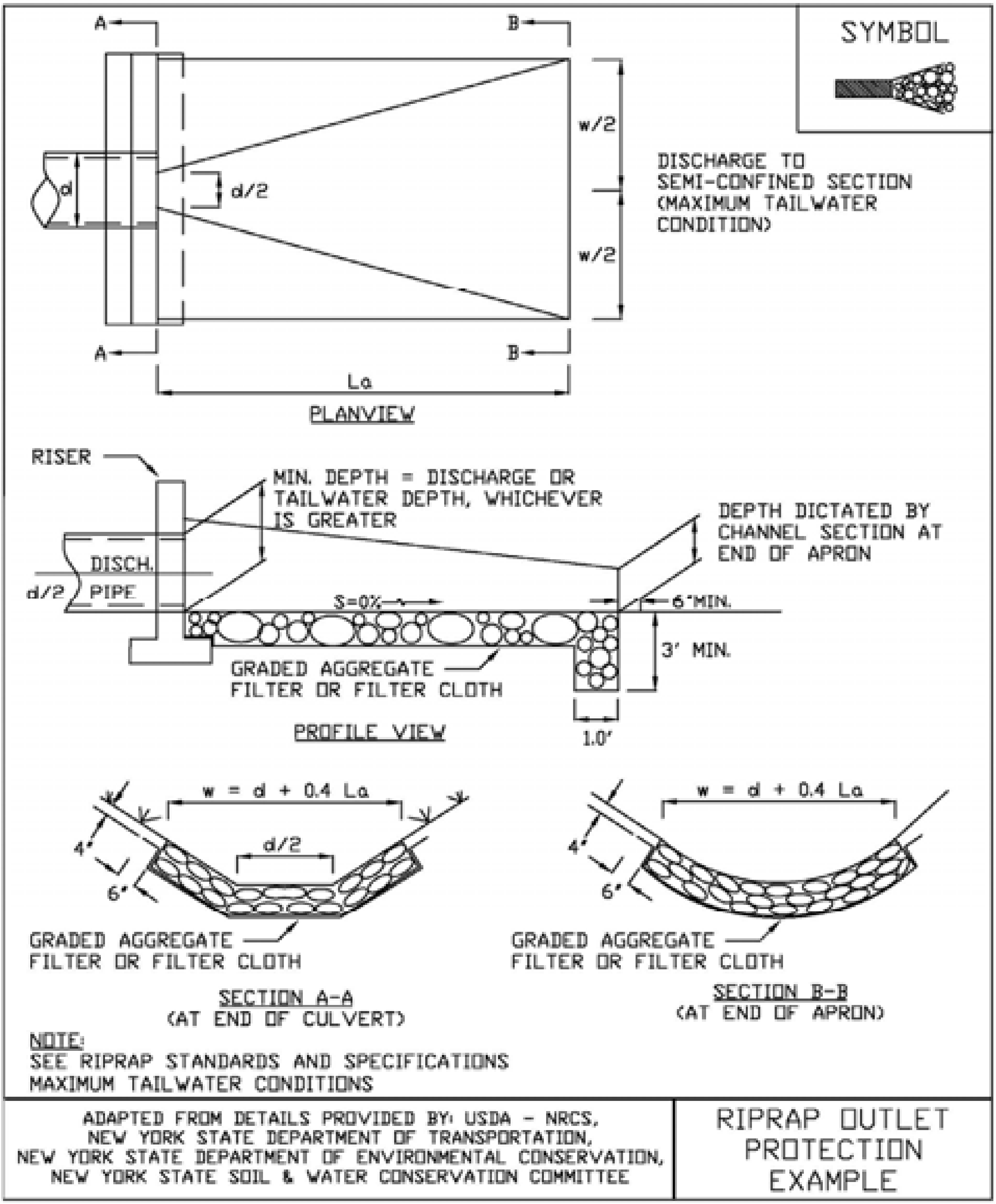


Figure 3.20
Riprap Outlet Protection Detail (3)



STANDARD AND SPECIFICATIONS FOR SITE POLLUTION PREVENTION

Definition & Scope

A collection of management practices intended to control non-sediment pollutants associated with construction activities to prevent the generation of pollutants due to improper handling, storage, and spills and prevent the movement of toxic substances from the site into surface waters.

Conditions Where Practice Applies

On all construction sites where the earth disturbance exceeds 5,000 square feet, and involves the use of fertilizers, pesticides, petroleum based chemicals, fuels and lubricants, as well as sealers, paints, cleared woody vegetation, garbage, and sanitary wastes.

Design Criteria

The variety of pollutants on a particular site and the severity of their impacts depend on factors such as the nature of the construction activity, the physical characteristics of the construction site, and the proximity of water bodies and conveyances to the pollutant source.

1. All state and federal regulations shall be followed for the storage, handling, application, usage, and disposal of pesticides, fertilizers, and petroleum products.

2. Vehicle and construction equipment staging and maintenance areas will be located away from all drainage ways with their parking areas graded so the runoff from these areas is collected, contained and treated prior to discharge from the site.

3. Provide sanitary facilities for on-site personnel.

4. Store, cover, and isolate construction materials including topsoil, and chemicals, to prevent runoff of pollutants and contamination of groundwater and surface waters.

5. Develop and implement a spill prevention and control plan. The plan should include NYSDEC's spill reporting and initial notification requirements.

6. Provide adequate disposal for solid waste including woody debris, stumps, and other construction waste and include these methods and directions in the construction details on the site construction drawings. Fill, woody debris, stumps and construction waste shall not be placed in regulated wetlands, streams or other surface waters.

7. Distribute or post informational material regarding proper handling, spill response, spill kit location, and emergency actions to be taken, to all construction personnel.

8. Refueling equipment shall be located at least 100 feet from all wetlands, streams and other surface waters.

STANDARD AND SPECIFICATIONS FOR STABILIZED CONSTRUCTION ACCESS

Definition & Scope

A stabilized pad of aggregate underlain with geotextile located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk, or parking area. The purpose of stabilized construction access is to reduce or eliminate the tracking of sediment onto public rights-of-way or streets.

Conditions Where Practice Applies

A stabilized construction access shall be used at all points of construction ingress and egress.

Design Criteria

See Figure 2.1 on page 2.31 for details.

Aggregate Size: Use a matrix of 1-4 inch stone, or reclaimed or recycled concrete equivalent.

Thickness: Not less than six (6) inches.

Width: 12-foot minimum but not less than the full width of points where ingress or egress occurs. 24-foot minimum if there is only one access to the site.

Length: As required, but not less than 50 feet (except on a single residence lot where a 30 foot minimum would apply).

Geotextile: To be placed over the entire area to be covered with aggregate. Filter cloth will not be required on a single-family residence lot. Piping of surface water under entrance shall be provided as required. If piping is impossible, a mountable berm with 5:1 slopes will be permitted.

Criteria for Geotextile: The geotextile shall be woven or nonwoven fabric consisting only of continuous chain polymeric filaments or yarns of polyester. The fabric shall be inert to commonly encountered chemicals, hydro-carbons, mildew, rot resistant, and conform to the fabric properties as shown:

Fabric Properties[3]	Light Duty[1] Roads Grade Subgrade	Heavy Duty[2] Haul Roads Rough Graded	Test Method
Grab Tensile Strength (lbs)	200	220	ASTM D1682
Elongation at Failure (%)	50	60	ASTM D1682
Mullen Burst Strength (lbs)	190	430	ASTM D3786
Puncture Strength (lbs)	40	125	ASTM D751 Modified
Equivalent	40-80	40-80	US Std Sieve
Opening Size			CW-02215
Aggregate Depth	6	10	-

[1]Light Duty Road: Area sites that have been graded to subgrade and where most travel would be single axle vehicles and an occasional multi-axle truck. Acceptable materials are Trevira Spunbond 1115, Mirafi 100X, Typar 3401, or equivalent.

[2]Heavy Duty Road: Area sites with only rough grading, and where most travel would be multi-axle vehicles. Acceptable materials are Trevira Spunbond 1135, Mirafi 600X, or equivalent.

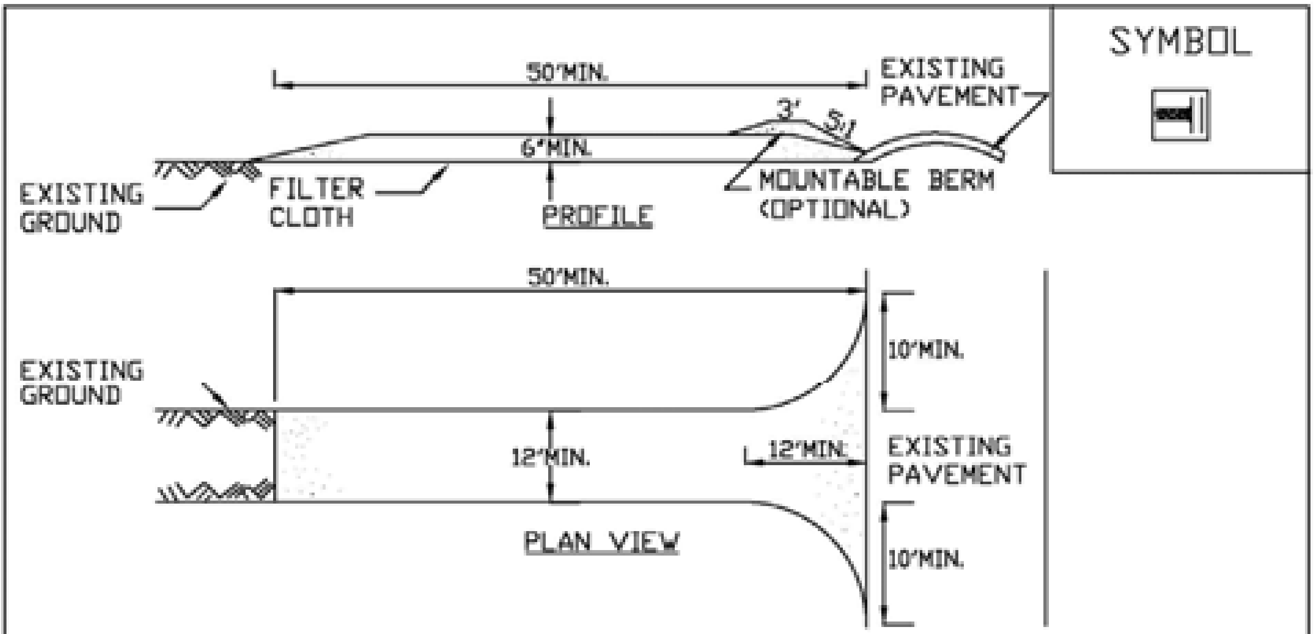
[3]Fabrics not meeting these specifications may be used only when design procedure and supporting documentation are supplied to determine aggregate depth and fabric strength.

Maintenance

The access shall be maintained in a condition which will prevent tracking of sediment onto public rights-of-way or streets. This may require periodic top dressing with additional aggregate. All sediment spilled, dropped, or washed onto public rights-of-way must be removed immediately.

When necessary, wheels must be cleaned to remove sediment prior to entrance onto public rights-of-way. When washing is required, it shall be done on an area stabilized with aggregate, which drains into an approved sediment-trapping device. All sediment shall be prevented from entering storm drains, ditches, or watercourses.

Figure 2.1
Stabilized Construction Access



CONSTRUCTION SPECIFICATIONS

1. STONE SIZE - USE 1-4 INCH STONE, OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.
2. LENGTH - NOT LESS THAN 50 FEET (EXCEPT ON A SINGLE RESIDENCE LOT WHERE A 30 FOOT MINIMUM LENGTH WOULD APPLY).
3. THICKNESS - NOT LESS THAN SIX (6) INCHES.
4. WIDTH - TWELVE (12) FOOT MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS OR EGRESS OCCURS. TWENTY-FOUR (24) FOOT IF SINGLE ENTRANCE TO SITE.
5. GEOTEXTILE - WILL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING OF STONE.
6. SURFACE WATER - ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ACCESS SHALL BE PIPED BENEATH THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM WITH 5:1 SLOPES WILL BE PERMITTED.
7. MAINTENANCE - THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.
8. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON A AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE.
9. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED AFTER EACH RAIN.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	STABILIZED CONSTRUCTION ACCESS

STANDARD AND SPECIFICATIONS FOR WINTER STABILIZATION

Definition & Scope

A temporary site specific, enhanced erosion and sediment control plan to manage runoff and sediment at the site during construction activities in the winter months to protect off-site water resources.

Conditions Where Practice Applies

This standard applies to all construction activities involved with ongoing land disturbance and exposure between November 15th to the following April 1st.

Design Criteria

1. Prepare a snow management plan with adequate storage for snow and control of melt water, requiring cleared snow to be stored in a manner not affecting ongoing construction activities.

2. Enlarge and stabilize access points to provide for snow management and stockpiling. Snow management activities must not destroy or degrade installed erosion and sediment control practices.

3. A minimum 25 foot buffer shall be maintained from all perimeter controls such as silt fence. Mark silt fence with tall stakes that are visible above the snow pack.

4. Edges of disturbed areas that drain to a waterbody within 100 feet will have 2 rows of silt fence, 5 feet apart, installed on the contour.

5. Drainage structures must be kept open and free of snow and ice dams. All debris, ice dams, or debris from plowing operations, that restrict the flow of runoff and meltwater, shall be removed.

6. Sediment barriers must be installed at all appropriate perimeter and sensitive locations. Silt fence and other practices requiring earth disturbance must be installed before the ground freezes.

7. Soil stockpiles must be protected by the use of established vegetation, anchored straw mulch, rolled stabilization matting, or other durable covering. A barrier must be installed at least 15 feet from the toe of the stockpile to prevent soil migration and to capture loose soil.

8. In areas where soil disturbance activity has temporarily or permanently ceased, the application of soil stabilization measures should be initiated by the end of the next business day and completed within three (3) days. Rolled erosion control blankets must be used on all slopes 3 horizontal to 1 vertical or steeper.

9. If straw mulch alone is used for temporary stabilization, it shall be applied at double the standard rate of 2 tons per acre, making the application rate 4 tons per acre. Other manufactured mulches should be applied at double the manufacturer's recommended rate.

10. To ensure adequate stabilization of disturbed soil in advance of a melt event, areas of disturbed soil should be stabilized at the end of each work day unless:

    a. work will resume within 24 hours in the same area and no precipitation is forecast or;

    b. the work is in disturbed areas that collect and retain runoff, such as open utility trenches, foundation excavations, or water management areas.

11. Use stone paths to stabilize access perimeters of buildings under construction and areas where construction vehicle traffic is anticipated. Stone paths should be a minimum 10 feet in width but wider as necessary to accommodate equipment.

Maintenance

The site shall be inspected frequently to ensure that the erosion and sediment control plan is performing its winter stabilization function. If the site will not have earth disturbing activities ongoing during the "winter season", **all** bare exposed soil must be stabilized by established vegetation, straw or other acceptable mulch, matting, rock, or other approved material such as rolled erosion control products. Seeding of areas with mulch cover is preferred but seeding alone is not acceptable for proper stabilization.

Compliance inspections must be performed and reports filed properly in accordance with the SWPPP for all sites under a winter shutdown.

STANDARD AND SPECIFICATIONS FOR BUFFER FILTER STRIP

Land Slope (%)	Minimum Filter Strip Width (ft.)
≤10	50
20	60
30	85
40	105
50	125
60	145
70	165

Definition & Scope

A **temporary/permanent** well vegetated grassed area below a disturbed area that can be used to remove sediment from runoff prior to it reaching surface waters or other designated areas of concern, such as parking lots and road pavement.

Condition Where Practice Applies

This practice is effective when the flow is in the form of sheet flow and the vegetative cover is established prior to disturbance. Surface water must be protected from sediment-laden runoff until buffer filter strip vegetation is established, and then the proposed disturbance can be undertaken. This practice is effective when the flow is in the form of sheet flow (maximum of 150 feet).

Design Criteria

1. The vegetation should be a well established perennial grass. Wooded and brushy areas are not acceptable for purposes of sediment removal.

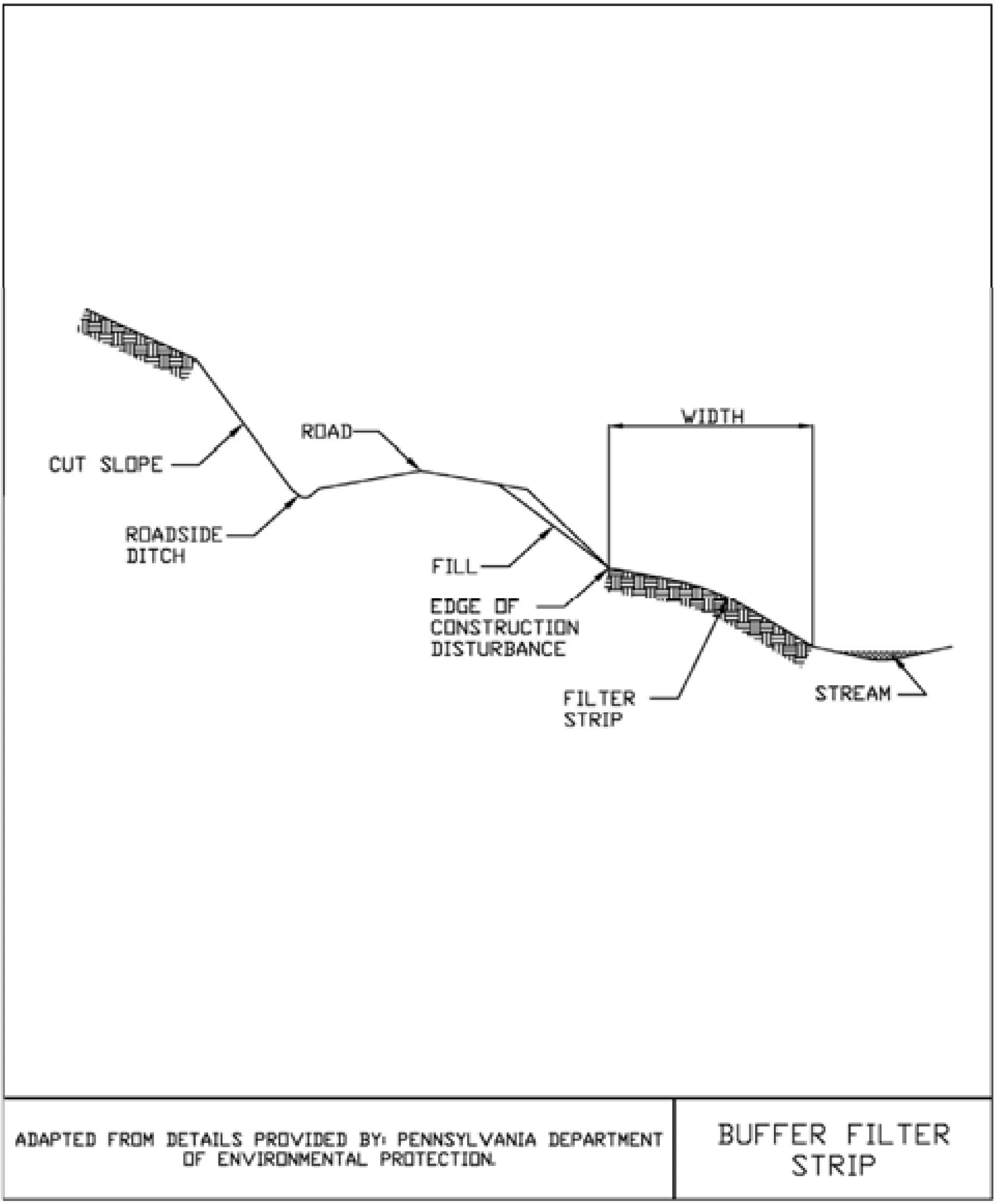
2. The minimum buffer filter strip width for stream protection shall be in accordance with the following table:

3. The minimum buffer filter strip width to protect paved areas during construction is 20 feet.

Maintenance

If at any time the width of the buffer filter strip has been reduced by sediment deposition to half its original width or concentrated flow has developed, suitable additional practices should be installed. The erosion and sediment control plan shall include these details.

Figure 5.1
Buffer Filter Strip



STANDARD AND SPECIFICATIONS FOR COMPOST FILTER SOCK

Definition & Scope

A **temporary** sediment control practice composed of a degradable geotextile mesh tube filled with compost filter media to filter sediment and other pollutants associated with construction activity to prevent their migration offsite.

Condition Where Practice Applies

Compost filter socks can be used in many construction site applications where erosion will occur in the form of sheet erosion and there is no concentration of water flowing to the sock. In areas with steep slopes and/or rocky terrain, soil conditions must be such that good continuous contact between the sock and the soil is maintained throughout its length. For use on impervious surfaces such as road pavement or parking areas, proper anchorage must be provided to prevent shifting of the sock or separation of the contact between the sock and the pavement. Compost filter socks are utilized both at the site perimeter as well as within the construction areas. These socks may be filled after placement by blowing compost into the tube pneumatically, or filled at a staging location and moved into its designed location.

Design Criteria

1. Compost filter socks will be placed on the contour with both terminal ends of the sock extended 8 feet upslope at a 45 degree angle to prevent bypass flow.

2. Diameters designed for use shall be 12” – 32” except that 8” diameter socks may be used for residential lots to control areas less than 0.25 acres.

3. The flat dimension of the sock shall be at least 1.5 times the nominal diameter.

4. The **Maximum Slope Length** (in feet) above a compost filter sock shall not exceed the following limits:

Dia. (in.)	Slope %						
	2	5	10	20	25	33	50
8	225*	200	100	50	20	—	—
12	250	225	125	65	50	40	25
18	275	250	150	70	55	45	30
24	350	275	200	130	100	60	35
32	450	325	275	150	120	75	50

* Length in feet

5. The compost infill shall be well decomposed (matured at least 3 months), weed-free, organic matter. It shall be aerobically composted, possess no objectionable odors, and contain less than 1%, by dry weight, of man-made foreign matter. The physical parameters of the compost shall meet the standards listed in Table 5.2 - Compost Standards Table. **Note: All biosolids compost produced in New York State (or approved for importation) must meet NYS DEC’s 6 NYCRR Part 360 (Solid Waste Management Facilities) requirements. The Part 360 requirements are equal to or more stringent than 40 CFR Part 503 which ensure safe standards for pathogen reduction and heavy metals content. When using compost filter socks adjacent to surface water, the compost should have a low nutrient value.**

6. The compost filter sock fabric material shall meet the

7. Compost filter socks shall be anchored in earth with 2” x 2” wooden stakes driven 12” into the soil on 10 foot centers on the centerline of the sock. On uneven terrain, effective ground contact can be enhanced by the placement of a fillet of filter media on the disturbed area side of the compost sock.

8. All specific construction details and material specifications shall appear on the erosion and sediment control constructions drawings when compost filter socks are included in the plan.

Maintenance

1. Traffic shall not be permitted to cross filter socks.

2. Accumulated sediment shall be removed when it reaches half the above ground height of the sock and disposed of in accordance with the plan.

3. Socks shall be inspected weekly and after each runoff event. Damaged socks shall be repaired in the manner required by the manufacturer or replaced within 24 hours of inspection notification.

4. Biodegradable filter socks shall be replaced after 6 months; photodegradable filter socks after 1 year. Polypropylene socks shall be replaced according to the manufacturer’s recommendations.

5. Upon stabilization of the area contributory to the sock, stakes shall be removed. The sock may be left in place and vegetated or removed in accordance with the stabilization plan. For removal the mesh can be cut and the compost spread as an additional mulch to act as a soil supplement.

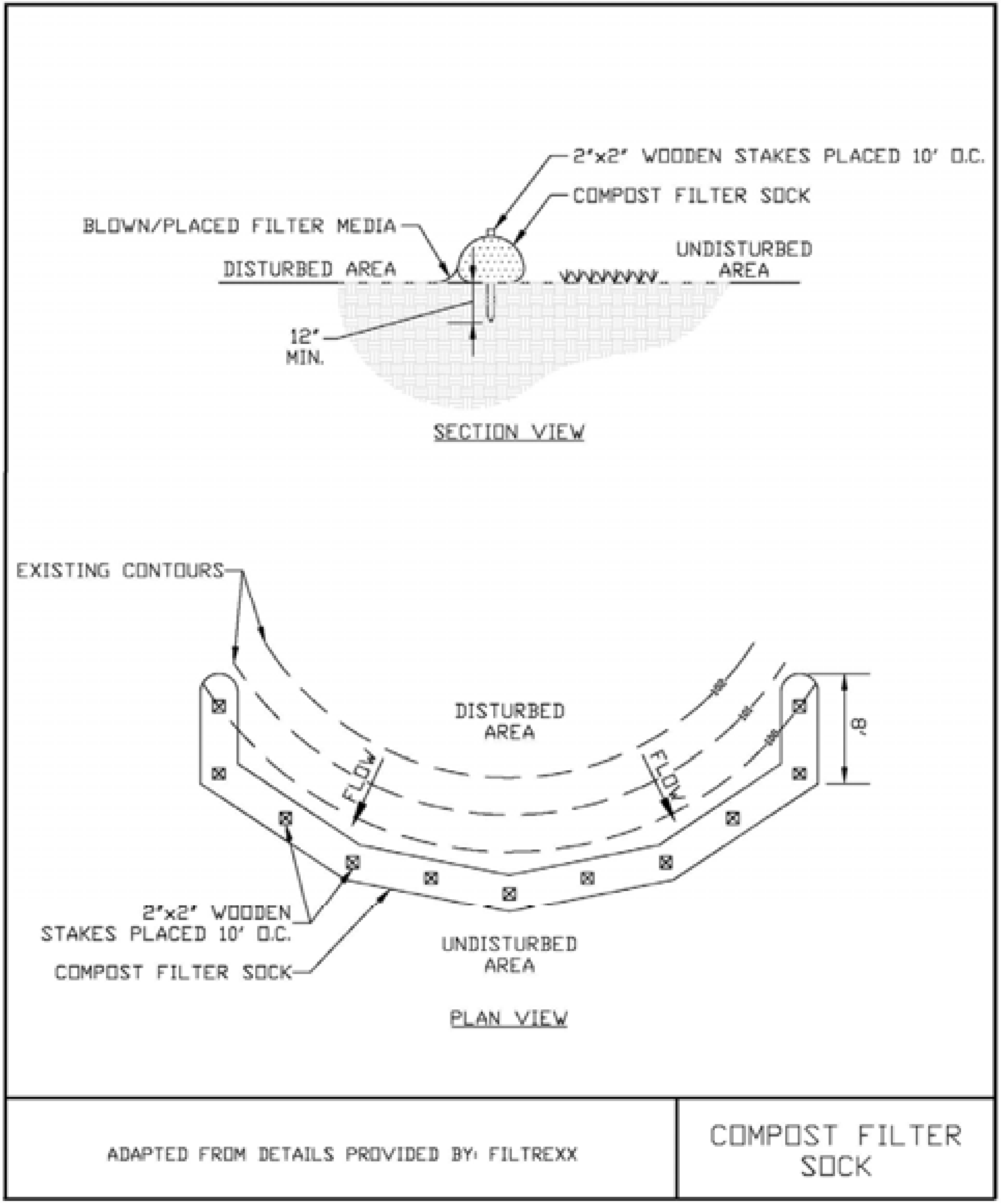
Table 5.1 - Compost Sock Fabric Minimum Specifications Table

Material Type	3 mil HDPE	5 mil HDPE	5 mil HDPE	Multi-Filament Polypropylene (MFPP)	Heavy Duty Multi-Filament Polypropylene (HDMFPP)
Material Characteristics	Photodegradable	Photodegradable	Biodegradable	Photodegradable	Photodegradable
Sock Diameters	12” 18”	12” 18” 24” 32”	12” 18” 24” 32”	12” 18” 24” 32”	12” 18” 24” 32”
Mesh Opening	3/8”	3/8”	3/8”	3/8”	1/8”
Tensile Strength		26 psi	26 psi	44 psi	202 psi
Ultraviolet Stability % Original Strength (ASTM G-155)	23% at 1000 hr.	23% at 1000 hr.		100% at 1000 hr.	100% at 1000 hr.
Minimum Functional Longevity	6 months	9 months	6 months	1 year	2 years

Table 5.2 - Compost Standards Table

Organic matter content	25% - 100% (dry weight)
Organic portion	Fibrous and elongated
pH	6.0 – 8.0
Moisture content	30% - 60%
Particle size	100% passing a 1” screen and 10 - 50% passing a 3/8” screen
Soluble salt concentration	5.0 dS/m (mmhos/cm) maximum

Figure 5.2
Compost Filter Sock



STANDARD AND SPECIFICATIONS FOR GEOTEXTILE FILTER BAG

Definition & Scope

A **temporary** portable device through which sediment laden water is pumped to trap and retain sediment prior to its discharge to drainageways or off-site.

Condition Where Practice Applies

On sites where space is limited such as urban construction or linear projects (e.g. roads and utility work) where rights-of-way are limited and larger de-silting practices are impractical.

Design Criteria

1. Location - The portable filter bag should be located to minimize interference with construction activities and pedestrian traffic. It should also be placed in a location that is vegetated, relatively level, and provides for ease of access by heavy equipment, cleanout, disposal of trapped sediment, and proper release of filtered water.

   The filter bag shall also be placed at least 50 feet from all wetlands, streams or other surface waters.

2. Size - Geotextile filter bag shall be sized in accordance with the manufacturers recommendations based on the pump discharge rate.

Materials and Installation

1. The geotextile material will have the following attributes:

Minimum Grab Tensile Strength	200 lbs.
Minimum Grab Tensile Elongation	50 %
Minimum Trapezoid Tear Strength	80 lbs.
Mullen Burst Strength	380 psi
Minimum Puncture Strength	130 lbs
Apparent Opening Size	40 - 80 US sieve
Minimum UV Resistance	70%
Minimum Flow Thru Rate	70 gpm/sq ft

2. The bag shall be sewn with a double needle machine using high strength thread, double stitched “Joe” type capable of minimum roll strength of 100 lbs/inch (ASTM D4884).

3. The geotextile filter bag shall have an opening large enough to accommodate a 4 inch diameter discharge hose with an attached strap to tie off the bag to the hose to prevent back flow.

4. The geotextile shall be placed on a gravel bed 2 inches thick, a straw mat 4 inches thick, or a vegetated filter strip to allow water to flow out of the bag in all directions.

Maintenance

1. The geotextile filter bag is considered full when remaining bag flow area has been reduced by 75%. At this point, it should be replaced with a new bag.

2. Disposal may be accomplished by removing the bag to an appropriate designated upland area, cut open, remove the geotextile for disposal, and spread sediment contents and seeded and mulched according to the vegetative plan.

STANDARD AND SPECIFICATIONS FOR MULCHING

Definition and Scope

Applying coarse plant residue or chips, or other suitable materials, to cover the soil surface to provide initial erosion control while a seeding or shrub planting is establishing. Mulch will conserve moisture and modify the surface soil temperature and reduce fluctuation of both. Mulch will prevent soil surface crusting and aid in weed control. Mulch can also be used alone for temporary stabilization in non-growing months. Use of stone as a mulch could be more permanent and should not be limited to non-growing months.

Conditions Where Practice Applies

On soils subject to erosion and on new seedings and shrub plantings. Mulch is useful on soils with low infiltration rates by retarding runoff.

Criteria

Site preparation prior to mulching requires the installation of necessary erosion control or water management practices and drainage systems.

Slope, grade and smooth the site to fit needs of selected mulch products.

Remove all undesirable stones and other debris to meet the needs of the anticipated land use and maintenance required.

Apply mulch after soil amendments and planting is accomplished or simultaneously if hydroseeding is used.

Select appropriate mulch material and application rate or material needs. Hay mulch shall not be used in wetlands or in areas of permanent seeding. Clean straw mulch is preferred alternative in wetland application. Determine local availability.

Select appropriate mulch anchoring material.

NOTE: The best combination for grass/legume establishment is straw (cereal grain) mulch applied at 2 ton/acre (90 lbs./1000sq.ft.) and anchored with wood fiber mulch (hydromulch) at 500 – 750 lbs./acre (11 – 17 lbs./1000 sq. ft.). The wood fiber mulch must be applied through a hydroseeder immediately after mulching.

Table 4.2
Guide to Mulch Materials, Rates, and Uses

Mulch Material	Quality Standards	per 1000 Sq. Ft.	per Acre	Depth of Application	Remarks
Wood chips or shavings	Air-dried. Free of objectionable coarse material	500-900 lbs.	10-20 tons	2-7"	Used primarily around shrub and tree plantings and recreation trails to inhibit weed competition. Resistant to wind blowing. Decomposes slowly.
Wood fiber cellulose (partly digested wood fibers)	Made from natural wood usually with green dye and dispersing agent	50 lbs.	2,000 lbs.	—	Apply with hydromulcher. No tie down required. Less erosion control provided than 2 tons of hay or straw.
Gravel, Crushed Stone or Slag	Washed; Size 2B or 3A—1 1/2"	9 cu. yds.	405 cu. yds.	3"	Excellent mulch for short slopes and around plants and ornamentals. Use 2B where subject to traffic. (Approximately 2,000 lbs./cu. yd.). Frequently used over filter fabric for better weed control.
Hay or Straw	Air-dried; free of undesirable seeds & coarse materials	90-100 lbs. 2-3 bales	2 tons (100-120 bales)	cover about 90% surface	Use small grain straw where mulch is maintained for more than three months. Subject to wind blowing unless anchored. Most commonly used mulching material. Provides the best micro-environment for germinating seeds.
Jute twisted yarn	Undyed, unbleached plain weave. Warp 78 ends/yd., Weft 41 ends/yd. 60-90 lbs./roll	48" x 50 yds. or 48" x 75 yds.	—	—	Use without additional mulch. Tie down as per manufacturers specifications. Good for center line of concentrated water flow.
Excelsior wood fiber mats	Interlocking web of excelsior fibers with photodegradable plastic netting	4' x 112.5' or 8' x 112.5'.	—	—	Use without additional mulch. Excellent for seeding establishment. Anchor as per manufacturers specifications. Approximately 72 lbs./roll for excelsior with plastic on both sides. Use two sided plastic for centerline of waterways.
Straw or coconut fiber, or combination	Photodegradable plastic net on one or two sides	Most are 6.5 ft. x 3.5 ft.	81 rolls	—	Designed to tolerate higher velocity water flow, centerlines of waterways, 60 sq. yds. per roll.

Table 4.3
Mulch Anchoring Guide

Anchoring Method or Material	Kind of Mulch to be Anchored	How to Apply
1. Peg and Twine	Hay or straw	After mulching, divide areas into blocks approximately 1 sq. yd. in size. Drive 4-6 pegs per block to within 2” to 3” of soil surface. Secure mulch to surface by stretching twine between pegs in criss-cross pattern on each block. Secure twine around each peg with 2 or more tight turns. Drive pegs flush with soil. Driving stakes into ground tightens the twine.
2. Mulch netting	Hay or straw	Staple the light-weight paper, jute, wood fiber, or plastic nettings to soil surface according to manufacturer’s recommendations. Should be biodegradable. Most products are not suitable for foot traffic.
3. Wood cellulose fiber	Hay or straw	Apply with hydroseeder immediately after mulching. Use 500 lbs. wood fiber per acre. Some products contain an adhesive material (“tackifier”), possibly advantageous.
4. Mulch anchoring tool	Hay or straw	Apply mulch and pull a mulch anchoring tool (blunt, straight discs) over mulch as near to the contour as possible. Mulch material should be “tucked” into soil surface about 3”.
5. Tackifier	Hay or straw	Mix and apply polymeric and gum tackifiers according to manufacturer’s instructions. Avoid application during rain. A 24-hour curing period and a soil temperature higher than 45^0 Fahrenheit are required.

STANDARD AND SPECIFICATIONS FOR SEDIMENT TRAP

Definition & Scope

A **temporary** sediment control device formed by excavation and/or embankment to intercept sediment-laden runoff and trap the sediment in order to protect drainageways, properties, and rights-of-way below the sediment trap from sedimentation.

Conditions Where Practice Applies

A sediment trap is usually installed in a drainageway, at a storm drain inlet, or other points of collection from a disturbed area for one construction season.

Sediment traps should be used to artificially break up the natural drainage area into smaller sections where a larger device (sediment basin) would be less effective.

Design Criteria

If the drainage area to the proposed trap location exceeds 5 acres, or the trap is in place beyond one construction season, or any of the additional design criteria presented here cannot be met, a full Sediment Basin must be used. See Standard and Specification for Sediment Basin on page 5.19.

Drainage Area

The maximum drainage area for all sediment traps shall be 5 acres.

Location

Sediment traps shall be located so that they can be installed prior to grading or filling in the drainage area they are to protect. Traps must **not be located any closer than 20 feet** from a proposed building foundation if the trap is to function during building construction. Locate traps to obtain maximum storage benefit from the terrain and for ease of cleanout and disposal of the trapped sediment.

Trap Size

The volume of a sediment trap as measured at the elevation of the crest of the outlet shall be at least 3,600 cubic feet per acre of drainage area. A minimum length to width ratio of 2:1 should be provided. The volume of a constructed trap shall be calculated using standard mathematical procedures. The volume of a natural sediment trap may be approximated by the equation: Volume (cu.ft.) = 0.4 x surface area (sq.ft.) x maximum depth (ft.).

Trap Cleanout

Sediment shall be removed and the trap restored to the original dimensions when the sediment has accumulated to ½ of the design depth of traps I-II, and 1/3 the depth for trap III. Sediment removed from the trap shall be deposited in a protected area and in such a manner that it will not erode.

Embankment

All earth embankments for sediment traps shall not exceed five (5) feet in height as measured at the low point of the original ground along the centerline of the embankment. Embankments shall have a minimum four (4) foot wide top and side slopes of 2:1 or flatter. The embankment shall be compacted by traversing with equipment while it is being constructed. The embankment shall be stabilized with seed and mulch as soon as it is completed

The elevation of the top of any dike directing water to any sediment trap will equal or exceed the maximum height of the outlet structure along the entire length of the trap.

Excavation

All excavation operations shall be carried out in such a manner that erosion and water pollution shall be minimal. Excavated portions of sediment traps shall have 1:1 or flatter slopes.

Outlet

The outlet shall be designed, constructed, and maintained in such a manner that sediment does not leave the trap and that erosion at or below the outlet does not occur.

Sediment traps must outlet onto stabilized (preferable undisturbed) ground, into a watercourse, stabilized channel, or into a storm drain system. Distance between inlet and outlet should be maximized to the longest length practicable.

All traps must be seeded and mulched immediately after construction.

Trap Details Needed on Erosion and Sediment Control Plans

Each trap shall be delineated on the plans in such a manner that it will not be confused with any other features. Each trap on a plan shall indicate all the information necessary to properly construct and maintain the structure. If the drawings are such that this information cannot be delineated on the drawings, then a table shall be developed. If a table is developed, then each trap on a plan shall have a number and the numbers shall be consecutive.

The following information shall be shown for each trap in a summary table format on the plans.

1. Trap number
2. Type of trap
3. Drainage area
4. Storage required
5. Storage provided (if applicable)
6. Outlet length or pipe sizes
7. Storage depth below outlet or cleanout elevation
8. Embankment height and elevation (if applicable)

Type of Sediment Traps

There are three (3) specific types of sediment traps which vary according to their function, location, or drainage area.

I. Pipe Outlet Sediment Trap
II. Stone Outlet Sediment Trap
III. Compost Filter Sock Sediment Trap

I. Pipe Outlet Sediment Trap

A Pipe Outlet Sediment Trap consists of a trap formed by embankment or excavation. The outlet for the trap is through a perforated riser and a pipe through the embankment. The outlet pipe and riser shall be made of steel, corrugated metal or other suitable material. The top of the embankment shall be at least 1 ½ feet above the crest of the riser. The preferred method of dewatering the sediment trap is by surface skimmer. See Dewatering Device Standard, page 5.10. If the riser alone is used for dewatering, the top 2/3 of the riser shall be perforated with one (1) inch nominal diameter holes or slits spaced six (6) inches vertically and horizontally placed in the concave portion of the corrugated pipe.

No holes or slits will be allowed within six (6) inches of the top of the horizontal barrel. All pipe connections shall be watertight. The riser shall be wrapped with ½ to ¼ inch hardware cloth wire then wrapped with filter cloth with a sieve size between #40-80 and secured with strapping or connecting band at the top and bottom of the cloth. The cloth shall cover an area at least six (6) inches above the highest hole and six (6) inches below the lowest hole. The top of the riser pipe shall not be covered with filter cloth. The riser shall have a base with sufficient weight to prevent flotation of the riser. Two approved bases are:

1. A concrete base 12 in. thick with the riser embedded 9 in. into the concrete base, or

2. One quarter inch, minimum, thick steel plate attached to the riser by a continuous weld around the circumference of the riser to form a watertight connection. The plate shall have 2.5 feet of stone, gravel, or earth placed on it to prevent flotation. In either case, each side of the square base measurement shall be the riser diameter plus 24 inches.

Pipe outlet sediment traps shall be limited to a five (5) acre maximum drainage area. Pipe outlet sediment trap is interchangeable in the field with stone outlet provided that these sediment traps are constructed in accordance with the detail and specifications for that trap.

Select pipe diameter from the following table:
See details for Pipe Outlet Sediment Trap ST-I in Figure 5.25 and 5.26 on pages 5.49 and 5.50.

Optional sediment trap dewatering devices are shown on Figure 5.29 on Page 5.53.

Minimum Sizes

Barrel Diameter[1] (in.)	Riser Diameter[1] (in.)	Maximum Drainage Area (ac.)
12	15	1
15	18	2
18	21	3
21	24	4
21	27	5

[1] Barrel diameter may be same size as riser diameter

II. Stone Outlet Sediment Trap

A Stone Outlet Sediment Trap consists of a trap formed by an embankment or excavation. The outlet of this trap is over a stone section placed on level ground. The minimum length (feet) of the outlet shall be equal to four (4) times the drainage area (acres).

Required storage shall be 3,600 cubic feet per acre of drainage area.

The outlet crest (top of stone in weir section) shall be level, at least one (1) foot below top of embankment and no more than one (1) foot above ground beneath the outlet. Stone used in the outlet shall be small riprap (4 in. x 8 in.). To provide more efficient trapping effect, a layer of filter cloth should be embedded one (1) foot back into the upstream face of the outlet stone or a one (1) foot thick layer of two (2) inch or finer aggregate shall be placed on the upstream face of the outlet.

Stone Outlet Sediment Traps may be interchangeable in the field with pipe outlet sediment traps provided they are constructed in accordance with the detail and specifications for those traps. Stone outlet sediment traps shall be limited to a five (5) acre maximum drainage area.

See details for Stone Outlet Sediment Trap ST-II in Figure 5.27 on page 5.51

III. Compost Sock Sediment Trap

A compost sock sediment trap consists of a trap formed by creating an enclosure of geotextile mesh tubes filled with a compost filter media. These traps are used in locations where there is no opportunity to direct runoff into larger traps or well vegetated areas. This could occur at site entrances and access points or in tight areas due to construction boundary limits.

Surface runoff can be directed to the trap with standard conveyance practices. Groundwater or surface ponding in low areas can be pumped into the compost sock sediment trap with appropriate energy dissipation at the pump outlet to prevent scour.
Design criteria for Compost Sock Sediment Trap

1. The maximum drainage area tributary to the trap shall be 5 acres.

2. The minimum settled height above ground shall be 2.0 feet formed by staking 3 compost filter socks in a pyramid as shown in Figure 5.28 on page 5.52.

3. The storage volume provided in the compost sock sediment trap shall be 3,600 cubic feet per tributary drainage acre.

4. If necessary, additional storage area can be created by excavating a sump 1 foot deep beginning at least 5 feet away from the inside sock.

5. All compost filter sock materials, mesh, and compost, will meet the material specifications listed in the Compost Filter Sock standard. No spillway is required.

6. Compost filter sock sediment traps shall be inspected weekly and after every rainfall event. Sediment shall be removed when it reaches one third, 1/3, the height of the trap.

7. The maximum limit of use for a compost sock sediment trap is one (1) year. The existing trap shall be replaced if there is a need for a trap beyond that time limit.

8. Upon completion of the work, the compost sock sediment trap shall be removed. The compost within the socks may be used during cleanup as a vegetative growth medium in accordance with the site stabilization plan.

Figure 5.25
Pipe Outlet Sediment Trap: ST-I

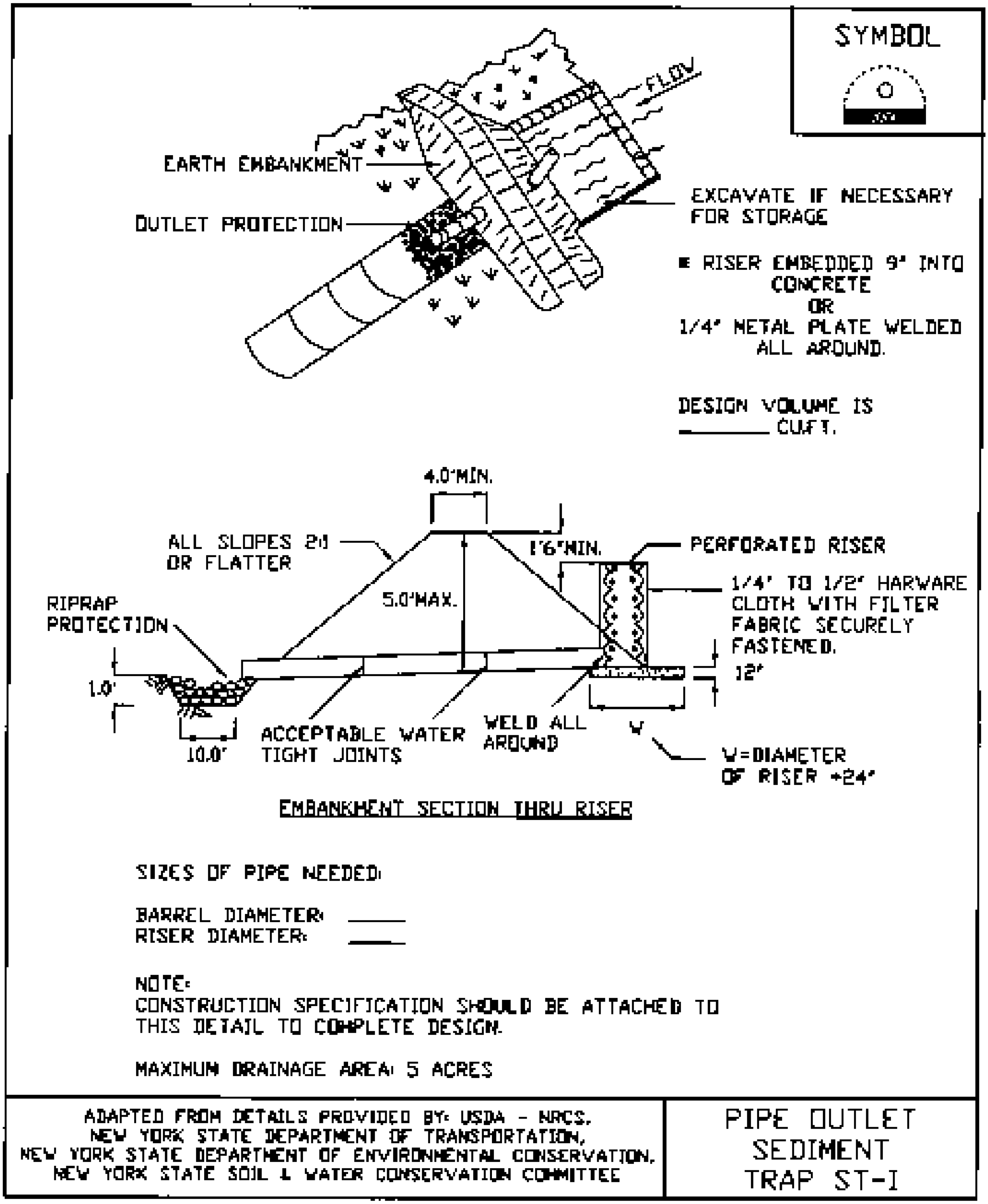
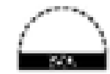


Figure 5.26
Pipe Outlet Sediment Trap: ST-I - Construction Specifications

SYMBOL



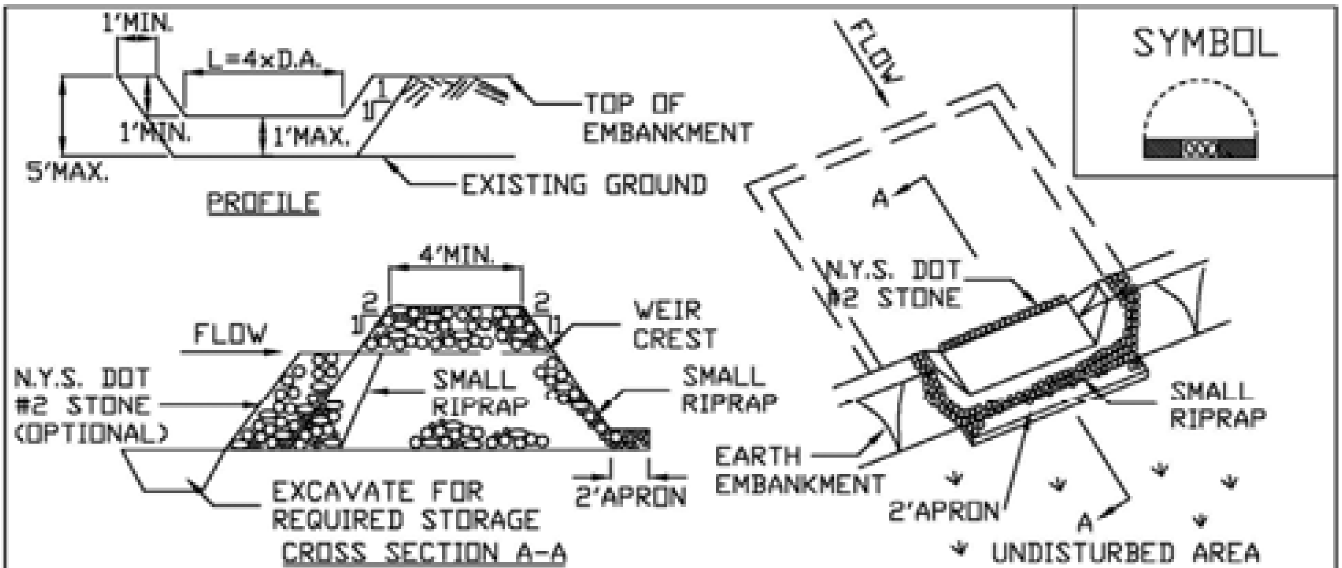
CONSTRUCTION SPECIFICATIONS

1. AREA UNDER EMBANKMENT SHALL BE CLEARED, GRUBBED AND STRIPPED OF ANY VEGETATION AND ROOT MAT. THE POOL AREA SHALL BE CLEARED.
2. THE FILL MATERIAL FOR THE EMBANKMENT SHALL BE FREE OF ROOTS OR OTHER WOODY VEGETATION AS WELL AS OVER-SIZED STONES, ROCKS, ORGANIC MATERIAL, OR OTHER OBJECTIONABLE MATERIAL. THE EMBANKMENT SHALL BE COMPACTED BY TRAVERSING WITH EQUIPMENT WHILE IT IS BEING CONSTRUCTED.
3. VOLUME OF SEDIMENT STORAGE SHALL BE 3600 CUBIC FEET PER ACRE OF CONTRIBUTORY DRAINAGE.
4. SEDIMENT SHALL BE REMOVED AND TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO 1/2 THE DESIGN DEPTH OF THE TRAP. REMOVED SEDIMENT SHALL BE DEPOSITED IN A SUITABLE AREA AND STABILIZED.
5. THE STRUCTURE SHALL BE INSPECTED AFTER EACH RAIN AND REPAIRS MADE AS NEEDED.
6. CONSTRUCTION OPERATIONS SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND SEDIMENT ARE CONTROLLED.
7. THE STRUCTURE SHALL BE REMOVED AND AREA STABILIZED WHEN THE DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.
8. ALL FILL SLOPES SHALL BE 2:1 OR FLATTER; CUT SLOPES 1:1 OR FLATTER.
9. ALL PIPE CONNECTIONS SHALL BE WATERTIGHT.
10. THE TOP 2/3 OF THE RISER SHALL BE PERFORATED WITH ONE (1) INCH DIAMETER HOLES OR SLITS SPACED SIX (6) INCHES VERTICALLY AND HORIZONTALLY AND PLACED IN THE CONCAVE PORTION OF PIPE. NO HOLES WILL BE ALLOWED WITHIN SIX (6) INCHES OF THE HORIZONTAL BARREL.
11. THE RISER SHALL BE WRAPPED WITH 1/4 TO 1/2 INCH HARDWARE CLOTH WIRE THEN WRAPPED WITH FILTER CLOTH (HAVING AN EQUIVALENT SIEVE SIZE OF 40-80). THE FILTER CLOTH SHALL EXTEND SIX (6) INCHES ABOVE THE HIGHEST HOLE AND SIX (6) INCHES BELOW THE LOWEST HOLE. WHERE ENDS OF THE FILTER CLOTH COME TOGETHER, THEY SHALL BE OVER-LAPPED, FOLDED AND STAPLED TO PREVENT BYPASS.
12. STRAPS OR CONNECTING BANDS SHALL BE USED TO HOLD THE FILTER CLOTH AND WIRE FABRIC IN PLACE. THEY SHALL BE PLACED AT THE TOP AND BOTTOM OF THE CLOTH.
13. FILL MATERIAL AROUND THE PIPE SPILLWAY SHALL BE HAND COMPACTED IN FOUR (4) INCH LAYERS. A MINIMUM OF TWO (2) FEET OF HAND COMPACTED BACKFILL SHALL BE PLACED OVER THE PIPE SPILLWAY BEFORE CROSSING IT WITH CONSTRUCTION EQUIPMENT.
14. THE RISER SHALL BE ANCHORED WITH EITHER A CONCRETE BASE OR STEEL PLATE BASE TO PREVENT FLOTATION. FOR CONCRETE BASE THE DEPTH SHALL BE TWELVE (12) INCHES WITH THE RISER EMBEDDED NINE (9) INCHES. A 1/4 INCH MINIMUM THICKNESS STEEL PLATE SHALL BE ATTACHED TO THE RISER BY A CONTINUOUS WELD AROUND THE BOTTOM TO FORM A WATERTIGHT CONNECTION AND THEN PLACE TWO (2) FEET OF STONE, GRAVEL, OR TAMPED EARTH ON THE PLATE.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS,
NEW YORK STATE DEPARTMENT OF TRANSPORTATION,
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION,
NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE

PIPE OUTLET
SEDIMENT TRAP
ST-I

Figure 5.27
Stone Outlet Sediment Trap: ST-II



OPTION: A ONE FOOT LAYER OF N.Y.S. DOT #2 STONE MAY BE PLACED ON THE UPSTREAM SIDE OF THE RIPRAP INPLACE OF THE EMBEDDED FILTER CLOTH.

CONSTRUCTION SPECIFICATIONS

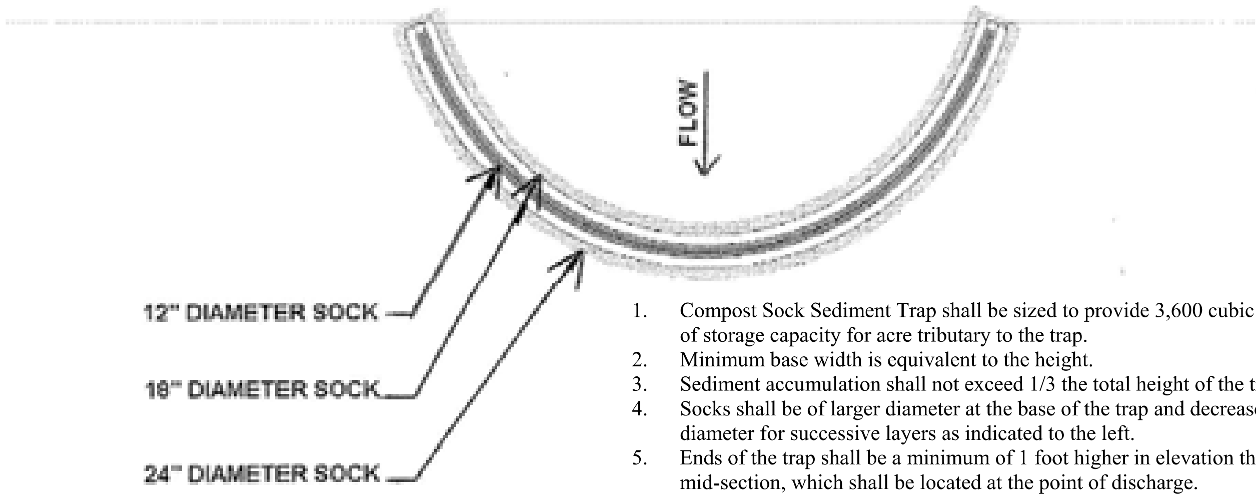
1. AREA UNDER EMBANKMENT SHALL BE CLEARED, GRUBBED AND STRIPPED OF ANY VEGETATION AND ROOT MAT. THE POOL AREA SHALL BE CLEARED.
2. THE FILL MATERIAL FOR THE EMBANKMENT SHALL BE FREE OF ROOTS AND OTHER WOODY VEGETATION AS WELL AS OVER-SIZED STONES, ROCKS, ORGANIC MATERIAL OR OTHER OBJECTIONABLE MATERIAL. THE EMBANKMENT SHALL BE COMPACTED BY TRAVERSING WITH EQUIPMENT WHILE IT IS BEING CONSTRUCTED.
3. ALL CUT AND FILL SLOPES SHALL BE 2:1 OR FLATTER.
4. THE STONE USED IN THE OUTLET SHALL BE SMALL RIPRAP 4"-8" ALONG WITH A 1' THICKNESS OF 2" AGGREGATE PLACED ON THE UP-GRADE SIDE ON THE SMALL RIPRAP OR EMBEDDED FILTER CLOTH IN THE RIPRAP.
5. SEDIMENT SHALL BE REMOVED AND TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO 1/2 THE DESIGN DEPTH OF THE TRAP. IT SHALL BE PLACED ON SITE AND STABILIZED.
6. THE STRUCTURE SHALL BE INSPECTED AFTER EACH RAIN AND REPAIRS MADE AS NEEDED.
7. CONSTRUCTION OPERATIONS SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND SEDIMENT ARE CONTROLLED.
8. THE STRUCTURE SHALL BE REMOVED AND THE AREA STABILIZED WHEN THE DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.

MAXIMUM DRAINAGE AREA 5 ACRES

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	STONE OUTLET SEDIMENT TRAP ST-II

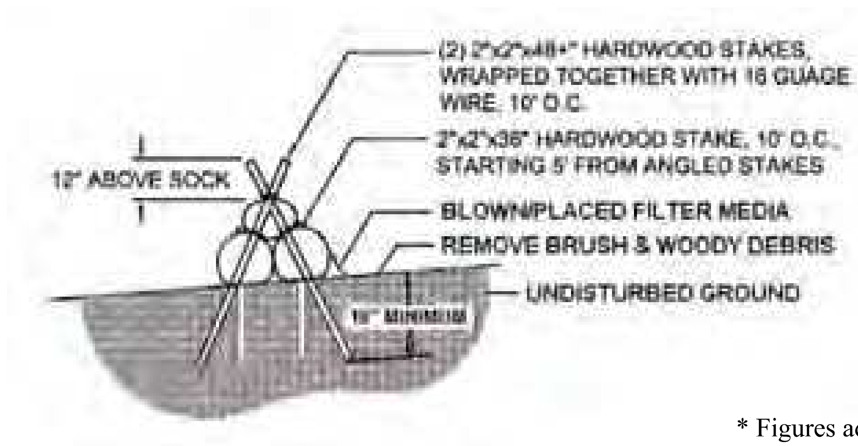
Figure 5.28
Compost Filter Sock Sediment Trap: ST-III

Plan View



1. Compost Sock Sediment Trap shall be sized to provide 3,600 cubic feet of storage capacity for acre tributary to the trap.
2. Minimum base width is equivalent to the height.
3. Sediment accumulation shall not exceed 1/3 the total height of the trap.
4. Socks shall be of larger diameter at the base of the trap and decrease in diameter for successive layers as indicated to the left.
5. Ends of the trap shall be a minimum of 1 foot higher in elevation that the mid-section, which shall be located at the point of discharge.

Staking Detail



* Figures adapted from Filtrexx

Specifications:

1. Sock infill and filter media material shall meet the standards of Table 5.1 on page 5.8 . Compost shall meet the compost filter sock standard of Table 5.2 on page 5.8.

2. Compost sock sediment traps shall not exceed three socks in height and shall be stacked in pyramidal form as shown above. Minimum trap height is one 24 inch diameter sock. Additional storage may be provided by means of an excavated sump 12 inches deep extending 1 to 3 feet upslope of the socks along the lower side of the trap.

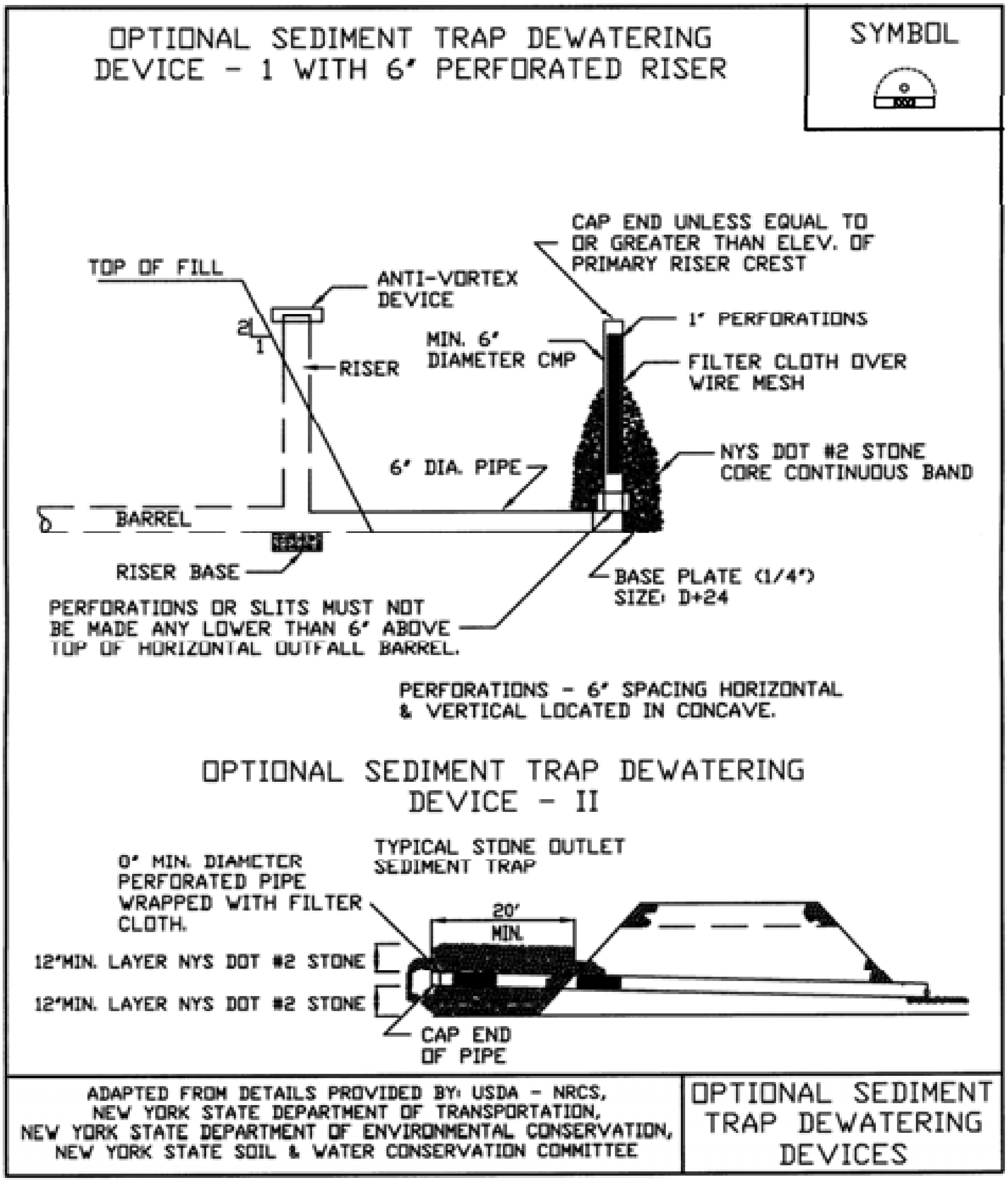
3. Compost sock sediment traps shall provide 3,600 cubic feet storage capacity with 12 inches of freeboard for each tributary drainage acreage. (See manufacturer for anticipated settlement.)

4. The maximum tributary drainage area is 5.0 acres. Since compost socks are "flow-through," no spillway is required.

5. Compost sock sediment traps shall be inspected weekly and after each runoff event. Sediment shall be removed when it reaches 1/3 the height of the socks.

6. Photodegradable and biodegradable socks shall not be used for more than 1 year.

Figure 5.29
Optional Sediment Trap Dewatering Devices
for Traps with <5 Acres Drainage Area



STANDARD AND SPECIFICATIONS FOR SILT FENCE

Definition & Scope

A **temporary** barrier of geotextile fabric installed on the contours across a slope used to intercept sediment laden runoff from small drainage areas of disturbed soil by temporarily ponding the sediment laden runoff allowing settling to occur. The maximum period of use is limited by the ultraviolet stability of the fabric (approximately one year).

Conditions Where Practice Applies

A silt fence may be used subject to the following conditions:

1. Maximum allowable slope length and fence length will not exceed the limits shown in the Design Criteria for the specific type of silt fence used ; and

2. Maximum ponding depth of 1.5 feet behind the fence; and

3. Erosion would occur in the form of sheet erosion; and

4. There is no concentration of water flowing to the barrier; and

5. Soil conditions allow for proper keying of fabric, or other anchorage, to prevent blowouts.

Design Criteria

1. Design computations are not required for installations of 1 month or less. Longer installation periods should be designed for expected runoff.

2. All silt fences shall be placed as close to the disturbed area as possible, but at least 10 feet from the toe of a slope steeper than 3H:1V, to allow for maintenance and roll down. The area beyond the fence must be undisturbed or stabilized.

3. The type of silt fence specified for each location on the plan shall not exceed the maximum slope length and maximum fence length requirements shown in the following table:

		Slope Length/Fence Length (ft.)		
Slope	Steepness	Standard	Reinforced	Super
<2%	< 50:1	300/1500	N/A	N/A
2-10%	50:1 to 10:1	125/1000	250/2000	300/2500
10-20%	10:1 to 5:1	100/750	150/1000	200/1000
20-33%	5:1 to 3:1	60/500	80/750	100/1000
33-50%	3:1 to 2:1	40/250	70/350	100/500
>50%	> 2:1	20/125	30/175	50/250

Standard Silt Fence (SF) is fabric rolls stapled to wooden stakes driven 16 inches in the ground.
Reinforced Silt Fence (RSF) is fabric placed against welded wire fabric with anchored steel posts driven 16 inches in the ground.
Super Silt Fence (SSF) is fabric placed against chain link fence as support backing with posts driven 3 feet in the ground.

4. Silt fence shall be removed as soon as the disturbed area has achieved final stabilization.

The silt fence shall be installed in accordance with the appropriate details. Where ends of filter cloth come together, they shall be overlapped, folded and stapled to prevent sediment bypass. Butt joints are not acceptable. A detail of the silt fence shall be shown on the plan. See Figure 5.30 on page 5.56 for Reinforced Silt Fence as an example of details to be provided.

Criteria for Silt Fence Materials

1. Silt Fence Fabric: The fabric shall meet the following specifications unless otherwise approved by the appropriate erosion and sediment control plan approval authority. Such approval shall not constitute statewide acceptance.

Fabric Properties	Minimum Acceptable Value	Test Method
Grab Tensile Strength (lbs)	110	ASTM D 4632
Elongation at Failure (%)	20	ASTM D 4632
Mullen Burst Strength (PSI)	300	ASTM D 3786
Puncture Strength (lbs)	60	ASTM D 4833
Minimum Trapezoidal Tear Strength (lbs)	50	ASTM D 4533
Flow Through Rate (gal/ min/sf)	25	ASTM D 4491
Equivalent Opening Size	40-80	US Std Sieve ASTM D 4751
Minimum UV Residual (%)	70	ASTM D 4355

2. Fence Posts (for fabricated units): The length shall be a minimum of 36 inches long. Wood posts will be of sound quality hardwood with a minimum cross sectional area of 3.5 square inches. Steel posts will be standard T and U section weighing not less than 1.00 pound per linear foot. Posts for super silt fence shall be standard chain link fence posts.

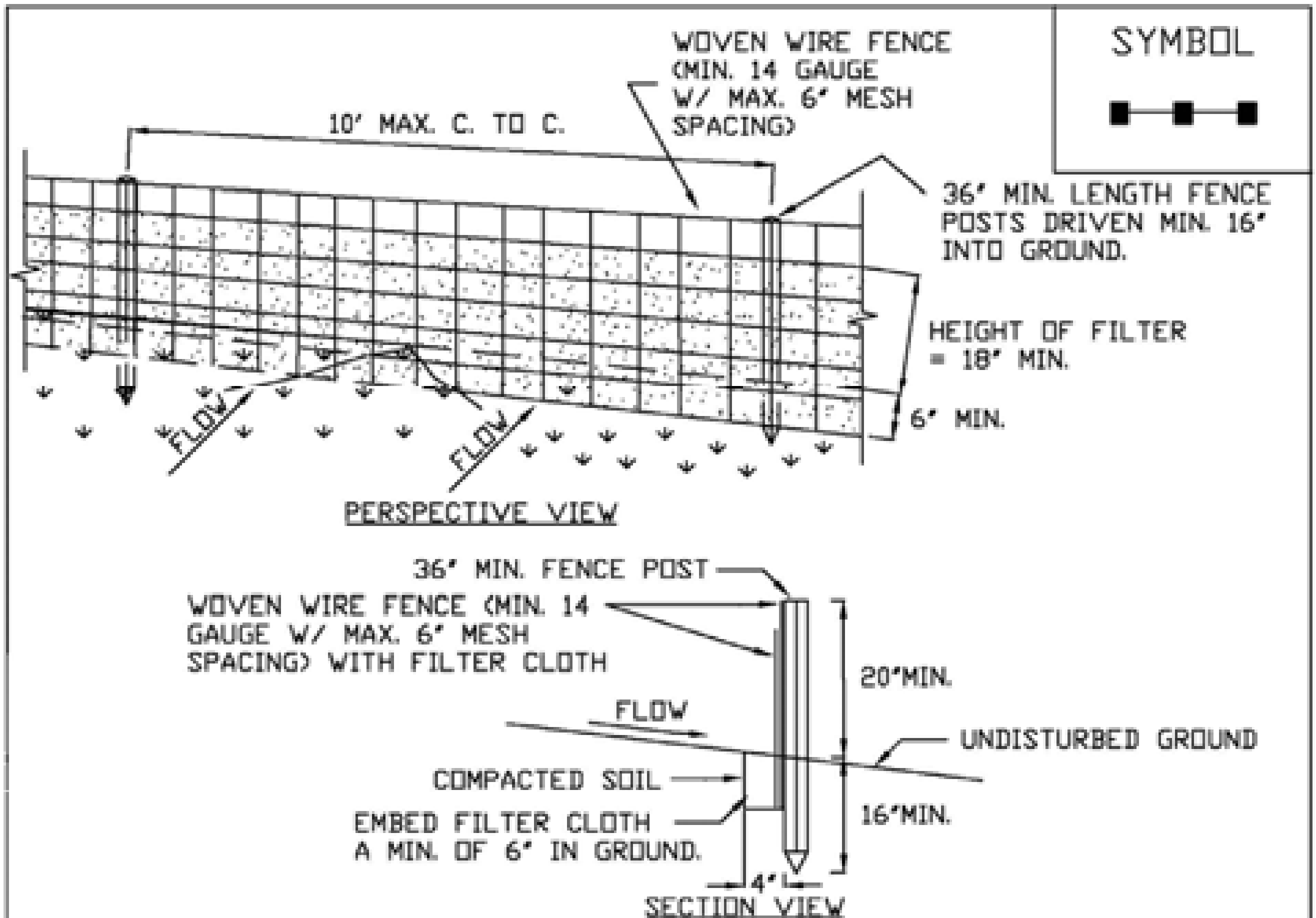
3. Wire Fence for reinforced silt fence: Wire fencing shall be a minimum 14 gage with a maximum 6 in. mesh opening, or as approved.

4. Prefabricated silt fence is acceptable as long as all material specifications are met.

Reinforced Silt Fence

Super Silt Fence

Figure 5.30
Reinforced Silt Fence



CONSTRUCTION SPECIFICATIONS

1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES OR STAPLES. POSTS SHALL BE STEEL EITHER "T" OR "U" TYPE OR HARDWOOD.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH TIES SPACED EVERY 24" AT TOP AND MID SECTION. FENCE SHALL BE WOVEN WIRE, 6" MAXIMUM MESH OPENING.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVER-LAPPED BY SIX INCHES AND FOLDED. FILTER CLOTH SHALL BE EITHER FILTER X, MIRAFI 100X, STABILINKA T140N, OR APPROVED EQUIVALENT.
4. PREFABRICATED UNITS SHALL MEET THE MINIMUM REQUIREMENTS SHOWN.
5. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	REINFORCED SILT FENCE

STANDARD AND SPECIFICATIONS FOR SOIL RESTORATION

Definition & Scope

The decompaction of areas of a development site or construction project where soils have been disturbed to recover the original properties and porosity of the soil; thus providing a sustainable growth medium for vegetation, reduction of runoff and filtering of pollutants from stormwater runoff.

Conditions Where Practice Applies

Soil restoration is to be applied to areas whose heavy construction traffic is done and final stabilization is to begin. This is generally applied in the cleanup, site restoration, and landscaping phase of construction followed by the permanent establishment of an appropriate ground cover to maintain the soil structure. Soil restoration measures should be applied over and adjacent to any runoff reduction practices to achieve design performance.

Design Criteria

1. Soil restoration areas will be designated on the plan views of areas to be disturbed.
2. Soil restoration will be completed in accordance with Table 4.6 on page 4.53.

Specification for Full Soil Restoration

During periods of relatively low to moderate subsoil moisture, the disturbed subsoils are returned to rough grade and the following Soil Restoration steps applied:

1. Apply 3 inches of compost over subsoil. The compost shall be well decomposed (matured at least 3 months), weed-free, organic matter. It shall be aerobically composted, possess no objectionable odors, and contain less than 1%, by dry weight, of man-made foreign matter. The physical parameters of the compost shall meet the standards listed in Table 5.2 - Compost Standards Table, except for "Particle Size" 100% will pass the 1/2" sieve. **Note: All biosolids compost produced in New York State (or approved for importation) must meet NYS DEC's 6 NYCRR Part 360 (Solid Waste Management Facilities) requirements. The Part 360 requirements are equal to or more stringent than 40 CFR Part 503 which ensure safe standards for pathogen reduction and heavy metals content.**

2. Till compost into subsoil to a depth of at least 12 inches using a cat-mounted ripper, tractor mounted disc, or tiller, to mix and circulate air and compost into the subsoil.
3. Rock-pick until uplifted stone/rock materials of four inches and larger size are cleaned off the site.
4. Apply topsoil to a depth of 6 inches.
5. Vegetate as required by the seeding plan. Use appropriate ground cover with deep roots to maintain the soil structure.
6. Topsoil may be manufactured as a mixture or a mineral component and organic material such as compost.

At the end of the project an inspector should be able to push a 3/8" metal bar 12 inches into the soil just with body weight. This should not be performed within the drip line of any existing trees or over utility installations that are within 24 inches of the surface.

Maintenance

Keep the site free of vehicular and foot traffic or other weight loads. Consider pedestrian footpaths.

Table 4.6
Soil Restoration Requirements

<table>
<tr><th>Type of Soil Disturbance</th><th colspan="2">Soil Restoration Requirement</th><th>Comments/Examples</th></tr>
<tr><td>No soil disturbance</td><td colspan="2">Restoration not permitted</td><td>Preservation of Natural Features</td></tr>
<tr><td>Minimal soil disturbance</td><td colspan="2">Restoration not required</td><td>Clearing and grubbing</td></tr>
<tr><td rowspan="2">Areas where topsoil is stripped only - no change in grade</td><td>HSG A&B</td><td>HSG C&D</td><td rowspan="2">Protect area from any ongoing construction activities.</td></tr>
<tr><td>Apply 6 inches of topsoil</td><td>Aerate* and apply 6 inches of topsoil</td></tr>
<tr><td rowspan="2">Areas of cut or fill</td><td>HSG A&B</td><td>HSG C&D</td><td rowspan="2"></td></tr>
<tr><td>Aerate* and apply 6 inches of topsoil</td><td>Apply full Soil Restoration**</td></tr>
<tr><td>Heavy traffic areas on site (especially in a zone 5-25 feet around buildings but not within a 5 foot perimeter around foundation walls)</td><td colspan="2">Apply full Soil Restoration (decompaction and compost enhancement)</td><td></td></tr>
<tr><td>Areas where Runoff Reduction and/or Infiltration practices are applied</td><td colspan="2">Restoration not required, but may be applied to enhance the reduction specified for appropriate practices.</td><td>Keep construction equipment from crossing these areas. To protect newly installed practice from any ongoing construction activities construct a single phase operation fence area</td></tr>
<tr><td>Redevelopment projects</td><td colspan="2">Soil Restoration is required on redevelopment projects in areas where existing impervious area will be converted to pervious area.</td><td></td></tr>
<tr><td colspan="4">* Aeration includes the use of machines such as tractor-drawn implements with coulters making a narrow slit in the soil, a roller with many spikes making indentations in the soil, or prongs which function like a mini-subsoiler.
** Per "Deep Ripping and De-compaction, DEC 2008".</td></tr>
</table>

STANDARD AND SPECIFICATIONS FOR STORM DRAIN INLET PROTECTION

Definition & Scope

A **temporary** barrier with low permeability, installed around inlets in the form of a fence, berm or excavation around an opening, detaining water and thereby reducing the sediment content of sediment laden water by settling thus preventing heavily sediment laden water from entering a storm drain system.

Conditions Where Practice Applies

This practice shall be used where the drainage area to an inlet is disturbed, it is not possible to temporarily divert the storm drain outfall into a trapping device, and watertight blocking of inlets is not advisable. **It is not to be used in place of sediment trapping devices.** This practice shall be used with an upstream buffer strip if placed at a storm drain inlet on a paved surface. It may be used in conjunction with storm drain diversion to help prevent siltation of pipes installed with low slope angle.

Types of Storm Drain Inlet Practices

There are five (5) specific types of storm drain inlet protection practices that vary according to their function, location, drainage area, and availability of materials:

I. Excavated Drop Inlet Protection
II. Fabric Drop Inlet Protection
III. Stone & Block Drop Inlet Protection
IV. Paved Surface Inlet Protection
V. Manufactured Insert Inlet Protection

Design Criteria

Drainage Area – The drainage area for storm drain inlets shall not exceed one acre. Erosion control/temporary stabilization measures must be implemented on the disturbed drainage area tributary to the inlet. The crest elevations of these practices shall provide storage and minimize bypass flow.

Type I – Excavated Drop Inlet Protection

This practice is generally used during initial overlot grading after the storm drain trunk line is installed.

Limit the drainage area to the inlet device to 1 acre. Excavated side slopes shall be no steeper than 2:1. The minimum depth shall be 1 foot and the maximum depth 2 feet as measured from the crest of the inlet structure. Shape the excavated basin to fit conditions with the longest dimension oriented toward the longest inflow area to provide maximum trap efficiency. The capacity of the excavated basin should be established to contain 900 cubic feet per acre of disturbed area. Weep holes, protected by fabric and stone, should be provided for draining the temporary pool.

Inspect and clean the excavated basin after every storm. Sediment should be removed when 50 percent of the storage volume is achieved This material should be incorporated into the site in a stabilized manner.

Type II – Fabric Drop Inlet Protection

This practice is generally used during final elevation grading phases after the storm drain system is completed.

Limit the drainage area to 1 acre per inlet device. Land area slope immediately surrounding this device should not exceed 1 percent. The maximum height of the fabric above the inlet crest shall not exceed 1.5 feet unless reinforced.

The top of the barrier should be maintained to allow overflow to drop into the drop inlet and not bypass the inlet to unprotected lower areas. Support stakes for fabric shall be a minimum of 3 feet long, spaced a maximum 3 feet apart. They should be driven close to the inlet so any overflow drops into the inlet and not on the unprotected soil. Improved performance and sediment storage volume can be obtained by excavating the area.

Inspect the fabric barrier after each rain event and make repairs as needed. Remove sediment from the pool area as necessary with care not to undercut or damage the filter fabric. Upon stabilization of the drainage area, remove all materials and unstable sediment and dispose of properly. Bring the adjacent area of the drop inlet to grade, smooth and compact and stabilize in the appropriate manner to the site.

Type III – Stone and Block Drop Inlet Protection

This practice is generally used during the initial and intermediate overlot grading of a construction site.

Limit the drainage area to 1 acre at the drop inlet. The stone barrier should have a minimum height of 1 foot and a maximum height of 2 feet. Do not use mortar. The height should be limited to prevent excess ponding and bypass flow.

Recess the first course of blocks at least 2 inches below the crest opening of the storm drain for lateral support. Subsequent courses can be supported laterally if needed by placing a 2x4 inch wood stud through the block openings perpendicular to the course. The bottom row should have a few blocks oriented so flow can drain through the block to dewater the basin area.

The stone should be placed just below the top of the blocks on slopes of 2:1 or flatter. Place hardware cloth of wire mesh with ½ inch openings over all block openings to hold stone in place.

As an optional design, the concrete blocks may be omitted and the entire structure constructed of stone, ringing the outlet ("doughnut"). The stone should be kept at a 3:1 slope toward the inlet to keep it from being washed into the inlet. A level area 1 foot wide and four inches below the crest will further prevent wash. Stone on the slope toward the inlet should be at least 3 inches in size for stability and 1 inch or smaller away from the inlet to control flow rate. The elevation of the top of the stone crest must be maintained 6 inches lower than the ground elevation down slope from the inlet to ensure that all storm flows pass over the stone into the storm drain and not past the structure. Temporary diking should be used as necessary to prevent bypass flow.

The barrier should be inspected after each rain event and repairs made where needed. Remove sediment as necessary to provide for accurate storage volume for subsequent rains. Upon stabilization of contributing drainage area, remove all materials and any unstable soil and dispose of properly.

Bring the disturbed area to proper grade, smooth, compact and stabilize in a manner appropriate to the site.

Type IV – Paved Surface Inlet Protection

This practice is generally used after pavement construction has been done while final grading and soil stabilization is occurring. These practices should be used with upstream buffer strips in linear construction applications, and with temporary surface stabilization for overlot areas, to reduce the sediment load at the practice. This practice includes sand bags, compost filter socks, geo-tubes filled with ballast, and manufactured surface barriers. Pea gravel can also be used in conjunction with these practices to improve performance. When the inlet is not at a low point, and is offset from the pavement or gutter line, protection should be selected and installed so that flows are not diverted around the inlet.

The drainage area should be limited to 1 acre at the drain inlet. All practices will be placed at the inlet perimeter or beyond to maximize the flow capacity of the inlet. Practices shall be weighted, braced, tied, or otherwise anchored to prevent movement or shifting of location on paved surfaces. Traffic safety shall be integrated with the use of this practice. All practices should be marked with traffic safety cones as appropriate. Structure height shall not cause flooding or by-pass flow that would cause additional erosion.

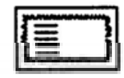
The structure should be inspected after every storm event. Any sediment should be removed and disposed of on the site. Any broken or damaged components should be replaced. Check all materials for proper anchorage and secure as necessary.

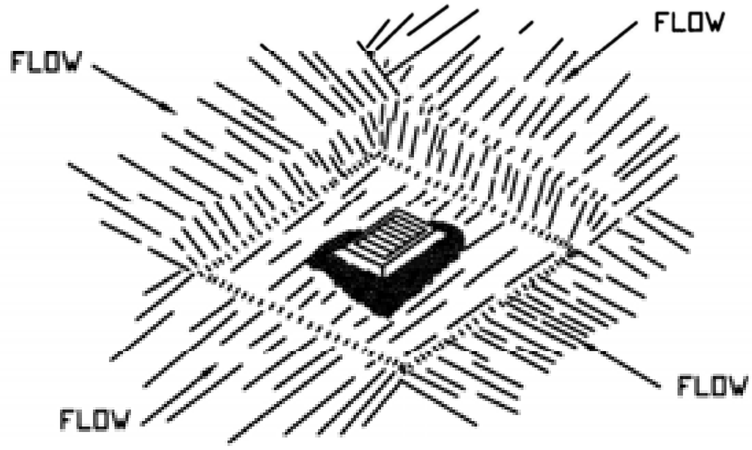
Type V - Manufactured Insert Inlet Protection

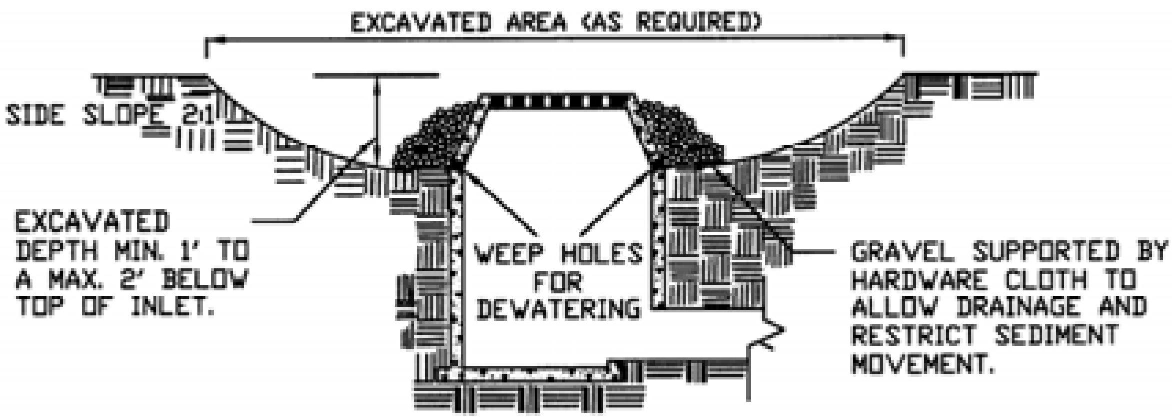
The drainage area shall be limited to 1 acre at the drain inlet. All inserts will be installed and anchored in accordance with the manufacturers recommendations and design details. The fabric portion of the structure will equal or exceed the performance standard for the silt fence fabric. The inserts will be installed to preserve a minimum of 50 percent of the open, unobstructed design flow area of the storm drain inlet opening to maintain capacity for storm events.

Figure 5.31
Excavated Drop Inlet Protection

SYMBOL







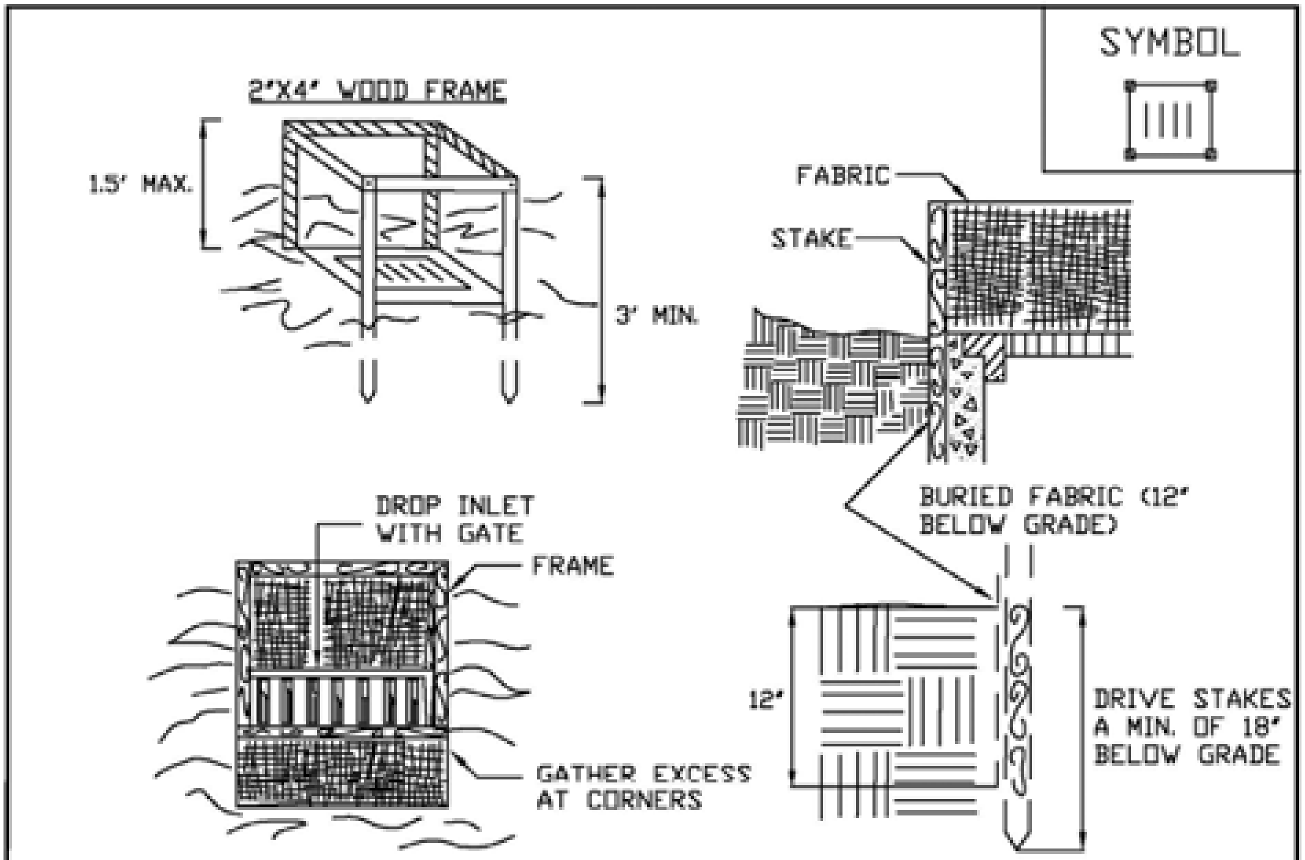
CONSTRUCTION SPECIFICATIONS

1. CLEAR THE AREA OF ALL DEBRIS THAT WILL HINDER EXCAVATION.
2. GRADE APPROACH TO THE INLET UNIFORMLY AROUND THE BASIN.
3. WEEP HOLES SHALL BE PROTECTED BY GRAVEL.
4. UPON STABILIZATION OF CONTRIBUTING DRAINAGE AREA, SEAL WEEP HOLES, FILL EXCAVATION WITH STABLE SOIL TO FINAL GRADE, COMPACT IT PROPERLY AND STABILIZE WITH PERMANENT SEEDING.

MAXIMUM DRAINAGE AREA 1 ACRE

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	EXCAVATED DROP INLET PROTECTION

Figure 5.32
Fabric Drop Inlet Protection



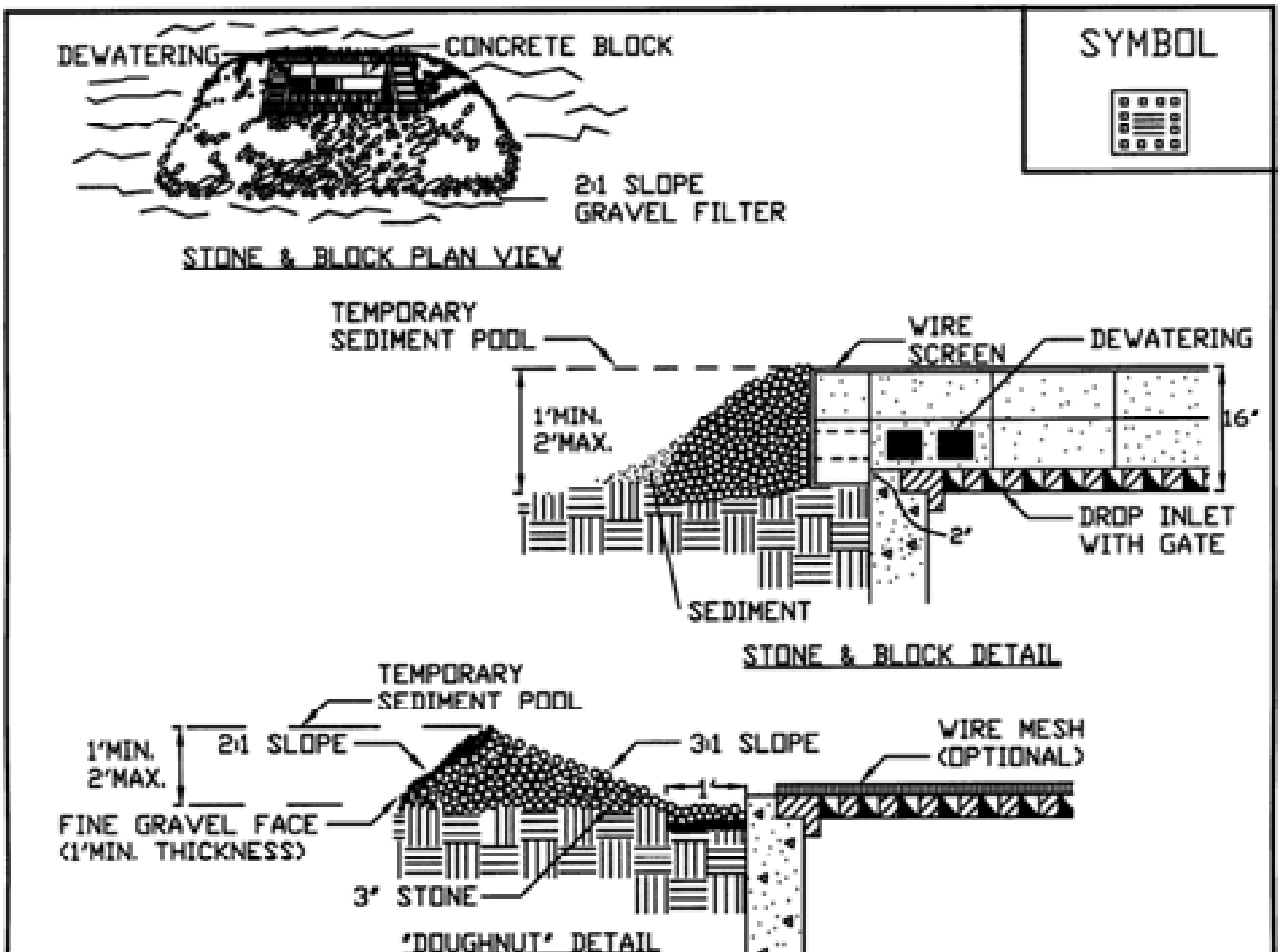
CONSTRUCTION SPECIFICATIONS

1. FABRIC SHALL HAVE AN EOS OF 40-85. BURLAP MAY BE USED FOR SHORT TERM APPLICATIONS.
2. CUT FABRIC FROM A CONTINUOUS ROLL TO ELIMINATE JOINTS. IF JOINTS ARE NEEDED THEY WILL BE OVERLAPPED TO THE NEXT STAKE.
3. STAKE MATERIALS WILL BE STANDARD 2" x 4" WOOD OR EQUIVALENT. METAL WITH A MINIMUM LENGTH OF 3 FEET.
4. SPACE STAKES EVENLY AROUND INLET 3 FEET APART AND DRIVE A MINIMUM 18 INCHES DEEP. SPANS GREATER THAN 3 FEET MAY BE BRIDGED WITH THE USE OF WIRE MESH BEHIND THE FILTER FABRIC FOR SUPPORT.
5. FABRIC SHALL BE EMBEDDED 1 FOOT MINIMUM BELOW GROUND AND BACKFILLED. IT SHALL BE SECURELY FASTENED TO THE STAKES AND FRAME.
6. A 2" x 4" WOOD FRAME SHALL BE COMPLETED AROUND THE CREST OF THE FABRIC FOR OVER FLOW STABILITY.

MAXIMUM DRAINAGE AREA 1 ACRE

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	FABRIC DROP INLET PROTECTION

Figure 5.33
Stone & Block Drop Inlet Protection



CONSTRUCTION SPECIFICATIONS

1. LAY ONE BLOCK ON EACH SIDE OF THE STRUCTURE ON ITS SIDE FOR DEWATERING. FOUNDATION SHALL BE 2 INCHES MINIMUM BELOW REST OF INLET AND BLOCKS SHALL BE PLACED AGAINST INLET FOR SUPPORT.
2. HARDWARE CLOTH OR 1/2" WIRE MESH SHALL BE PLACED OVER BLOCK OPENINGS TO SUPPORT STONE.
3. USE CLEAN STONE OR GRAVEL 1/2-3/4 INCH IN DIAMETER PLACED 2 INCHES BELOW TOP OF THE BLOCK ON A 2:1 SLOPE OR FLATTER.
4. FOR STONE STRUCTURES ONLY, A 1 FOOT THICK LAYER OF THE FILTER STONE WILL BE PLACED AGAINST THE 3 INCH STONE AS SHOWN ON THE DRAWINGS.

MAXIMUM DRAINAGE AREA 1 ACRE

ADAPTED FROM DETAILS PROVIDED BY: USDA - NRCS, NEW YORK STATE DEPARTMENT OF TRANSPORTATION, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION, NEW YORK STATE SOIL & WATER CONSERVATION COMMITTEE	STONE & BLOCK DROP INLET PROTECTION

STANDARD AND SPECIFICATIONS FOR SURFACE ROUGHENING

Definition & Scope

Roughening a bare soil surface whether through creating horizontal grooves across a slope, stair-stepping, or tracking with construction equipment to aid the establishment of vegetative cover from seed, to reduce runoff velocity and increase infiltration, and to reduce erosion and provide for trapping of sediment.

Conditions Where Practice Applies

All construction slopes require surface roughening to facilitate stabilization with vegetation, particularly slopes steeper than 3:1.

Design Criteria

There are many different methods to achieve a roughened soil surface on a slope. No specific design criteria is required. However, the selection of the appropriate method depends on the type of slope. Methods include tracking, grooving, and stair-stepping. Steepness, mowing requirements, and/or a cut or fill slope operation are all factors considered in choosing a roughening method.

Construction Specifications

1. Cut Slope, No mowing.

   A. Stair-step grade or groove cut slopes with a gradient steeper than 3:1 (Figure 4.18).

   B. Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Slopes of soft rock with some soil are particularly suited to stair-step grading.

   C. Make the vertical cut distance less than the horizontal distance, and slightly slope the horizontal position of the "step" to the vertical wall.

   D. Do not make vertical cuts more than 2 feet in soft materials or 3 feet in rocky materials.

Grooving uses machinery to create a series of ridges and depressions that run perpendicular to the slope following the contour. Groove using any appropriate implement that can be safely operated on the slope, such as disks, tillers, spring harrows, or the teeth of a front-end loader bucket. Do not make the grooves less than 3 inches deep or more than 15 inches apart.

2. Fill Slope, No mowing

   A. Place fill to create slopes with a gradient no steeper than 2:1 in lifts 9 inches or less and properly compacted. Ensure the face of the slope consists of loose, uncompacted fill 4 to 6 inches deep. Use grooving as described above to roughen the slope, if necessary.

   B. Do not back blade or scrape the final slope face.

3. Cuts/Fills, Mowed Maintenance

   A. Make mowed slopes no steeper than 3:1.

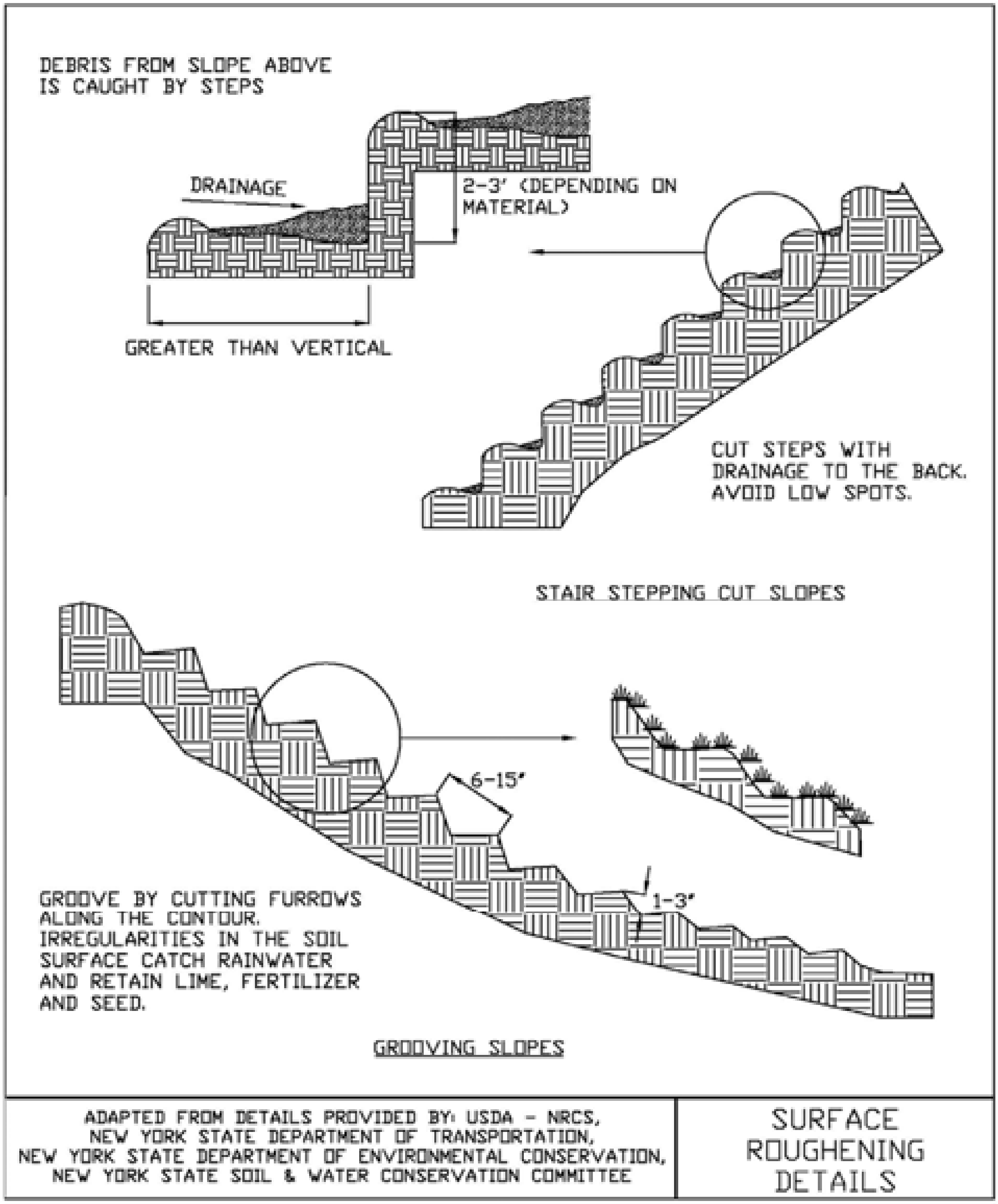
   B. Roughen these areas to shallow grooves by normal tilling, disking, harrowing, or use of cultipacker-seeder. Make the final pass of such tillage equipment on the contour.

   C. Make grooves at least 1 inch deep and a maximum of 10 inches apart.

   D. Excessive roughness is undesirable where mowing is planned.

Tracking should be used primarily in sandy soils to avoid undue compaction of the soil surface. Tracking is generally not as effective as the other roughening methods described. (It has been used as a method to track down mulch.) Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.

Figure 4.18
Surface Roughening



STANDARD AND SPECIFICATIONS FOR TOPSOILING

Definition & Scope

Spreading a specified quality and quantity of topsoil materials on graded or constructed subsoil areas to provide acceptable plant cover growing conditions, thereby reducing erosion; to reduce irrigation water needs; and to reduce the need for nitrogen fertilizer application.

Conditions Where Practice Applies

Topsoil is applied to subsoils that are droughty (low available moisture for plants), stony, slowly permeable, salty or extremely acid. It is also used to backfill around shrub and tree transplants. This standard does not apply to wetland soils.

Design Criteria

1. Preserve existing topsoil in place where possible, thereby reducing the need for added topsoil.
2. Conserve by stockpiling topsoil and friable fine textured subsoils that must be stripped from the excavated site and applied after final grading where vegetation will be established. Topsoil stockpiles must be stabilized. Stockpile surfaces can be stabilized by vegetation, geotextile or plastic covers. This can be aided by orientating the stockpile lengthwise into prevailing winds.
3. Refer to USDA Natural Resource Conservation Service soil surveys or soil interpretation record sheets for further soil texture information for selecting appropriate design topsoil depths.

Site Preparation

1. As needed, install erosion and sediment control practices such as diversions, channels, sediment traps, and stabilizing measures, or maintain if already installed.
2. Complete rough grading and final grade, allowing for depth of topsoil to be added.
3. Scarify all compact, slowly permeable, medium and fine textured subsoil areas. Scarify at approximately right angles to the slope direction in soil areas that are steeper than 5 percent. Areas that have been overly compacted shall be decompacted in accordance with the Soil Restoration Standard.
4. Remove refuse, woody plant parts, stones over 3 inches in diameter, and other litter.

Topsoil Materials

1. Topsoil shall have at least 6 percent by weight of fine textured stable organic material, and no greater than 20 percent. Muck soil shall not be considered topsoil.
2. Topsoil shall have not less than 20 percent fine textured material (passing the NO. 200 sieve) and not more than 15 percent clay.
3. Topsoil treated with soil sterilants or herbicides shall be so identified to the purchaser.
4. Topsoil shall be relatively free of stones over 1 1/2 inches in diameter, trash, noxious weeds such as nut sedge and quackgrass, and will have less than 10 percent gravel.
5. Topsoil containing soluble salts greater than 500 parts per million shall not be used.
6. Topsoil may be manufactured as a mixture of a mineral component and organic material such as compost.

Application and Grading

1. Topsoil shall be distributed to a uniform depth over the area. It shall not be placed when it is partly frozen, muddy, or on frozen slopes or over ice, snow, or standing water puddles.
2. Topsoil placed and graded on slopes steeper than 5 percent shall be promptly fertilized, seeded, mulched, and stabilized by “tracking” with suitable equipment.
3. Apply topsoil in the amounts shown in Table 4.7 below:

Table 4.7 - Topsoil Application Depth		
Site Conditions	**Intended Use**	**Minimum Topsoil Depth**
1. Deep sand or loamy sand	Mowed lawn	6 in.
	Tall legumes, unmowed	2 in.
	Tall grass, unmowed	1 in.
2. Deep sandy loam	Mowed lawn	5 in.
	Tall legumes, unmowed	2 in.
	Tall grass, unmowed	none
3. Six inches or more: silt loam, clay loam, loam, or silt	Mowed lawn	4 in.
	Tall legumes, unmowed	1 in.
	Tall grass, unmowed	1 in.

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APPENDIX R: MAINTENANCE/CONSTRUCTION INSPECTION REPORTS

Stormwater Pond/Wetland Operation, Maintenance and Management Inspection Checklist

Project ___________________________
Location: ___________________________
Site Status: ___________________________

Date: ___________________________
Time: ___________________________

Inspector: ___________________________

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
1. Embankment and emergency spillway (Annual, After Major Storms)		
1. Vegetation and ground cover adequate		
2. Embankment erosion		
3. Animal burrows		
4. Unauthorized planting		
5. Cracking, bulging, or sliding of dam		
a. Upstream face		
b. Downstream face		
c. At or beyond toe		
downstream		
upstream		
d. Emergency spillway		
6.Pond, toe & chimney drains clear and functioning		
7.Seeps/leaks on downstream face		
8.Slope protection or riprap failure		
9. Vertical/horizontal alignment of top of dam “As-Built”		

Maintenance Item	**Satisfactory/ Unsatisfactory**	**Comments**
10. Emergency spillway clear of obstructions and debris		
11. Other (specify)		
2. Riser and principal spillway (Annual)		
Type: Reinforced concrete _______ Corrugated pipe ________ Masonry ________ 1. Low flow orifice obstructed		
2. Low flow trash rack. a. Debris removal necessary		
b. Corrosion control		
3. Weir trash rack maintenance a. Debris removal necessary		
b. corrosion control		
4. Excessive sediment accumulation insider riser		
5. Concrete/masonry condition riser and barrels a. cracks or displacement		
b. Minor spalling (<1")		
c. Major spalling (rebars exposed)		
d. Joint failures		
e. Water tightness		
6. Metal pipe condition		
7. Control valve a. Operational/exercised		
b. Chained and locked		
8. Pond drain valve a. Operational/exercised		
b. Chained and locked		
9. Outfall channels functioning		
10. Other (specify)		

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
3. Permanent Pool (Wet Ponds) (monthly)		
1. Undesirable vegetative growth		
2. Floating or floatable debris removal required		
3. Visible pollution		
4. Shoreline problem		
5. Other (specify)		
4. Sediment Forebays		
1.Sedimentation noted		
2. Sediment cleanout when depth < 50% design depth		
5. Dry Pond Areas		
1. Vegetation adequate		
2. Undesirable vegetative growth		
3. Undesirable woody vegetation		
4. Low flow channels clear of obstructions		
5. Standing water or wet spots		
6. Sediment and / or trash accumulation		
7. Other (specify)		
6. Condition of Outfalls (Annual , After Major Storms)		
1. Riprap failures		
2. Slope erosion		
3. Storm drain pipes		
4.Endwalls / Headwalls		
5. Other (specify)		
7. Other (Monthly)		
1. Encroachment on pond, wetland or easement area		

Maintenance Item	**Satisfactory/ Unsatisfactory**	**Comments**
2. Complaints from residents		
3.Aesthetics a. Grass growing required		
b. Graffiti removal needed		
c. Other (specify)		
4. Conditions of maintenance access routes.		
5. Signs of hydrocarbon build-up		
6. Any public hazards (specify)		
8. Wetland Vegetation (Annual)		
1. Vegetation healthy and growing Wetland maintaining 50% surface area coverage of wetland plants after the second growing season. (If unsatisfactory, reinforcement plantings needed)		
2. Dominant wetland plants: Survival of desired wetland plant species Distribution according to landscaping plan?		
3. Evidence of invasive species		
4. Maintenance of adequate water depths for desired wetland plant species		
5. Harvesting of emergent plantings needed		
6. Have sediment accumulations reduced pool volume significantly or are plants “choked” with sediment		
7. Eutrophication level of the wetland.		
8. Other (specify)		

Comments:

Actions to be Taken:

Bioretention Operation, Maintenance and Management Inspection Checklist

Project:
Location:
Site Status:

Date:

Time:

Inspector:

MAINTENANCE ITEM	SATISFACTORY / UNSATISFACTORY	COMMENTS
1. Debris Cleanout (Monthly)		
Bioretention and contributing areas clean of debris		
No dumping of yard wastes into practice		
Litter (branches, etc.) have been removed		
2. Vegetation (Monthly)		
Plant height not less than design water depth		
Fertilized per specifications		
Plant composition according to approved plans		
No placement of inappropriate plants		
Grass height not greater than 6 inches		
No evidence of erosion		
3. Check Dams/Energy Dissipaters/Sumps (Annual, After Major Storms)		
No evidence of sediment buildup		

MAINTENANCE ITEM	SATISFACTORY / UNSATISFACTORY	COMMENTS
Sumps should not be more than 50% full of sediment		
No evidence of erosion at downstream toe of drop structure		
4. Dewatering (Monthly)		
Dewaters between storms		
No evidence of standing water		
5. Sediment Deposition (Annual)		
Swale clean of sediments		
Sediments should not be > 20% of swale design depth		
6. Outlet/Overflow Spillway (Annual, After Major Storms)		
Good condition, no need for repair		
No evidence of erosion		
No evidence of any blockages		
7. Integrity of Filter Bed (Annual)		
Filter bed has not been blocked or filled inappropriately		

Comments:

Actions to be Taken:

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APPENDIX S: SHPO LETTER OF NO IMPACT (EXCERPT FROM SWPPP PREPARED BY CPL: ARCHITECTURE, ENGINEERING AND PLANNING DATED SEPTEMBER 2021)

April 06, 2021

Lauren Tarsio
Associate
CPL
50 Front St.
Suite 202
Newburgh, NY 12550

Re: SED
NECSD - New CTE Center
201 Fullerton Ave, Newburgh, NY 12550
20PR07209
44-16-04-01-0-053-001

Dear Lauren Tarsio:

Thank you for requesting the comments of the Division for Historic Preservation of the Office of Parks, Recreation and Historic Preservation (OPRHP). We have reviewed the submitted materials in accordance with the New York State Historic Preservation Act of 1980 (section 14.09 of the New York Parks, Recreation and Historic Preservation Law). These comments are those of the Division for Historic Preservation and relate only to Historic/Cultural resources.

OPRHP has reviewed *Phase I Archaeological Investigation for the Newburgh High School CTE Building City of Newburgh, Township of Newburgh, Orange County, New York* (Tracker Archaeology, March 2021).

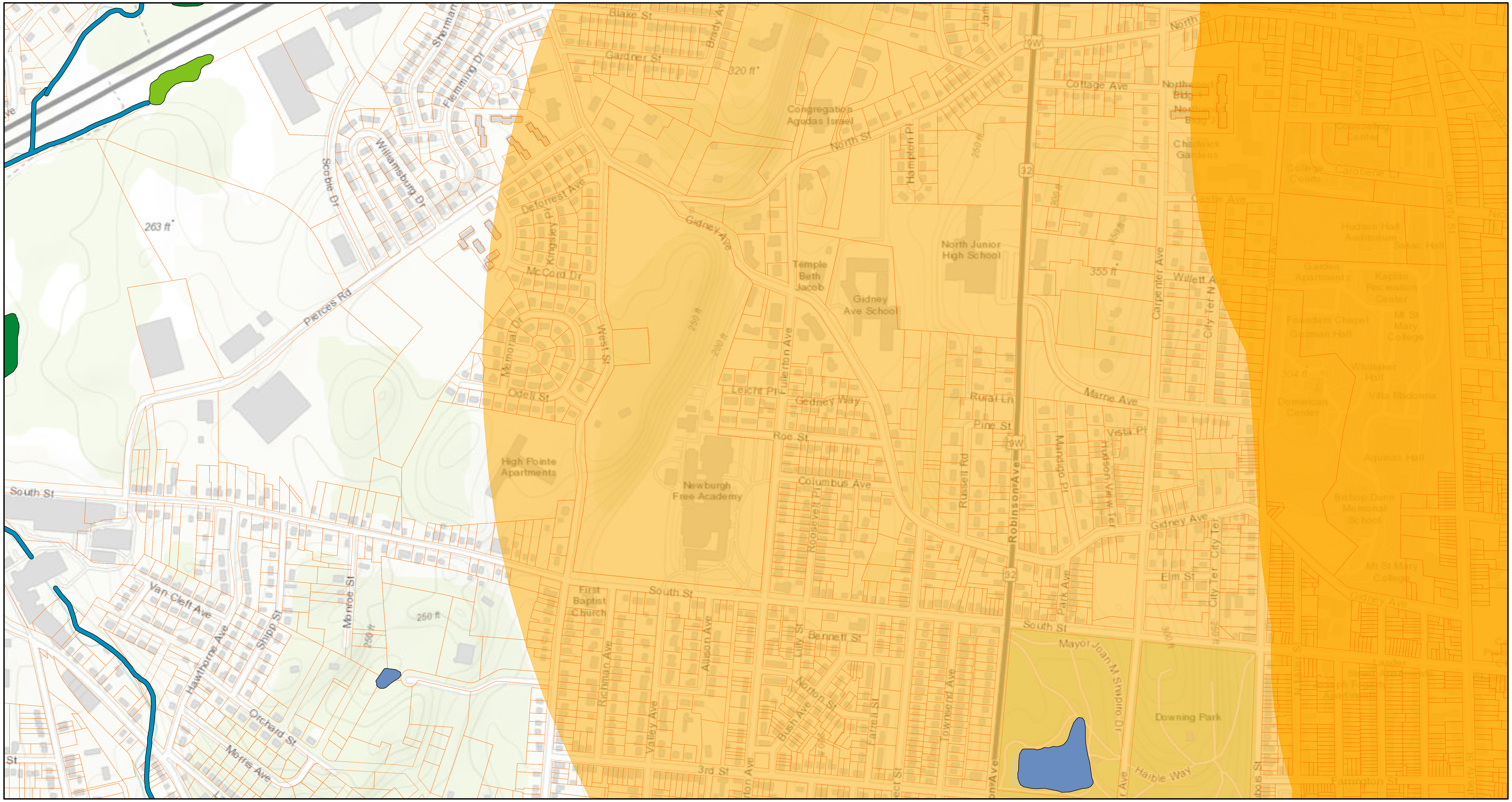
Based upon this review, it is the opinion of OPRHP that no properties, including archaeological and/or historic resources, listed in or eligible for the New York State and National Registers of Historic Places will be impacted by this project.

If you have any questions, please don't hesitate to contact me.

Sincerely,

Philip A. Perazio, Historic Preservation Program Analyst - Archaeology Unit
Phone: 518-268-2175
e-mail: philip.perazio@parks.ny.gov via email only

Newburgh CTE



May 5, 2021

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

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