

SECTION 055213

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Exterior steel pipe and tube guard rail system.

1.3 DEFINITIONS

- A. Definitions in ASTM E 985 for railing-related terms apply to this section.

1.4 PERFORMANCE REQUIREMENTS

- A. General: In engineering handrail and railing systems to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength
- B. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within the limits and under conditions indicated:
 - 1. Top of guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of guards:
 - a. Concentrated load of 50lbf applied horizontally on an area of 1 square foot.
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F material surfaces.

- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.5 SUBMITTALS

- A. Product Data:
 - 1. Manufacturers product lines of mechanically connected railings.
 - 2. Railing brackets.
 - 3. Grout, anchoring cement, and paint products.
- B. Shop drawings showing fabrication and installation of guard rail including plans, elevations, sections, details of components, and attachments to other units of work.
- C. Samples for Initial Selection: Color samples of powder coat finishes and paint products.
- D. Samples for Verification: For each type of power coating finish required.
- E. Mill Certificates: Signed by manufacturers of steel products certifying that products furnished comply with the requirements.
- F. Welding Certificates.

1.6 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain systems of each type and material from a single manufacturer.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1 "Structural Welding Code – Steel."
- C. Regulatory Requirements:
 - 1. Components and installation are to follow current ADA and ICC/ANSI 117.1 guidelines.

1.7 STORAGE

- A. Store handrails and railing systems in clean, dry location, away from uncured concrete and masonry, protected against damage of any kind. Cover with waterproof paper, tarpaulin, or polyethylene sheeting; allow for air circulation inside the covering.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Where guard rails are indicated to fit to other construction, check actual dimensions of other construction by accurate field measurements before fabrication; show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabrication of products without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.1 METALS

- A. General: Provide metal forms and types that comply with requirements of referenced standards and that are free from surface blemishes where exposed to view in the finished unit. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable.
- B. Steel Tubing: Product type (manufacturing method) and other requirements as follows:
 1. Cold-Formed Cold-Drawn Buttweld Carbon Steel Mechanical Tubing: ASTM A 513.
 - a. Grade B, extra strong, galvanized per ASTM A 53 on inside and outside surfaces.
- C. Steel Plates, Shapes, and Bars: ASTM A 36.

2.2 WELDING MATERIALS, FASTENERS, AND ANCHORS

- A. Welding Electrodes and Filler Metal: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of the type, grade, and class required to produce connections that are suitable for anchoring railing to other types of construction indicated and capable of withstanding design loadings.
 1. For steel railings and fittings use plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating or ASTM B 696, Class 12 for cadmium plating.
- C. Railing Mounting Brackets: Galvanized Steel or Iron Bracket.
 1. Wagner, R&B Inc; a division of Wagner Companies: 1705-2
 2. Blum, Julius & Co, Inc: No. 1306
 3. Or approved equal.

2.3 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, non staining, non corrosive, non gaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- B. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include, but are not limited to, the following:
 - 1. Nonshrink, Nonmetallic Grouts:
 - a. Super Por-Rok - Lambert Corporation
 - b. Euco N-S Grout - Euclid Chemical Co.
 - c. Masterflow 928 and 173 - Master Builders Technologies, Inc.
 - d. Sealtight 588 Grout - W.R. Meadows, Inc.
 - e. SonogROUT 14 - Sonneborn Building Products – ChemRex, Inc.

2.4 FABRICATION

- A. General: Fabricate handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of hollow members, post spacings, and anchorage, but not less than those required to support structural loads.
- B. Preassemble railing systems in shop to greatest extent possible to minimize field splicing and assembly. Clearly mark units for reassembly and coordinated installation.
- C. Form changes in direction of railing members as follows:
 - 1. By insertion of prefabricated elbow fittings.
- D. Welded Connections: Fabricate railing systems and handrails for connections of members by welding. For connections made during fabrication, weld corners and seams continuously to comply with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At tee and cross intersections, notch ends of intersecting members to fit contour of pipe to which end is joined and weld all around.
 - 5. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- E. Non-welded Connections: Fabricate railing systems and handrails for connection of members by means of railing manufacturer's standard concealed mechanical fasteners and fittings unless otherwise indicated. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection using epoxy structural adhesive where this represents manufacturer's standard splicing method.
- F. Shear and punch metals cleanly and accurately. Remove burrs from exposed cut edges.

- G. Provide temporary weepholes or other means for evacuation of entrapped water in hollow sections of railing members during manufacturing and finishing.
- H. Fabricate joints that will be exposed to weather in a manner to exclude water.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering prior to shipment.

2.6 GALVANIZED FINISH

- A. General: Hot-dip galvanize items indicated to be galvanized to comply with applicable standard listed below:
 - 1. ASTM A 153 for galvanizing iron and steel hardware.
 - 2. ASTM A 123 for galvanizing iron and steel products made from rolled, pressed and forged steel shapes, castings, plates, bars, and strips.
- B. After galvanizing:
 - 1. Fill vent and drain holes that will be exposed in the finished Work by plugging with zinc solder and filing off smooth.
 - 2. Touch up all areas affected by finishing procedures after galvanizing with galvanizing repair paint.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.7 POWDER COAT FINISH

- A. Prior to applying powder, the product shall be preheated to 350 degrees Fahrenheit for 20 minutes to encourage out gassing of zinc.
- B. Powder Coat System: Polyester based powder applied by electrostatic spray process. Two coats minimum, each coat shall be baked at 350 degrees Fahrenheit for 30 minutes (2 to 5 mils. per coat).
- C. Provide owner with powder coat touch-up material for each color to repair minor scratches that occur after acceptance of railing systems.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, concrete inserts, anchor bolts, and

miscellaneous items having integral anchors, that are to be embedded in concrete as masonry construction. Coordinate delivery of such items to project site.

3.2 INSTALLATION, GENERAL

- A. File exposed connections accurately together to form tight, hairline joints.
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of guard rail. Set accurately in location, alignment, and elevation, measured from established lines and levels and free from rack.
 - 1. Do not weld, cut, or abrade surfaces of components that have been coated or finished after fabrication and are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/4 inch in 12 feet.
 - 3. Align rails so that variations from level for horizontal members and from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing to in-place construction.

3.3 ANCHORING POSTS

- A. Adjust systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.

3.4 RAILING CONNECTIONS

- A. Nonwelded Connections: Use manufacturer's standard mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws with plastic filler cement colored to match finish handrails and railing systems.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact or use manufacturer's standard fittings designed for this purpose.
- C. Expansion Joints: Install expansion joints at locations indicated but not further apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending

2 inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches of post.

3.5 ADJUSTING AND CLEANING

- A. Touch-Up Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

3.6 PROTECTION

- A. Protect finishes of systems from damage during construction period by use of temporary protective coverings approved by railing manufacturer. Remove protective covering at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.7 RAILING FINISH SCHEDULE

- A. Exterior Guard Railings: Galvanize and Powder Coat
 - 1. Color: Shall be black.
 - 2. Submit 4 color samples on 1-1/2 inch diameter by 12-inch long rail section for review and selection by owner.
- B.

END OF SECTION 055213

SECTION 101453
TRAFFIC SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions, and Division 1 Specification sections apply to work of this Section.

1.2 APPLICABLE PUBLICATIONS

- A. The following publications of the issues below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:
 - 1. NYSDOT Manual of Uniform Traffic Control Devices (MUTCD)

1.3 DESCRIPTION OF WORK

- A. The extent of signage is shown on the drawings.
- B. Provide all materials, labor, equipment, and services required to accomplish all related work in accordance with the drawings and specifications.

1.4 SUBMITTALS

- A. Required submittals are:
 - 1. Traffic Signs: Shop drawings and applicable manufacturer's product data.

1.5 JOB CONDITIONS

- A. All job conditions in Section 312010 – Earth Moving Outside Building apply.
- B. Construction Review: Notify the Landscape Architect when signs are staked out.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Traffic Signage:
 - 1. 0.080" aluminum with reflective background as manufactured by Voss Signs, LLC, or approved equivalent.

B. Metal Post:

1. 2" x 2" - 12 gauge perforated galvanized steel sign post with break-away base as manufactured by Voss Signs, LLC, or approved equivalent.

C. Concrete:

1. Reference specification section 321313 Concrete Work.

D. Plastic Bollard and Sign Post Cover

1. Polyethylene Thermoplastic (LDPE) tubes having ultra-violet resistance and anti static properties.
2. Nominal thickness 0.250 inches.
3. Color shall be OSHA yellow unless otherwise noted.
4. Size covers for pipe diameters and sign post heights.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install signs and posts in accordance with contract documents.

END OF SECTION 101453

SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Protecting existing vegetation to remain.
 - 2. Removing existing vegetation.
 - 3. Clearing and grubbing.
 - 4. Stripping and stockpiling topsoil.
 - 5. Removing above- and below-grade site improvements.
 - 6. Disconnecting, capping or sealing, and removing site utilities.
 - 7. Temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

- A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally 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 nonsoil materials.
- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.

1.7 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 Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
 - 1. Do not proceed with work on adjoining property until directed by Architect.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Utility Locator Service: Notify Dig Safe New York- telephone number 811 before commencing any subsurface work or excavation.
- E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.
- F. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.

3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Division 31 Section "Earth Moving Outside Building."
1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.
- C. Protect existing site improvements to remain from damage during construction.
1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

- A. General: Protect trees and plants remaining on-site.
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.
 - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Architect's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
 - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
 - 3. Use only hand methods for grubbing within protection zones.
 - 4. Chip removed tree branches and dispose of off-site.

- B. 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 a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
 - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
 - 1. Limit height of topsoil stockpiles to 72 inches.
 - 2. Do not stockpile topsoil within protection zones.
 - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
 - 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- 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 along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
 - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. 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.
- B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312010

EARTH MOVING OUTSIDE BUILDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing subgrade for walks and pavements.
 - 2. Preparing subbase for pavements.
 - 3. Excavating and backfilling for underground utilities.
 - 4. Providing ordinary fill as indicated to establish finish grades shown.
 - 5. Excavation and placement of compacted backfill.
 - 6. Placement of compacted backfill (if required) and compacted granular fill courses.
 - 7. Installation of all sheathing, shoring and bracing required to execute the work.
 - 8. Disposal of all excavated material off site, unless satisfactory for site earthwork fill.
 - 9. Testing and test reports.

1.3 DEFINITIONS

- A. Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of excess or unusable materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient soil material complying with the specifications is not available from excavations.
- D. Unauthorized excavation consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Owner's Testing Agency. Unauthorized excavation, as well as remedial work (for such unauthorized excavation) directed by the Owner's Testing Agency, shall be at the Contractor's expense.
- E. Structure: Retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- F. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.4 SUBMITTALS

- A. Test Reports: In addition to test reports required under field quality control, submit the following:
1. Laboratory analysis of each soil material proposed for fill and backfill from on-site and borrow sources.
 2. One optimum moisture-maximum density curve for each soil material.
 3. The standard against which the results of field density test are to be measured is the modified proctor laboratory compaction test, ASTM D 1557. Perform one test for each type of soil material.
 4. The origin of each soil material.
 5. Laboratory analysis of each soil material proposed for fill and backfill indicating it is free of any hazardous waste.

1.5 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: The Owner will employ and pay for a qualified independent testing agency to perform soil testing and inspection service during earthwork operations. It is the Contractor's responsibility to inquire about testing arrangements to the Owner's Testing Agency, Architect and Owner, with sufficient time to engage a testing laboratory to perform the work.
1. Contractors shall cooperate with the Owners Testing Agency representatives, and shall notify the agency in advance of all operations which require testing.
- C. Reference Standards:
1. The following standards shall be applicable.
 - a. "Standard Specifications, Construction and Materials, New York State Department of Transportation, Office of Engineering".
 - b. "Guidelines For Erosion and Sediment Control in Urban Areas of New York State".

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
1. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult Landscape Architect immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility Owner.

2. Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Owner and then only after acceptable temporary utility services have been provided.
 - a. Provide minimum of 72-hour notice to the Owner and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide acceptable borrow soil materials from off-site when sufficient soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Subbase Material: Naturally or artificially graded crushed stone conforming to NYS DOT Item 304-2.02, Type 2 as follows:

U.S. Sieve No.	Percent Passing By Weight
2 inch	100
1/4 inch	25-65
No. 40	5-40
No. 200	0-10

- E. Backfill Material: Naturally or artificially graded mixture of sand, natural or crushed stone or gravel conforming to NYS DOT Item 304-2.02, Type 4 as follows:

U.S. Sieve No.	Percent Passing by Weight
2 inch	100
1/4 inch	30-65
No. 40	5-40
No. 200	0-10

- F. Ordinary Fill Material: Satisfactory soil materials free of clay, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
1. Be of such a nature and character that it can be compacted to the specific densities in a reasonable length of time.
 2. Have a maximum dry density of not less than 115 pounds per cubic foot.

- G. NYSDOT # 2 crushed stone, clean, durable, angular, and of uniform quality throughout, conforming to NYSDOT Item 703-02.

U.S. Sieve No.	Percent Passing by Weight
1-1/2 inch	100
1 inch	90-100
1/2 inch	0-15

- H. Drainage Fill: Material shall consist of crushed stone, sand, gravel or screened gravel. The soundness of the material shall be tested and shall have a loss not exceeding 20 percent by weight after four cycles of the Magnesium Sulphate Soundness Test (NYS DOT 207), conforming to NYS DOT 605-2.02, Underdrain Filter Type 1 as follows:

U.S. Sieve No.	Percent Passing by Weight
1 inch	100
1/2 inch	30-90
1/4 inch	0-30
No.10	0-10
No.20	0-5

- I. NYSDOT #1A crushed stone, clean, durable, angular, and of uniform quality throughout, conforming to NYSDOT Item 703-02.

U.S. Sieve No.	Percent Passing by Weight
1/2 inch	100
1/4 inch	90-100
1/8 inch	0-15

- J. NYSDOT #1 crushed stone, clean, durable, angular, and of uniform quality throughout, conforming to NYSDOT Item 703-02.

U.S. Sieve No.	Percent Passing by Weight
1 inch	100
1/2 inch	90-100
1/4 inch	0-15

2.2 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 2'-6" deep.
1. Tape Colors: Provide tape colors to utilities as follows:
 - a. Red: Electrical
 - b. Orange: Communication / CATV
 - c. Blue: Water
 - d. Green: Storm drainage and Sanitary Sewer system.
 2. Manufacturers: Subject to compliance with requirements, provide products by one the following, or an approved equal:
 - a. Allen Systems, Inc.; Reef Industries, Inc.
 - b. Brady (W.H.) Co.; Signmark Div.
 - c. EMED Co., Inc.

2.3 STABILIZATION FABRIC

- A. Design criteria: shall be a woven fabric:

Property	Design Value	Test Method
Grab Tensile Strength	200 lbf (min)	ASTM D 4632
Grab Tensile Elongation	15% (min)	ASTM D 4632
Trapezoid Tear Strength	75 lbf (min)	ASTM D 4533
Puncture Strength	90 lbf (min)	ASTM 4833
Flow Rate	5 gal / min/ ft ² (min)	ASTM D 4491
UV Resistance after 500 hrs	70%	ASTM D 4355

- B. Manufactures: Subject to compliance with requirements, provide products by one of the following, or an approved equal:
1. TC Mirafi
 2. Amoco fabrics and Fibers Co.
 3. Webtec, Inc.

2.4 FILTER FABRIC

- A. Design criteria: shall be a non woven drainage fabric.

Property	Design Value	Test Method
Grab Tensile Strength	120 lbf (min)	ASTM D 4632
Grab Tensile Elongation	50% (min)	ASTM D 4632
Trapezoid Tear Strength	50 lbf (min)	ASTM D 4533
Puncture Strength	65 lbf (min)	ASTM 4833
Flow Rate	135 gal / min/ ft2 (min)	ASTM D 4491
UV Resistance after 500 hrs	70%	ASTM D 4355

- B. Products: Subject to compliance with requirements, provide products by one of the following, or an approved equal:
1. Mirafi Inc.
 2. Hoechst Celanese Corporation.
 3. Amoco Fabrics and Fibers Company.

PART 3 - EXECUTION

3.1 LAYOUT, LINES AND LEVELS

- A. Establish base lines. Mark well and protect during construction.
- B. Check existing elevations.
- C. Corner, offset corners and grade stakes shall be located where spot elevations are shown, at breaks in grade, and as otherwise required to complete the work as shown.

3.2 DEWATERING

- A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
- B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain any pumps, well points, sumps, suction and discharge lines and any other dewatering system components as needed to convey water away from excavations.
- C. Convey water removed from excavations and rain water to collecting or run off areas. Establish and maintain temporary drainage ditches and other diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.
- D. Do not discharge sediment laden water into municipal systems or road-side conveyance system.

3.3 EXCAVATION

- A. Explosives: Do not use explosives.
- B. Unclassified Excavation: Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

3.4 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.
 - 1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
- B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations. Unauthorized excavation shall be at Contractor's expense.
 - 1. Under footings, fill unauthorized excavation by extending indicated bottom elevation of footing or bases to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position.
 - 2. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification.
- C. Additional Excavation:
 - 1. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material with subbase material and approved by The Owner's Representative
 - 2. Removal of unsuitable material and its replacement as directed will be paid on basis of contract conditions relative to changes in work.
- D. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling. Bracing will not be permitted against pipes or structures in trenches.
- E. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross braces in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses. Bracing will not be permitted against pipes or structures in trenches.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide required clearance on both sides of pipe or conduit.
 - 1. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations.
 - 2. For pipes or conduit less than 6" in nominal size, excavate beyond indicated depth. Hand excavate bottom cut to accurate elevations and support pipe on undisturbed soil.
 - 3. For pipes or conduit 6" or larger in nominal size, excavate to subbase depth indicated, or, if not otherwise indicated, to 6" below bottom of work to be supported.
 - 4. Except as otherwise indicated, excavate for exterior water-bearing drainage piping so top of piping is not less than 1'-6" below finished grade. Piping for domestic water and fire protection shall have top of piping 5'-0" below finished grade.
 - 5. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.
 - 6. Do not backfill trenches until tests and inspections have been made. Use care in backfilling to avoid damage or displacement of pipe systems.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.8 REVIEW OF SUBGRADE

- A. Notify Owner's Representative when excavations have reached required subgrade.
- B. When Owner's Representative determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner's Representative.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 STABILIZATION FABRIC

- A. Place stabilization fabric under pavement, where noted on plans, only after subgrade has been proof-rolled and weak subgrade materials replaced with suitable material.
- B. Fabric shall be installed prior to placement of the first course of subbase material.
- C. Stabilization fabric may be joined by either sewing or overlapping. Sewn seams shall be lapped a minimum of 4 inches and double sewn with nylon or polypropylene. Overlapped seams shall have a minimum overlap of 18 inches.
- D. Fabric which is torn or damaged shall be replaced or patched. The patch shall extend 3 feet beyond the perimeter of the tear or damage.
- E. Traffic or construction equipment shall not be permitted directly upon the fabric. Maintain a minimum of 8 inches loose thickness of aggregate above the stabilization fabric subject to traffic.

3.11 BACKFILL

- A. Backfill excavations promptly, but not before completing the following:
 - 1. Owner's Representative review of construction below finish grade.
 - 2. Surveying locations of underground utilities for record documents.
 - 3. Concrete formwork removal.
 - 4. Removal of trash and debris from excavation.
 - 5. Removal of temporary shoring and bracing, and sheeting.
- B. Backfill Around Structures and Utilities: No dumping shall be allowed where materials would flow against or around such structures. Place specified material in 6" layers thoroughly compacted by hand or pneumatic tampers to specified density.

3.12 FILL

- A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. Plow, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth recommended by the Owner's Testing Agency pulverize, moisture condition or aerate soil and re-compact to required density.
- C. Place fill material in layers to required elevations for each location listed below.
 - 1. Under grass, use satisfactory excavated or ordinary fill material.
 - 2. Under walks and pavements, use backfill material and/or subbase material as indicated.
 - 3. Adjacent to foundations and other excavations, use Backfill material.

4. Under slabs-on-grade, use Backfill Material to within eight inches of bottom of slabs.
5. Use Granular Fill between bottom of slab and Backfill Material.
6. Around underground utilities use backfill material.

3.13 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
 - a. Stockpile or spread and dry removed wet satisfactory soil material.

3.14 PLACEMENT AND COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure.
- C. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:
 1. Place fill in uniform layers of 6" deep. Compact fill to a density schedule at optimum moisture content as determined by AASHTO Standard Method T99 modified to suit 6" mold.
 2. Under steps, and pavements, compact each layer of backfill or fill material at 95 percent maximum dry density.
 3. Under walkways, compact each layer of backfill or fill material at 95 percent maximum dry density.
 4. Under lawn or unpaved areas, compact each layer of backfill or fill material at 90 percent maximum dry density.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between existing adjacent grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 0.10 foot.
 - 2. Walks: Plus or minus 0.10 foot.
 - 3. Pavements: Plus or minus 1/2 inch.
- C. Compaction: After grading, compact material to the depth and percentage of maximum density for each area classification.

3.16 SUBBASE COURSES

- A. Under pavements, place subbase course material on prepared subgrades.
 - 1. Compact subbase courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent of ASTM D 4254 relative density.
 - 2. Shape subbase to required crown elevations and cross-slope grades.
 - 3. When thickness of compacted subbase course is 6 inches or less, place materials in a single layer.
 - 4. When thickness of compacted subbase course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.17 FIELD QUALITY CONTROL

- A. Testing Agency Services: Allow Owners Testing Agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and retest until required density is obtained.

3.18 EROSION CONTROL

- A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction and as indicated.

3.19 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace material to depth directed by the Landscape Architect; reshape and re-compact at optimum moisture content to the required density.
- C. Settling: Where settling occurs, remove finished surfacing, backfill with additional specified material, compact, and reconstruct surfacing.
 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.20 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 312010

SECTION 312500

EROSION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of General and Supplementary General Conditions and Division 1 Specifications apply to work of this Section.

1.2 PROJECT DESCRIPTION

- A. The Contractor shall provide all labor, materials, equipment, and services necessary for, and incidental to, temporary measures to control soil erosion and water pollution through the use of berms, sediment basins, fiber mats, netting, stone, mulches, grasses, slope drains, silt fencing, straw bales, and other erosion control devices as shown on the Drawings or in accordance with State and Local regulations.
- B. The use of temporary control measures shall be coordinated with the permanent erosion control features specified elsewhere to the extent practical, to assure effective and continuous erosion control.

1.3 QUALITY ASSURANCE

- A. Reference Standards: The latest edition of the following standards shall be applicable.
 - 1. "New York Standards and Specifications for Erosion and Sediment Control", New York Soil and Water Conservation Society.

1.4 SUBMITTALS

- A. Submit product data, samples, specifications and manufacturer's installation procedures for approval.

1.5 PROJECT REQUIREMENTS

- A. The contractor shall maintain onsite a current copy of "New York Standards and Specifications for Erosion and Sediment Control".

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Temporary Seeding - Rye grass, cereal grasses, or other quick-growing species suitable to the area and as a temporary cover, which will not compete with the grasses specified for permanent cover.

- B. Permanent Seeding - (See specification section 329200 - "Lawns and Grasses")
- C. Fiber Blanket - "S75" by North American Green, "Curlex Blanket" by American Exclesior Company, or equal.
- D. Netting - "Enkamat" by American Enka Company, "Miramat" by Mirafi, or equal.
- E. Stone - NYSDOT Section 620-2.02, Fine
- F. Mulch - Straw, wood chips, or other suitable material reasonably clean of noxious weeds and deleterious materials.
- G. Slope Drains - Pipe, flexible pipe, stone, asphalt, concrete or plastic sheets.
- H. Silt Fencing - "Envirofence" by Mirafi, "Propex Silt Stop" by Amoco, or equal.
- I. Straw Bales - Straw bales, 2 inch x 2 inch stakes, and permeable gravel filter.
- J. Permanent turf reinforcement mat: "V Max" Sc250 by North American Green, or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. All work under this contract shall be performed in such a manner that objectionable conditions shall not be created in water courses through or adjacent to the project area.
- B. The Contractor may submit alternate schemes of control measures for each potentially impacted area prior to construction for engineer's approval.

3.2 INSTALLATION

- A. The Owner shall have the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface area of erodible earth material exposed by excavation, borrow and fill operations and to direct the contractor to provide immediate permanent or temporary pollution control measures to minimize damage to adjacent property and to minimize contamination of adjacent streams or other watercourses, lakes, ponds or other areas of water impoundment.
- B. The Contractor shall incorporate all permanent erosion control features into the project at the earliest practical time as outlined in his accepted schedule. Temporary control measures shall be those that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.
- C. Where erosion is likely to be a problem, clearing and grubbing operations should be so scheduled and performed that grading operations and permanent erosion control features can

follow immediately thereafter if the project conditions permit; otherwise temporary erosion control measures may be required between successive construction stages.

END OF SECTION 312500

SECTION 320111

PAVEMENT CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification sections, apply to work of this Section.

1.2 SUMMARY

- A. Sweep and clean pavement of dust and debris.

1.3 SUBMITTALS

- A. Equipment specifications / data.

1.4 QUALITY ASSURANCE

- A. Reference Standards: The latest edition of the following standards, as available herein, shall be applicable.
 - 1. "New York Standards and Specifications for Erosion and Sediment Control," New York Soil and Water Conservation Society.

PART 2 - TOOLS AND EQUIPMENT

2.1 MACHINERY

- A. General: Manually operated, gas powered air-broom or self-propelled sweeper designed especially for cleaning pavements are to be used to remove dust, dirt and debris from pavement surface.
- B. Hand Tools: Brooms, shovels, scrappers, etc.
- C. Road Sweeper with water spray bars.
 - 1. Road sweeper shall be Tymco 600 or approved equivalent.

PART 3 - EXECUTION

3.1 SURFACE INSPECTION

- A. Cracks and or pot holes

B. Stains

C. Vegetation

3.2 SWEEPING

A. Open parking lots shall be cleaned by using a road sweeper.

B. Enclosed areas and areas not accessible to the road sweeper shall be cleaned by small power and or hand tools.

3.3 FIELD QUALITY CONTROL

A. General: Allow owner's representative to inspect pavement surfaces for compliance with requirements for surface cleaning. Re-clean areas that are unsatisfactory to the owner.

3.4 CLEANUP

A. Entire area of pavement cleaning shall be left in a clean and orderly condition with no loose sediment at surface and all vegetation / debris removed.

3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove debris and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the Owner's property.

END OF SECTION 320111

SECTION 320119.61

SEALING CRACKS IN ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification sections, apply to work of this Section.

1.2 SUMMARY

- A. Random crack sealing.

1.3 JOB CONDITIONS

- A. Seal asphalt cracks only when atmospheric temperature is above 50 degrees Fahrenheit and when base is dry.

1.4 SUBMITTALS

- A. Material Certificates: Provide material certificates certifying that each material item complies with, or exceeds, specified requirements, include Material Safety Data Sheet.

1.5 QUALITY ASSURANCE

- A. Testing Service: The Owner will engage a testing laboratory to verify compliance to asphalt specified thickness.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradation which exhibit a satisfactory record of previous installations.
- B. Random crack sealer:
 - 1. Crack sealer material:
 - a. Federal Specification SS-S-1401C or ASTM D3405 hot-poured joint sealer.
 - b. SS-C-192g Portland cement, type 1 or 2.
 - c. Bituminous treated hemp or jute roving or reclaimed neoprene material ground to maximum size of 1/4"
 - 2. Crack sealer material shall be as manufactured by one of the following or an approved equivalent:

- a. Copeland Coating Company.
- b. ROADSaver 222, by Crafcro Inc.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Clean asphalt surface over cracks to receive asphalt overlay fabric where noted on plan.

3.2 RANDOM CRACK SEALING

- A. Refer to contract drawing for approximate limits of random crack sealing.
- B. All cracks shall be thoroughly cleaned to remove all dirt, moisture foreign material and loose edges from crack wall, by use of compressed air or other approved means.
- C. All cracks of sufficient depth and 3/4-inch or over in width shall first be pre-filled with bituminous treated hemp or reclaimed neoprene to a maximum size of 1/4 to 1/2-inch to within 1-inch of top of pavement before applying prepared joint sealer.
- D. Joint sealing material shall be heated to approximately 600-degrees or as recommended by the manufacturer. Cracks shall be filled flush with pavement.
- E. Any workmanship determined to be below the high standards of the particular craft involved will not be accepted and will be corrected and / or replaced as directed by the Engineer.

3.3 CLEANUP

- A. Entire site shall be left in a clean and orderly condition with all construction materials, debris, tools, and equipment removed.

END OF SECTION 320119.61

SECTION 32 01 19.75

ASPHALT SEALING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification sections, apply to work of this Section.

1.2 SUMMARY

- A. The extent of the asphalt seal coating is noted on the contract drawings.

1.3 JOB CONDITIONS

- A. Apply Asphalt Seal Coating only when atmospheric temperature is above 50 degrees Fahrenheit, and when base is dry, with a relative humidity near 50% and permeably accompanied by a slight breeze. The contractor shall verify local weather reports that rain is not forecasted or eminent for 24-hours
- B. Contractor shall notify the Owner 24-hours before applying asphalt seal coat.
- C. Contractor shall provide barricades, fencing, and signage to keep vehicles and pedestrians out of areas to be seal coated.
- D. A pre- construction meeting will be required between the applicator and engineer before the contractor starts any seal coat work.

1.4 SUBMITTALS

- A. Material Certificates
 - 1. Provide material certificates, including MSD sheets, certifying that each material item complies with, or exceeds, specified requirements.

1.5 QUALITY ASSURANCE

- A. The asphalt seal coat shall be applied to previously prepared sound, bituminous asphalt paving.
- B. Testing Service
 - 1. The Owner may engage a testing laboratory to verify compliance of product and application.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradation which exhibit a satisfactory record of previous installations.
- B. Asphalt sealer:
 - 1. Asphalt sealant material:
 - a. Shall be "Jennite" pavement sealer as manufactured by NEYRA Industries, Inc. or an approved equivalent.
 - b. Provide NJ-S1 Low Traffic System.
- C. Mineral Aggregate: Shall be clean, dry, hard, durable, evenly graded silica sand. Sand shall have of sieve gradation rating of 45 to 85.
- D. Oil Spot Primer: As recommended by asphalt sealant manufacturer.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Clean surface per Section 320111 - "Pavement Cleaning."
- B. Removal all vegetation from surface to be coated.
- C. Fill cracks 1/8" and wider per Section 320119.61 - "Sealing Cracks in Asphalt Paving."
- D. Petroleum stains and oil spots shall be cleaned by scraping or wire brushing the area and /or lightly burring off the area with a propane torch to remove volatile. These areas shall then be coated with Oil Spot Primer.
- E. After inspecting asphalt surface, apply one coat of asphalt primer per manufactures' instructions.
- F. Apply one coat of asphalt slurry seal coat per manufactures directions.
- G. Apply Seal Coat to dry surfaces per manufacturer's recommendations.
- H. Each seal coat application shall be allowed to dry and cure to the touch before applying subsequent sealcoats.
- I. The final coat should be allowed to dry and cure under good drying conditions for the time specified by the manufacturer before allowing traffic.
- J. Any workmanship determined to be below the high standards of the particular craft involved will not be accepted and will be corrected and / or replaced as directed by the Engineer.

3.2 CLEANUP

- A. Entire site shall be left in a clean and orderly condition with all construction materials, debris, tools, and equipment removed.

END OF SECTION 320119.75

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification sections, apply to work of this Section.

1.2 SUMMARY

- A. The extent of paving is shown on the drawings.

1.3 JOB CONDITIONS

- A. Surface Conditions: Asphalt paving shall not be placed until subbase surface is checked for grades. Surface must not be wet or soft.
- B. Construct asphalt surface course only when atmospheric temperature is above 50 degrees Fahrenheit and when base is dry.
- C. Grade Control: Establish and maintain required lines and elevations.

1.4 SUBMITTALS

- A. Material Certificates for asphalt pavement: Provide material certificates certifying that each material item complies with, or exceeds, specified requirements.

1.5 QUALITY ASSURANCE

- A. Testing Service: The Owner may engage a testing laboratory to verify compliance to asphalt temperature placement, specified thickness, and density.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradation that exhibit a satisfactory record of previous installations.
- B. Asphalt-aggregate mixture:
 - 1. Provide asphalt-aggregate mixture as follows: NYS DOT Table 401-1, Type 1 base, Type 3 binder, and Type 7 top course.

- C. Tack Coat: Cut-back asphalt; ASTM D 977, NYS DOT Item 702-11, 702-12, 702-14, Table 702-3, per testing requirements on Table 702-9. Tack coat shall not be used on porous asphalt.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

- A. Proof roll prepared subbase surface to check for unstable areas and areas requiring additional compaction.
- B. Do not begin paving work until deficient subbase areas have been corrected and are ready to receive paving.
- C. Tack Coat: Apply to contact surfaces of previously constructed asphalt and portland cement concrete and surfaces abutting or projecting into asphalt concrete pavement. Distribute at rate of 0.05 to 0.15 gallons per square yard of surface.

3.2 PLACING MIX

- A. General: Place asphalt concrete mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 250° Fahrenheit. Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness.
- B. Pavement Placement: Place in strips not less than 10 feet wide, unless otherwise acceptable. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
- C. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

3.3 ROLLING

- A. General: Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
 - 1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927 AASHTO T 245, but not less than 94 percent or greater than 100 percent.

2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent or greater than 96 percent.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and 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.

3.4 FULL DEPTH ASPHALT PAVING.

- A. Refer to Specification section 31 20 10 - Earth Moving Outside Building for excavation, placement and subbase material.
- B. Provide and place indicated asphalt binder and topping thickness. Shape, by rolling, pavement to provide a smooth but positive slope that abuts flush with existing pavement.
- C. Seal joints between new and existing asphalt pavement.

3.5 FIELD QUALITY CONTROL

- A. General: Allow testing agency to inspect asphalt courses for compliance with requirements for thickness and surface smoothness. Repair or remove and replace unacceptable paving.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding the following allowable variation from required thickness:
 1. Parking Lots
 - a. Binder Course: 1/2" plus
 - b. Top Course: 1/4" plus
- C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness using a 10-foot straightedge applied parallel with and at right angles to centerline of paved areas. Surface will not be acceptable if exceeding the following tolerances for smoothness:
 1. Parking Lots
 - a. Binder Course: 3/8"
 - b. Top Course: 1/8"

- D. In-Place Density: Testing agency shall determine density of asphalt paving by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

3.6 CLEANUP

- A. Entire site shall be left in a clean and orderly condition with all construction materials, debris, tools, and equipment removed.

END OF SECTION 321216

SECTION 321313

CONCRETE WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification Sections, apply to work of this section.
- B. See Division 31 Specification Sections for foundation excavation, backfill, and slab subgrade information.

1.2 SUMMARY

- A. Extent of concrete work is shown on drawings.
- B. Pervious Concrete.

1.3 SUBMITTALS

- A. Reinforcing Shop Drawings: Submit original shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with CRSI - Manual of Standard Practice showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures. Submit two prints of each drawing. Reproduction of contract drawings is not permitted.
- B. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design test.
- C. Material Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Architect. Material certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.
- D. Product Data: Submit data on admixtures, anchors, forming accessories, waterstops, vapor retarders, curing compounds, non-shrink grout.
- E. Qualifications listed under 1.04 Quality Assurance for installer of Pervious Concrete Pavement.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301 "Specifications for Structural Concrete for Buildings."
 2. ACI 318 "Building Code Requirements for Reinforced Concrete."
 3. Concrete Reinforcing Steel Institute, (CRSI) "Manual of Standard Practice."
- B. Concrete Testing Service: The Owner will employ and pay for an independent testing laboratory to perform material evaluation tests and to design concrete mixes.
- C. Materials and installed work may require testing and retesting at anytime during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.
- D. Preconstruction Meeting: Convene a preconstruction meeting with the Contractor's Superintendent and Contractor's concrete supplier, flatwork installer, testing laboratory and the Engineer to review procedures to be used to place, protect, cure and finish the concrete components in the project.
- E. At or before the pre-construction meeting, the bidder/contractor shall submit evidence that a minimum of two members of the crew shall be certified by the NRMCA Pervious Concrete Contractor Certification program, or equal. A Minimum of one Certified individual as listed above must be present on each pervious concrete placement, and the certified individual must be in charge of the placement crew and procedures.
- F. Bidder and bidder's concrete supplier must supply proof of NRMCA Pervious Concrete Certification, or equal, and proof of two successful pervious concrete pavement projects, each greater than 1,000 square feet, including but not limited to the following:
1. Project name and address, owner name, and contact information.
 2. Test results including density (unit weight), void content, and thickness.
 3. This requirement may be waived by the Architect/Engineer provided the Bidder/Contractor demonstrates successful experience in the concrete industry and constructs test panel(s) for inspection and testing.

1.5 WATER CONTENT OF DELIVERED CONCRETE:

- A. The concrete supplier shall certify that no "trim water" or any other description or amount of water which does not show on the truck ticket, including any "drum water" or any water in the truck before batching of the concrete, has been added to the mix.
- B. The truck batch tickets will include the amount of water that can be added to the truck's batched mix without exceeding the specified W/C ratio. If water is added at the site, it must be recorded on the ticket.

1.6 PROJECT CONDITIONS

- A. Protection of Footings Against Freezing: Cover completed work at footing level with sufficient temporary or permanent cover as required to protect footings and adjacent subgrade against possibility of freezing; maintain cover for time period as necessary.

- B. Protection of Slab Subgrade Against Heaving: Sequence work, provide temporary heat, or provide sufficient cover as required to prevent subgrade under slabs on grade from heaving or settling due to freezing.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth exposed surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
- D. Form Ties: Factory-fabricated, adjustable-length, removable or snap off metal or fiberglass form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units which will leave no metal closer than 1" to surface.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.
- D. Supports for Reinforcement: Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or I/II. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.
- B. Fly Ash: ASTM C 618, Type C or F with Loss on Ignition no greater than 6%.
- C. Normal Weight Aggregates: ASTM C33, Class "S", and as herein specified. Provide aggregates from a single source for exposed concrete. Coarse aggregate to be crushed, without whole, uncrushed gravel.
- D. Pervious Concrete Aggregate:

1. Use No. 8 coarse aggregate (3/8" to No. 16) per ASTM C 33 or No. 89 coarse aggregate (3/8" to No. 50) per ASTM D 448.
 2. For fine aggregate, provide aggregate complying with ASTM C 33. Fine aggregate should make up 6 percent (+/- 2 percent) of the total aggregate weight to improve cold-climate durability.
 3. A combined coarse and fine aggregates gradation shall be provided and a minimum of 10 percent of the material shall pass the No. 4 U.S. Sieve.
 4. If other gradation of aggregate is to be used, submit data on proposed material to owner for approval.
- E. Water: Potable.
- F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. "Air-Mix": Euclid Chemical Co.
 - b. "Sika AER"; Sika Corp.
 - c. "MB-VR or MB-AE"; Master Builders
 - d. "Darex AEA" or "Daravair"; W.R. Grace.
- G. Water Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. "Accelguard 90"; Euclid Chemical Co.
 - b. "Pozzolith 122-HE"; Master Builders.
 - c. "Gilco Accelerator"; Gifford-Hill/American Admixtures
- H. Strength-Accelerating Admixture: ASTM C 494, certified by manufacturer to be compatible with other admixtures.
- I. Mid - Range Water Reducing Non-Chloride Admixture: ASTM C494, Type A and F, certified by manufacturer to be compatible with other admixtures.
1. Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:
 - a. "PolyHeed 997"; Master Builders Technologies
 - b. "Daracem ML 330"; Grace
 - c. "Sikament 86"; Sika Corp.
- J. Prohibited Admixtures: Calcium chloride thiocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.

- K. Fibrous Reinforcement: Collated, fibrillated, polypropylene fibers, 3/4" maximum length. Fiber-reinforced concrete shall comply with ASTM C1116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete". Dosage rate of 1.5 pounds per cubic yard to produce concrete which complies with ASTM C-1116, Performance Level I.

2.4 LIQUID APPLIED WATERPROOFING MEMBRANE

- A. Products: Subject to compliance with requirements, provide one of the following, or an approved equal:
1. Sonoshield HLM 5000
 2. Tremco Tremproof 201/60
 3. Sika Sikalastic 450

2.5 DETECTABLE WARNING TILE UNITS

- A. Replaceable Composite Cast In Place Tiles: A homogenous glass and carbon composite which is colorfast and UV stable. Truncated domes shall be fiberglass reinforced. Tiles shall meet AASHTO HS20 vehicle loading. Install per manufacturers recommendations.

B. Physical Characteristics:

1.	Compressive Strength	28,900 psi	ASTM D 695
2.	Flexural Strength	29,300 psi	ASTM D 790
3.	Water Absorption	.07%	ASTM D 570
4.	Slip Resistance	1.18 Dry, 1.05 Wet	ASTM C 1028
5.	Flame Spread Index	20	ASTM E 84
6.	Salt Spray	No Change (200 hours)	ASTM B 117
7.	Chemical Stain Testing	No Deterioration	ASTM 1308
8.	Abrasion Resistance	549	ASTM C 501
9.	Accelerated Weathering	Delta E < 5.0 (2,000 hours)	ASTM G 155
10.	Tensile Strength	11,600 psi	ASTM D 638
11.	Load Bearing at 16,000 lbs.	No Damage	AASHTO-H20
12.	Freeze/Thaw/Heat	No Disintegration	ASTM C 1026

- C. Fasteners: 1/2 inch by 1-1/2 inch stainless steel bolts.

- D. Color: Brick Red, Federal Standard #22144.

- E. Subject to compliance with requirements, provide the following or an approved equal:

1. Replaceable Composite (Wet-Set) Tactile Warning Surfaces for Pedestrians, as manufactured by ADA Solutions, Inc., www.adatile.com, (800-372-0519)

- F. Warranty: Units shall be guaranteed in writing for a period of five (5) years from date of contract's final completion. The guarantee includes defective work, breakage, deformation, and loosening of the tactile warning surface material.

2.6 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type of strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. Mix designs submitted for review shall be less than one year old and shall be representative of the concrete materials currently being used. If trial batch method used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.
- B. Submit written reports to the Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Architect.
- C. Acceptance of design mix will require that average strength of test cylinders exceed the specified strength (f'c) established by ACI 318 Section 5.3. If a suitable record of strength test performance is not available from the concrete supplier, proportions of the design mix shall be selected to provide an average strength at least 1200 psi greater than the specified strength (f'c).
- D. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

1. Sidewalks, Concrete Paver containment band at Hazard Branch:

56 day compressive strength	-	4500 psi
Max. Aggregate Size	-	1-1/2"
Air Entrainment	-	5% to 7%
Maximum W/C	-	.45
Slump	-	4" max
Fly Ash	-	20%
Fibrous Reinforcement	-	1.5 lbs. per cu. yd.

2. Sidewalks - City of Syracuse Standard (Delayed Integral Topping):

Concrete Base:

Min. 28 day compressive strength	4000 psi
Min. Cement Factor	6 Bags
Max. Aggregate Size	1"
Air Entrainment	5% to 7%
Maximum W/C	.45
Slump Range	4 - 6 inches
Fibrous Reinforcement	1.5#/cy

Concrete Topping:

Min. 28 day compressive strength	5000 psi
Minimum Cement Content	10.0 bags/cu. yd.
Max. Aggregate Size	1/4" crushed stone (Concrete sand)
Air Content	7% to 8%
Maximum W/C	.45

Concrete Base:

Slump Range 3" to 4" slump

3. Curb Backing, Sign and Bollard Footings:
 - Compressive Strength: - 3000 psi
 - Max. Aggregate Size: - 1-1/2"
 - Maximum W/C - .50
 - Slump - min. 1" max. 5"

4. Concrete Grade Extensions, Heavy Duty Concrete:
 - 56 day compressive strength - 5000 psi
 - Max. Aggregate Size - 1-1/2"
 - Air Entrainment - 5% to 7%
 - Maximum W/C - .40
 - Slump - 4" max
 - Fly Ash - 20%

5. Pervious Concrete:
 - a. Cement Content: For pavements subjected to vehicular traffic loading, the total cementitious material shall not be less than 600 lbs per cubic yard.
 - b. Aggregate Content: The volume of aggregate per cubic yard shall be equal to 27 cubic feet when calculated as a function of the unit weight determined in accordance with ASTM C 29 jigging procedure. Fine aggregate, if used, should not exceed 3 cubic feet and shall be included in the total aggregate volume.
 - c. Admixtures: Shall be used in accordance with the manufacturer's instructions and recommendations.
 - d. Mix Water: Mix water shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. (Mix water yielding a cement paste with a dull-dry appearance has insufficient water for hydration.)
 - e. Insufficient water results in inconsistency in the mix and poor bond strength.
 - f. High water content results in the paste sealing the void system primarily at the bottom and poor surface bond.
 - g. An aggregate/cement (A/C) range of 4:1 to 4.5:1 and a water/cement (W/C) ratio range of 0.27 to 0.34 should produce porous pavement of satisfactory properties in regard to permeability, load carrying capacity, and durability.

- E. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by the Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the Engineer before using in work.

- F. Admixtures:
 1. Use water-reducing admixture in concrete as required for placement and workability.

2. Use air-entraining admixture in exterior exposed concrete and concrete exposed to freezing temperatures during construction. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus-or-minus 1.0 percent within following limits:
 - a. 1-1/2" max. aggregate: 6.0 percent

2.7 CONCRETE MIXING

- A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
- B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.
- C. Pervious Concrete:
 1. Mix Time: Truck mixers shall be operated at the speed designated as mixing speed by the manufacturer for 75 to 100 revolutions of the drum.
 2. Transportation: The aggregate mixture may be transported or mixed on site and should be used within one (1) hour of the introduction of mix water, unless otherwise approved by the Engineer. Each truck should not haul more than two (2) loads before being cycled to another type concrete.

2.8 CURING COMPOUND

- A. Liquid type, water base, V.O.C. complying with ASTM C-309.
- B. Products: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 1. "Master-Kure 200 W" by Master Builders Inc.
 2. "RX Cure" by Conspec
 3. "Kurez DR" by The Euclid Chemical Company

2.9 CONCRETE SEALER

- A. Anti-spalling compound shall be a clear penetrating solution which will not discolor or alter the appearance of concrete.
- B. Products: Provide the following or an approved equal:
 1. ENVIROSEAL 40.

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral static and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position. Maintain formwork construction tolerances as noted in ACI 347, Section 3.3.1.
- B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- E. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges if indicated on structural or architectural drawings, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.
- H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retightening forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

3.3 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.4 JOINTS

- A. The maximum length of any section of slab placed monolithically, without formed construction joints or metal shear key bulkheads, shall be 75 feet in any direction.
- B. Construction Joints: Locate and install construction joints as indicated, or if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.
- C. For joints in pervious concrete:
 - 1. Joints shall be installed by rolling not sawing. They shall be installed immediately after rolling, before curing. They shall be constructed by attaching a beveled fin with a minimum depth of 1/4 the thickness of the slab which has been attached around the circumference of a steel roller. Layout as shown on the plan.
 - 2. Edging shall not be performed along joints in order to reduce potential for raveling under traffic.
 - 3. Isolation joints shall only be used when abutting fixed vertical structures such as light pole bases, building foundations, etc.

3.5 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.6 PREPARATION OF FORM SURFACES

- A. Clean re-used forms of concrete matrix residue. Repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.

- C. Thin form-coating compounds only with thinning agent of type, and amount, and under conditions of, form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.7 CONCRETE PLACEMENT

- A. **Preplacement Inspection:** Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
- B. Prior to placing pervious concrete, the subbase shall be thoroughly moistened and in a wet condition. Failure to provide a moist subbase will result in a reduction in strength of the pavement.
- C. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as close as practicable to its final location to avoid segregation.
- D. **Placing Concrete in Forms:** Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI Specifications.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- E. **Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 - 1. The contractor shall use special precautions in placement of concrete slabs on metal deck and ground to prevent excessive shrinkage, cracking, and slab curl. Slump limitations, timing of concrete placement with regard to atmospheric conditions and curing are several but not necessarily all the requirements that should be met. If curling and/or shrinkage cracks should develop, the contractor shall correct the condition, including grinding, at his own expense.
 - 2. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 4. Maintain reinforcing in proper position during concrete placement operations.
- F. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures. Work on this project shall conform to all requirements of ACI 306.1, Standard Specification for Cold Weather Concreting, published by the American Concrete Institute, Detroit, Michigan, except as modified by the requirements of these Contract Documents.
1. When air temperature has fallen to or is expected to fall below 40°F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- G. Placing Pervious Concrete:
1. Rolling compaction shall be achieved using a steel roller that spans the width of the section being placed and that exerts a minimum vertical pressure of 10 psi on the concrete or by using a hydraulically actuated rotating, weighted, tube screed (i.e. Allen Engineering, Bunyan, or equivalent roller screed). The pervious concrete pavement shall be placed to the required cross section and shall not deviate more than +/- 3/8 inch in 10 feet from profile grade.
 2. Placement should be continuous and spreading and strikeoff should be rapid. It is recommended to strike off about 1/2 to 3/4 inch above the forms to allow for compaction. An adjustable-height vibratory screed may be used to provide this extra height. With vibratory screeds, care should be taken that the frequency of vibration is reduced to avoid over compaction or closing off of the surface. Edges near forms shall be compacted using a 1-foot by 1-foot steel tamp, a gloat, or other similar device to prevent raveling of the edges. If vibration, internal or surface applied, is used, it shall be shut off immediately when forward progress is halted for any reason.
 3. Consolidation shall be accomplished by rolling over the concrete with a steel roller, compacting the concrete to the height of the forms. Consolidation shall be completed within 15 minutes of placement to prevent problems associated with rapid hardening and evaporation. Cross-rolling should be performed using the minimum number of passes required to achieve an acceptable surface; however, overworking the concrete will close voids and limit porosity.
 4. No finishing operation other than that described in this specification shall be allowed unless otherwise approved by the Engineer. The Contractor will be restricted to pavement placement widths of a maximum of fifteen feet (15') unless the Contractor can demonstrate competence to provide pavement placement widths greater than the maximum specified to the satisfaction of the Engineer.
 5. Porous concrete shall not be placed later than September 1st.

- H. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 3. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.
 4. Contractor shall make preparations for protecting the concrete before placement. Materials and means shall be on hand for erecting temporary windbreaks, and shades as needed to protect against drying winds and direct sun light.

3.8 FINISH OF FORMED SURFACES

- A. General: Remove all ties and patch holes, including those below grade. All exposed to view concrete to conform to Architectural concrete per ACI 301 and have a pleasing appearance with minimal color and texture variations and minimal surface defects when viewed at a distance of 20'
- B. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work unless otherwise indicated. Concrete surface to have texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

3.9 MONOLITHIC SLAB FINISHES

- A. Sidewalk and Stair Finishing: Shall be done by competent masons who can produce a walk of uniform texture and color. The topping shall be finished with a wood float. Walks shall be textured with a hair broom to form a non-slip surface. Finish all edges with an edging tool 1/2" radius. This includes all scored or tooled joints.

3.10 CONCRETE CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Special precautions shall be taken for concrete slabs exposed to high winds and direct sun.
- B. Cold Weather Curing: Work on this project shall conform to all requirements of ACI 306.1, Standard Specification for Cold Weather Concreting, published by the American Concrete Institute, Detroit, Michigan, except as modified by the requirements of these Contract Documents.
- C. Begin curing procedures before concrete surface has dried. Continue curing for not less than 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

- D. Heated blankets shall be used during curing if the temperature is expected to drop below 50 degrees fahrenheit.
- E. Concrete curing for sidewalks and slabs shall be achieved as follows:
 - 1. Apply curing compound to concrete surface immediately after finishing of concrete.
 - 2. After the concrete has set, cover concrete surface with a moisture curing blanket, thoroughly saturating cover with water and keeping continuously wet for a minimum of 4-days. Concrete shall remain fully covered for a minimum of 7-days. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
 - 3. Curing for pervious concrete shall be achieved as follows:
 - a. Curing procedures shall begin within 20 minutes after placement. Placing, finishing, and joints must be completed within the 20-minute window after discharge.
 - b. Curing shall be wet curing only.
 - c. Curing shall be for 7 days minimum. After 7 days passenger car / light truck use is acceptable. No truck traffic for 10 days.

3.11 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of walls and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10 deg C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
- B. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.
- C. Stair forms shall be stripped within 12 hours and stripped of concrete placement, and hand rubbed while the concrete is still green to fill all voids, air holes, etc.

3.12 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.13 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.
- B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color

and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

3.14 SEALANTS

- A. Allow concrete to cure a minimum of 21 days before applying sealant.
- B. Surfaces shall be cleaned with a wire brush and shall be free of dirt, moisture, loose particles, oil and curing compound.
- C. Apply primer in accordance with manufacture's instructions
- D. Mix and install sealant in accordance with manufacture's instructions.
- E. Expansion joints should have a maximum width of 1/2 - inch x 1/2 -inch deep.
- F. Clean surfaces of excess sealant.
- G. Protect sealant from pedestrian and vehicular traffic until sealant has cured.
- H. Pervious concrete shall not receive sealant.

3.15 CONCRETE SEALER

- A. Apply Concrete Sealer to concrete surfaces no sooner than 21 days after placement, to clean, dry concrete free of oil, dirt, and other foreign material. Apply Concrete Sealer in one application at the rate of 150 sq. ft./gallon. Apply concrete sealer per manufacturer's recommendations.

3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. Sampling and testing for quality control during concrete placement will be provided by the Owner and may include the following:
 - 1. Concrete testing shall occur, at minimum, during the arrival of the first and second truck of the day to verify that the concrete meets the design requirements. Concrete testing for each truck shall occur as follows:
 - a. Testing for the first truck shall include Slump, Air content and temperature and Compression Test Specimens.
 - b. Test for the second truck shall include Slump, Air content and temperature.
 - c. Testing shall occur for every other truck after the second truck and in which testing shall include Slump, Air content and temperature, up to 50 cu. yds, of concrete placed at which point Compression Test Specimens will be taken and the testing cycle shall be repeated.
 - 2. Slump: per ASTM C 143.
 - 3. Air Content: per ASTM C 173.

4. Concrete Temperature: ASTM C 1064.
 5. Compression Test Specimen: ASTM C 31; one set of four standard cylinders for each compressive-strength test. unless otherwise directed. Mold and store cylinders for laboratory-cured test specimens.
 6. Compressive-Strength Tests: ASTM C 39; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.
- B. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength and no individual strength test result falls below specified compressive strength by more than 500 psi.
- C. Test results will be reported in writing to the Contractor, Concrete Supplier and Engineer.
1. Reports of compressive strength tests shall contain the following:
 - a. Project identification name and number.
 - b. Date of concrete placement, name of concrete testing service.
 - c. Concrete type and class.
 - d. Detailed and specific location of concrete placement
 - e. Design compressive strength at 28 days. (Based on approved concrete mix design)
 - f. Concrete mix proportions and materials.
 - g. Compressive breaking strength and type of break for both 7-day tests and 28-day tests.
 - h. Provide concrete design parameters, ie: compression strength, w/c ratio, air and slump per approved concrete mix design.

END OF SECTION 321313

SECTION 321400

UNIT PAVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification Sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The Contractor shall provide all labor, materials, equipment and services necessary for and incidental to, the placement of unit pavers as shown on the Drawings and as specified herein.
- B. Installer Qualifications: Engage an experienced installer who has successfully completed unit paver installations similar in material, design, and extent to that indicated for Project.
- C. Single-Source Responsibility: Obtain each color, type, and variety of unit pavers and setting materials from a single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying progress of the Work.

1.3 SUBMITTALS

- A. Samples for initial selection purposes in form of actual unit paver showing full range of colors, textures, and patterns available.

1.4 PROJECT CONDITIONS

- A. Protect unit pavers and aggregate during storage and construction against wetting by rain, snow, or ground water and against soilage or contamination from earth and other materials.
- B. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Permeable Clay Unit Pavers - Provide the following or an approved equivalent:
 - 1. Pine Hall Brick Porous Paver:
 - a. 2-3/4" x 8" x 4"
 - b. Style: English edge
 - c. Color: Red

B. Mow edge / and paver edge restraints with granular subbase anchoring system - Provide the following or an approved equivalent:

1. Product: PermEdge.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION

A. Paver bedding material will be placed on a stone base.

3.2 INSPECTION

A. Verify gradients and elevations of base are correct.

3.3 INSTALLATION

A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible or cause staining in finished work.

B. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

C. Spread the NYSDOT #1A course evenly over the filter fabric and screed to 1" inch thickness. The screeded 1A material should not be disturbed. Place sufficient 1A material to stay ahead of the laid pavers.

D. Set unit pavers in pattern indicated. Maintain straight pattern lines. Joints between the pavers shall be based on the paver separation nubs.

E. Fill gaps at the edges of the paved area with cut pavers or edge units.

F. Use a low amplitude, high frequency plate vibrator capable of 3000 to 5000 lbs. centrifugal compaction force to vibrate pavers into sand.

G. Remove and replace unit pavers which are loose, chipped, broken, stained, or otherwise damaged, or if pavers do not match adjoining paver. Provide new pavers to match adjoining pavers and install in same manner as original with same joint treatment to eliminate evidence of replacement.

H. Sweep NYSDOT #1A stone into joints. Fill all joints and sweep off excess when the job is complete.

I. Provide final protection and maintain conditions in a manner which ensures unit paving work is without damage or deterioration at the time of Substantial Completion.

3.4 TOLERANCES

- A. Surface Smoothness: Surface will not be acceptable if exceeding the following tolerances for smoothness by using 10' straightedge applied parallel with and at right angles to, centerline of paved areas.
- B. Surface Course: 1/8"

END OF SECTION 321400

SECTION 321600

GRANITE CURBS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.2 SUMMARY

- A. This section includes:
 - 1. Granite curb installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Refer to Section 321313 Concrete Work and Section 312010 Earth Moving Outside Building.
- B. Granite Curb: Shall be free from seams which would impair its strength. The curb shall have a sawed top and smooth quarry split face. No drill marks shall appear on the exposed faces, nor on the top of the back of the curb.
 - 1. The ends of all stones shall be square with the planes of the top and face, and so finished that when the stones are placed end to end as closely as possible, no space more than one-half (1/2) inch shall show in the joint for the full width of the top or down on the face for eight (8) inches.
 - 2. Minimum length shall be 4 ft.; maximum 8 ft. All curbs set to radius of less than 50 ft. shall be cut to the curve required.
 - 3. Size: 5-inch width.
 - 4. Manufacturers: Subject to compliance with requirements, manufacturers providing products which may be incorporated in the Work include, but are not limited to, the following:
 - a. H. E. Fletcher Company
 - b. Barretto Granite Corporation
 - c. North Carolina Granite Corporation
- C. Mortar for joints shall be lime-cement mortar, 1:1:3 (cement, lime and sand by volume) gray in color.
- D. Dry concrete shall be mixed in the following proportion:

- (1.5) one and a half parts of Portland Cement.
- (3) three parts of fine aggregate.
- (6) six parts of coarse aggregate.

PART 3 - EXECUTION

3.1 GRANITE CURBING

- A. Grade: As shown on plan and detail; not more than 1/4" from established by spot elevations and contours.
- B. Profile: No deviation in excess of 3/8" as shown by a 10' straightedge.
- C. The curb shall be set in trench, as shown on the details and in the following manner: A four (4) inch layer of dry concrete mix shall be placed upon the prepared stone foundation.
- D. The curb shall be set carefully to line and grade, with close joints and even and continuous surfaces, upon the concrete foundation. Concrete is to be placed back of the curb to within six (6) inches of the curb grade, and in front to the subgrade of the concrete foundation for the pavement.
- E. Drop curb: Set as per details, and in locations shown.

3.2 CLEANUP

- A. Contractor shall remove stains from curbing and leave work site in a neat and clean condition.

END OF SECTION 321600

SECTION 321723.13

PAINTED LINE MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification sections, apply to work of this Section.

1.2 SUMMARY

- A. Provide painted line markings.

1.3 JOB CONDITIONS

- A. Surface Conditions: Asphalt paving shall not be placed until subbase surface is checked for grades. Surface must not be wet or soft.
- B. Place line markings on asphalt surface course only when atmospheric temperature is above 50 degrees Fahrenheit and when base is dry.
- C. Grade Control: Establish and maintain required lines and elevations.

1.4 SUBMITTALS

- A. Material Certificates: Provide material certificates certifying that each material item complies with, or exceeds, specified requirements.

1.5 QUALITY ASSURANCE

- A. Testing Service: The Owner will engage a testing laboratory to verify compliance to asphalt specified thickness.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Use locally available materials and gradation which exhibit a satisfactory record of previous installations.
- B. Line Paint: Chlorinated Rubber-Alkyd type, AASHTO M 248 (FS TT-115), Type III or 100% acrylic waterborne traffic paint.
- C. Provide traffic paint provide by one of following manufacturers or approved equivalent:
 - 1. Sherwin Williams Leadfree paint or approved equivalent.

2. TTP-85 Alkyd Zone Marking Paint, by Franklin Paint Company.
3. Hydrophast, Waterborne Traffic Paint by Franklin Paint Company.

PART 3 - EXECUTION

3.1 PAINTED LINES AND ACCESSIBILITY SYMBOLS

- A. All surfaces shall be cleaned, free of dirt, sand, grease, oil , salt, etc
- B. Layout: contractor shall accurately layout all parking stalls and line markings.
 1. Line markings shall be uniform and straight lines, unless noted otherwise.
- C. Paint four inch wide strips, unless noted otherwise. Paint shall be applied to dry surfaces with the temperature at 50 degrees Fahrenheit or above.
 1. Color: Shall match existing, or:
 - a. Striping shall be: white.
 - b. Handicapped symbols shall be: blue.
 2. Line markings shall be applied with two coats of paint at the rate of 7 to 8 mils each coat. Allow 24 hours between coats. Applying line markings in one thick coat is not allowed.
- D. Paint handicap parking space symbol per detail.

3.2 CLEANUP

- A. Entire site shall be left in a clean and orderly condition with all construction materials, debris, tools, and equipment removed.

END OF SECTION 321723.13

SECTION 323113

CHAIN LINK FENCE

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification sections, apply to the work of this Section.

1.2. DESCRIPTION OF WORK

- A. The scope of this section includes all labor, materials, tools, equipment, trucking and all related items to furnish and install all work of this section as shown on the drawing and specifications.

- 1. Extent of chain link fences and gates is indicated on drawings.

1.3. QUALITY ASSURANCE

- A. Provide chain link fences and gates as complete units controlled by a single source, including necessary erection accessories, fittings, and fastenings.

1.4. SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for metal fencing, fabric, and swing gates.
- B. Shop Drawing: Submit dimensioned shop drawings indicating plan and sections, showing gauges for major elements.

PART 2 - PRODUCTS

2.1. GENERAL

- A. Dimensions for fence: See drawings, or existing conditions.
- B. Manufacturer: Subject to compliance with requirements, provide products by one of the following or an approved equal:
 - 1. Bethlehem Steel
 - 2. U. S. Steel
 - 3. Page Aluminized Steel Corporation
- C. Steel Fabric:

1. Comply with Chain Link Fence Manufacturers Institute (CLFMI) Product Manual. Furnish one-piece fabric widths for fencing up to 12 feet high. Wire size does not include aluminum coating.
 - a. Standard fence size: 2-inch mesh, 9 gauge.
 2. Fabric Finish: Aluminized, protective coating per ASTM A491.
 3. Selvage: Top and bottom shall be knuckled at both selvages.
- D. Framing
1. Steel Framework: Schedule 40 galvanized steel with minimum 1.8 ounce zinc coating per square foot.
- E. Fittings and Accessories
1. Material: Comply with ASTM F 626. Mill-finished aluminum or galvanized iron or steel to suit manufacturer's standards.
 - a. Zinc Coating: Unless specified otherwise, galvanize steel fence fittings and accessories in accordance with ASTM A 153, with zinc weights per Table I.
 2. Tension Wire: 6-gauge (0.192-inch diameter) mill-finished aluminum wires, ASTM B 211, alloy 6061-T94 with 50,000 psi minimum tensile strength.
 3. Tie Wires: 9-gauge (0.106-inch-diameter) aluminum wire alloy 1100-H14 or equal to match fabric core material.
 4. Top Rail: Manufacturer's longest lengths with expansion type couplings, approximately 6" long, for each joint. Provide means for attaching top rail securely to each gate corner, pull, and end posts.
 5. Bottom Rail: Schedule 40 galvanized steel with minimum 1.8 ounce zinc coating per square foot.
 6. Post Tops: Weathertight closure cap with loop to receive tension wire or top rail; one cap for each post.
 7. Stretcher Bars: One-piece lengths equal to full height of fabric with minimum cross-section of 3/16" x 3/4". Provide one stretcher bar for each gate and end post and two for each corner and pull post, except where fabric is integrally woven into post.
 8. Stretcher Bar Bands: Minimum 3/4-inch-wide, space not over 15" o.c., to secure stretcher bars to end, corner, pull, and gate posts.
 9. Concrete: Refer to Section 321313.

PART 3 - CONSTRUCTION AND INSTALLATION

3.1. GENERAL

- A. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

- B. Excavation: Drill or hand excavate (using post hole digger) holes for posts to diameters and spacings indicated, in firm, undisturbed, or compacted soil.
 - 1. Unless otherwise indicated, excavate hole depths approximately 3" lower than post bottom, with bottom of posts set not less than 48" below finish grade surface.

3.2. FENCING

- A. Setting Posts/Sleeves: Center and align posts/sleeves in holes.
 - 1. Place concrete around posts/sleeves and vibrate or tamp for consolidation. Check each post/sleeve for vertical and top alignment and hold in position during placement and finishing operations.
- B. Brace Assemblies: Install braces so posts/sleeves are plumb when diagonal rod is under proper tension.
- C. Fabric: Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence and anchor to framework so that fabric remains in tension after pulling force is released.
- D. Stretcher Bars: Thread through or clamp to fabric 4" o.c. and secure to posts with metal bands spaced 15" o.c.
- E. Swing Gate: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.
- F. Tie Wires: Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
 - 1. Tie fabric to line posts with wire ties spaced 12" o.c. Tie fabric to rails and braces with wire ties spaced 24" o.c. Tie fabric to tension wires with hog rings spaced 24" o.c.
- G. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

END OF SECTION 323113

SECTION 329000

PLANTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions and Division 1 Specification sections apply to work of this Section.

1.2 DESCRIPTION OF WORK

- A. The extent of the planting is shown on the drawings

1.3 JOB CONDITIONS

A. Reference Standards

1. Size and Grading Standards: Conform to the current edition of "American Standard For Nursery Stock" - Sponsor - the American Association of Nurserymen, Inc., unless otherwise specified.
2. Plant Nomenclature: Conform to the latest edition of "Standardized Plant Names" as adopted by the American Joint Committee of Horticultural Nomenclature.

B. Quality Assurance

1. Contract work to a single firm specializing in landscape work.
2. Provide trees and shrubs nursery grown in accordance with good horticultural practice. Provide only healthy, vigorous stock grown under similar climatic conditions.
3. Experience: Eight years experience in landscape installation.
4. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

C. Product Delivery

1. Notify Landscape Architect 48 hours prior to delivery of plant material.
2. All certificates of inspection required by regulatory agencies.
3. Furnish a substantial label for each plant packed or shipped individually or for each bundle of plants, indicating true name and size.
4. Properly handle and pack all plants for transit and storage on site to insure adequate protection against climatic, seasonal and mechanical injuries.
5. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery, and while stored at the site.
6. Trees and Shrubs - Provide freshly dug trees and shrubs. Do not prune prior to delivery. Do not bend or bind-tie trees or shrubs in such manner as to damage

bark, break branches or destroy natural shape. Provide protective covering during delivery.

1.4 SUBMITTALS

- A. Submit quantities, sizes, quality, and sources for all plant materials.
- B. Provide on-site samples of boulders, giving full color range for Architect's review and approval.
- C. Warranty: Sample of warranty.
- D. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

1.5 WARRANTY

- A. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty performance of tree stabilization, or mechanized tree spade relocation.
 - 2. Warranty period shall be 1 year from date of planting completion and shall include all trees, shrubs, and perennials.

1.6 COORDINATION

- A. Proceed with and complete the landscape work as rapidly as portions of the site become available, working within the seasonal limitations for each kind of landscape work required.
- B. Cooperate with other trades working in and adjacent to the landscape work areas. Examine drawings which show the development of the entire site and become familiar with the scope of other work required.
- C. Utilities - Determine location of underground utilities and perform work in a manner which will avoid possible damage.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS

- A. Nursery grown plants shall mean plants which are healthy, vigorous plants lined out in rows in a nursery and which are annually cultivated, sprayed, pruned and fertilized all in accordance with good horticultural practice. All plants shall be nursery grown unless specified to be collected.
- B. All plants shall be freshly dug; neither heeled-in plants nor plants from cold storage will be accepted. All nursery grown plants shall have been transplanted or root pruned at least once in the past three years. Balled and burlapped plants must come from soil which will hold a firm ball.
- C. All plants shall be typical of their species or variety and shall have normal habit of growth and shall be first quality, sound, healthy, vigorous, well branched and densely foliated. They shall be free of disease, insect pests, eggs, or larvae, and shall have healthy, well furnished root systems.
- D. All plants and all tree trunks shall be measured when the branches are in their normal position. Dimensions for height and spread as contained herein refer to the main body of the plant and not from branch-tip to branch-tip. Shade trees shall be free of branches up to six feet, with a single leader, well branched and reasonably straight stems. No trees which have had their leaders cut, or damaged will be accepted. All trees must have straight trunks with single leader intact. There shall be no abrasion of the bark and no fresh cuts of limbs over 1 inch which has not been completely calloused over.
- E. Plants will be approved before planting at the site.

2.2 PLANTING ACCESSORIES

- A. Planting Mixture
 - 1. For Rain Gardens, Infiltration Tree Trenches, and Infiltration Trenches see Section 329010 Planting Soils.
 - 2. For all other plantings:
 - a. Topsoil as specified in Section 329200 – Lawns and Grasses
 - b. Amend topsoil with 10% organic matter for all planting beds, typical.
- B. Stakes
 - 1. Shall be 8 ft. long, 2 - 2-1/2 inch square or round.
- C. Boulder Outcrop
 - 1. Weathered limestone boulders and slabs ranging from 6 to 9 cubic feet in volume.

- D. Cobble Stone
 - 1. Smooth round or oval stones varying in size from 4” to 7” with a blended range of natural earth-tone colors.
- E. Mulch:
 - 1. Shrub & Tree Beds: Shall be No. 1-quality organic shredded hardwood mulch, 3” maximum, at isolated bed areas per drawings. Mulch shall not be dyed.
- F. Decorative Stone Mulch:
 - 1. Round washed No. 2 size gravel with blended range of natural earth-tone colors.
- G. Bonded Decorative Stone Mulch:
 - 1. Round washed No. 2 size gravel with blended range of natural earth-tone colors.
 - 2. Bonding Agent – moderate viscosity, single component, moisture cured liquid to stabilize aggregate. Install per manufacturer’s recommendations.
 - a. Gravel-Lok, or an approved equivalent
- H. Plastic Edge Restraints: Manufacturer's standard flexible triangular HDPE designed to serve as edge restraints for rain gardens and unit with connectors and 10” minimum spikes.
 - 1. Manufacturers: available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. SEK: PermEdge

PART 3 - EXECUTION

3.1 PLANTING OPERATIONS

- A. Prior to the excavation of planting areas or plant pits, driving or placing of stakes or deadmen, the Contractor shall ascertain the location of all electrical cables, all conduits, all utility lines, so that proper precautions may be taken not to disturb or damage any improvements.
- B. All plants shall be set plumb and straight and at such a level that after settlement, a normal or nature relationship at the crown of the plant with the ground surface will be established. Each plant shall be planted in the center of the pit. When balled, burlapped, and platformed plants are set, the platform shall first be removed from the pit and topsoil shall be carefully tamped under and around the base of each ball to fill all void. All burlap, ropes, and wires shall be removed from the sides and tops of balls, but no burlap shall be pulled out from under the balls.

- C. All plants shall be planted in soil mixture which shall be thoroughly watered and tamped. On level ground or slight slopes a shallow basin a little larger than the diameter of the plant pit shall be left around each plant as shown on the plans. On steep slopes, the soil on the lower side of the plant shall be graded in such a manner that it will catch and hold water.
- D. Mulching: Spread mulch over finished surface of each plant, plant bed or hedge trench as detailed - water plants thoroughly after mulching. Mulch shall be held back 3 inches from trunk of plant.
- E. Immediately after planting and staking, all plant materials shall be sprayed with anti-desiccant, using an approved power sprayer to apply an adequate film over trunks, branches, twigs and/or foliage. Apply according to manufacturer's recommendations.

3.2 MAINTENANCE

- A. The Contractor shall provide one year of maintenance to all tree and shrub plantings installed or relocated as part of this job. The Contractor shall not maintain any of the existing tree and shrub plantings on the site. Maintenance shall include watering, pruning, and spraying as required for proper maintenance. The mulch in the planting areas shall be topdressed as necessary to maintain a minimum of 3" depth.
- B. Until substantial completion is issued the Contractor shall repair protecting fences and stakes and all other items necessary to protect the tree and shrub plantings.

END OF SECTION 329000

SECTION 329010

PLANTING SOILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this Section and are hereby made a part of this Section.

1.2 SUMMARY

- A. Scope of Work: The work of this Section consists of all site preparation work and related items as indicated on the Drawings and/or as specified herein and includes, but is not limited to the following:

1. Evaluation of rough subgrade water infiltration.
2. Planting soil material acquisition.
3. Testing and analysis for specification conformance.
4. Inspection and testing of subgrade for preparation of subgrade.
5. Preparation of mixes and testing for conformance.
6. Installation and placement of planting soils.
7. Decompaction of soils.
8. Mock-up of planting soil profiles.
9. Final in-place testing of soils.
10. Coordination with other trades.
11. Clean-up.

- B. Related Work Under Other Sections:

1. Carefully examine all of the Contract Documents for the requirements that affect the work of this Section. Other specification Sections that directly relate to the work of this Section include, but are not limited to, the following:
 - a. Section 334100 – Storm Utility Drainage Piping
 - b. Section 329000 – Planting
 - c. Section 329200 – Lawns and Grasses

- C. Definitions:

1. Compaction: Compaction of the soil fabric is any force applied to the soil that reduces porosity and where 90 percent of all compaction can be accomplished with only three applications of force under optimum soil moisture conditions.
2. Dry Soil: The condition of the soil at or below the wilting point of plant available water in which the soil is powdery and subject to blowing.
3. Frozen Soil: The point at which the soil water has frozen and the soil has become very hard and cloddy. Ice crystals can be seen in the pore spaces of the soil.

4. Field Capacity: The percentage of water remaining in a soil two or three days after having been saturated and after free gravimetric drainage has ceased.
5. Moist Soil: The condition of the soil in where it can be formed into a ball and maintain its shape. Deformation of the soil is difficult with hand pressure. Free water is not visible and is usually considered the point between the wilting point and field capacity of the soil.
6. Saturated: All the pore space within a soil is filled with water and the remaining water is under gravitational forces to drain through the profile.
7. Scarification: The loosening of the surface of a soil lift by mechanical or manual means to alleviate compaction of the soil surface. Depth of scarification is dependent on material and extent of compaction. Depths are noted within the specifications.
8. Subsoil: The soil horizon directly below topsoil that provides water holding and structural support to plants. Source of the majority of micro-nutrients.
9. Subgrade: The in-situ soil material that the planting soil will be installed upon.
10. Topsoil: The mineral surface layer of soil that exhibit obliteration of all or much of the original rock structure and must show the following: (1) an accumulation of humified organic matter closely mixed with the mineral fraction and not dominated by properties characteristic of subsurface horizons; (2) has reasonable tilth (biological, chemical and physical properties) to support plant growth; and have two or more of the following:
 - a. a bulk density of less than 1.5g/cc installed
 - b. less than 15 percent by weight coarse fragments greater than 2mm
 - c. identifiable structure between clods called peds, no massive structure
 - d. no contamination (ie. Toxic weeds, chemicals, heavy metals, construction debris)
11. Wet Soils: Soils that are considered wet will easily be deformed by hand pressure, maintain their shape, and free water will be visible within the pore spaces. The water content at this soil condition is considered at field capacity or wetter.

D. Qualifications and Quality Assurance:

1. Analysis and Testing of Materials Qualifications: For each type of packaged material required for the work of this Section, provide manufacturer's certified analysis. For all other materials, provide complete analysis by a recognized laboratory made in strict compliance with the standards and procedures of the following:
 - a. American Society of Testing Materials (ASTM)
 - b. American Society of Agronomy
 - c. Soil Science Society of America
 - d. Association of Official Agricultural Chemists.
 - e. U.S Composting Council
2. Quality Assurance Qualifications: Work and materials shall meet the standards of the following references:

- a. International Society of Arboriculture (ISA)
 - b. American Society for Testing Materials (ASTM)
 - c. Environmental Protection Agency (EPA)
 - d. New York Department of Conservation (NYDEC)
3. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of exterior plants.
- a. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site who has at least 5 years experience with projects of similar scale and complexity.
 - b. The Landscape Contractor shall have experience in the proper and safe transportation and installation of soil material.
 - c. The Landscape Contractor shall have adequate supervision, staff, equipment and experience needed to complete a project of this magnitude.
 - d. The Landscape Contractor shall prepare and present to the Engineer required soil submittals, and their associated specified test results at an absolute minimum of four weeks prior to the scheduled soil and plant installation.
 - e. The Landscape Contractor shall have at between 3 to 5 years experience in installing designed soil mixes.
4. Soil Mixing Contractor Qualifications:
- a. Shall be able to provide soil mixes that meet the specifications within tolerances assigned.
 - b. Shall be able to produce enough consistently uniform soil material for the project to meet the scheduled demands.
 - c. The soil mixing contractor shall be engaged at least six weeks prior to scheduled soil installation to allow for sufficient time for material searches and initial planting mix approval.
5. Testing Laboratory Qualifications: An independent laboratory, recognized as an agricultural based testing agency, with experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- a. Employ a qualified independent testing and inspection laboratory acceptable to the Engineer and Owner to perform tests and certifications indicated.
 - b. It is the responsibility of Landscape Contractor in conjunction with the Soil Supplier to submit material for the soil and compost tests.
 - c. Tests shall be made in strict compliance with the standards of the Association of Official Analytical Chemists and follow standards from ASTM, EPA, and/or Methods of Soil Analysis, Soil Science Society of America.
 - d. Approved Laboratories, other equivalent laboratories can be substituted, but require approval by the Soil Scientist.
 - e. Testing Laboratories: These are some examples of testing facilities that can accomplish part of or complete testing of all soil mixes:

Atlantic Testing Laboratories	6085 Court St., Syracuse, NY	315-699-5281
Norm Hummel (Hummel & Co.)	35 King Street, PO Box 606 Trumansburg, NY	607-387-5694
CME Associates, Inc.	PO Box 1824, 8560 Brewerton Rd., Cicero, NY	315-698-9315
PW Laboratories, Inc.	6544 Fremont Road, East Syracuse, NY	315-437-1420

1.3 SUBMITTALS AND TESTING

- A. Certificates: Provide certificates required by authorities having jurisdiction, including any composted materials containing sewage sludge and material sources as defined by the Sites documentation. Approval as EPA Type 1 “exceptional quality” is required as well standards for application of composted organic material by state or local regulations.
- B. Testing Intervals for Organic Amendments, Planting Soil Mixes: Testing is required at the following intervals:
 - 1. Testing of the organic compost material: Test certificates required for producers of municipal yard waste composts or composted biosolids are described within this Section 02941 Part 1 and shall follow criteria listed within Part 2 of this section.
 - 2. Submit complete test results and samples of the S3, S2, S1, and organic soil amendment materials for approval as described within Part 1 following criteria of Part 2 of this section.
 - 3. After test results for the composted organic material have been accepted the Contractor shall create sample soil mixes for the S1 layer for the planting soil mix and perform the complete tests described in Section 329010, Part 1.
 - 4. In-place planting soil testing shall follow methods specified in Part 1 of this section for the layers and intervals noted following the specific ranges and limits noted within Part 2 of this section. Incomplete test results shall not be reviewed delaying the approval process.
- C. Test Procedures and Reporting: Submit certified report for each test required. Each test report shall have its associated soil layer clearly marked along with the name of the soil supplier and soil material product name or designation. Only complete submittals with all corresponding test results and samples as list within Part 1 will be reviewed. Submit test results for compost and S3, then after approval, mix and submit the S1 layer.
 - 1. Compost: Analyses of composted organic materials, including composted biosolids, are required prior to initial soil mix acceptance. Analyses shall include all tests specified below and meet the criteria listed in Part 2 of this section. Incomplete test results will not be reviewed, delaying submittal approval.

- a. Maturity index either by Solvita, Dewar Self Heating or CO₂ evolution sometimes called respirometry.
 - b. Reaction in 1:1 water
 - c. Carbon/Nitrogen ratio
 - d. Foreign Material on a dry weight basis
 - e. Organic Mater percent on a dry weight basis
 - f. Ammonium-N using an extract method
 - g. Salinity using a 1:1 water paste method
 - h. Basic Nutrient content of macro nutrients (P, K, Ca, Mg)
 - i. If the compost material contains any biosolids, heavy metals must be tested to meet EPA Chapter 503 and/or the New York State levels for human use.
2. Soil Mixes and Topsoil: Testing shall be performed and reported for particle size requiring percent of gravel (>2.0 mm), very coarse sand (2.0 – 1.0 mm), coarse sand (1.0 – 0.5 mm), medium sand (0.5 – 0.25 mm), fine sand (0.25 – 0.10 mm), very fine sand (0.10 – 0.05 mm), silt (0.05 – 0.002 mm) and clay (< 0.002 mm). Ammonium-N content, conductivity, soil reaction (pH), basic macro nutrients, CEC and organic matter percentage on a dry weight basis shall also be tested as specifically noted below.
- a. Particle size distribution by ASTM F1632-03 for all soil layers and topsoil. Fines passing the #270 sieve are to be measured using the hydrometer method as outlined in ASTM F1632. If any alternate method is used, the results still must be reported at the specified particle size breaks listed above or by plotting as a particle size distribution curve on a five cycle semi-log graph.
 - b. Organic matter content by ASTM F 1647, commonly known as loss on ignition.
 - c. Salts and Ammonium test using Woods End Research Laboratory # 104 Soluble Ion Test or 1:2 soil/water extract test as specified in Methods of Soil Analysis, Part 3 and must be tested and made available to the Engineer or Soil Scientist within two weeks of planned soil installation.
 - d. Plant available Phosphorous, Potassium, Magnesium, Calcium and Cation Exchange Capacity tested for the S1 Planting Soil Mix. Quality Assurance samples shall complete only particle size distribution, conductivity (EC), organic matter content, pH, ammonium-N for the S1 material.
 - e. Quality Assurance testing for S3 shall consist of particle size distribution by ASTM F1632, organic matter content, pH and conductivity (EC).
- D. Sources for Soil Components and Planting Soil Mixes: Submit information identifying sources for all soil components and the contractor responsible for mixing of planting soil mixes.
1. Owner or Engineer shall have the right to reject any soil supplier that cannot meet the testing requirements in a timely fashion, cannot provide timely deliveries, or cannot provide required quantities and/or uniform material.
 2. Soil mix supplier shall have a minimum of five years experience at supplying custom planting soil mixes.
 3. Submit supplier name, address, telephone and fax numbers and contact name.

4. Submit certification that accepted supplier is able to provide sufficient quantities of materials and mixes for the entire project. Indicate quantity and type of material from each supplier.

1.4 QUALITY ASSURANCE / ACCEPTANCE

- A. Planting Soil QA: During the placement of planting soils, test every 200 cubic yards (or one test for every planting area) of planting soil mix delivered to the job site. Tests shall be for soil mix quality assurance. Required tests for all layers include particle size distribution, pH, and organic matter. Report organic matter content on a percent by weight basis. Additional tests for salts (EC) and Ammonium-N shall be completed for S1 soil layer only. Testing procedures are described in Part 1 of this section.
- B. Samples: Planting soils requires a long lead time. Prior to ordering the listed materials, submit representative samples of the same organic batches and soil mixes that will be used to the Soil Scientist for selection and approval. Do not order materials until the Owner's approval has been obtained. Schedule at least 4 months for soil ingredient search and initial submittal approval. Delivered materials shall closely match the approved samples.
 1. Organic amendment: duplicate samples of 1 quart.
 2. Planting Soils: duplicate samples of 1 quart for each soil layer after mixing organic material and soil. The Soil Mix shall match the material being placed as closely as possible.
 3. A duplicate 1 quart sample of the soil layers and compost shall be sent to the soil consultant for review.
- C. In-place Designed Soil Testing:
 1. General planting soil installation for planting beds, infiltration areas, and rain garden areas shall be tested using a cone penetrometer or equivalent for approximately one point every 100 ft² at an interval after S3 layer installation and again after complete soil profile installation. The planting soil penetration resistance shall be uniformly increasing in density with depth, not exceeding 275 lbs/in². There shall not be any compacted dense layers within the soil profile greater than 50 lbs/in² than the background resistance. Specific penetration resistance rates are given in Part 2 of this section for each soil layer. Infiltration rates of the soil surface (not in mulch) of the Bio-retention areas shall be tested at one test per basin at the lowest point using ASTM 3385 to determine saturated hydraulic conductivity at installation. Records of initial testing will be used to monitor long term performance of the basins with other conductivity testing over time. The soil scientist will also conduct additional investigations on compaction and conductivity based on observed installed soil geomorphological parameters for all Rain Gardens.

- D. Planting Soil and Compost Submittal Acceptance: Submittals for planting soil approval must have complete test results attached as specified for each soil, results shall be clearly marked for their corresponding soil layer, clearly labeled with the soil supplier's name, and receipt of soil samples by the Soil Scientist before review of the submittal can take place. Incomplete test results will not be reviewed delaying the approval process.
- E. Soil Installation Acceptance: Notify the soil scientist at least 10 days in advance of date of soil placement. Inspection of the soil installation shall take place during placement of the S3 layer while some of the subgrade is visible and another inspection during the placement of the S3 layer before placement of the S1 layer. Final inspection shall take place during S1 installation.
- F. Partial Acceptance: Acceptance of partial areas or portions of the total work may be granted at the option of the Engineer or Landscape Architect only if the area to be inspected for acceptance is large, well defined and easily described. The Engineer or Landscape Architect is not obligated to provide partial acceptance of the work.
- G. Final Acceptance: Final acceptance shall be defined as the date after which the Engineer and Soil Scientist determine that all work, including Punch List items has been satisfactorily completed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle packaged materials in strict compliance with manufacturer's instructions and recommendations. Protect all materials from weather, damage, injury and theft.
- B. Sequence deliveries to avoid delay. On-site storage space is permissible only with written notice from Owner. Deliver soil materials only after preparations for placement of planting soil have been completed.
- C. Prohibit vehicular and pedestrian traffic on or around stockpiled planting soil.
- D. Install planting soil layers directly before planting is to commence. Do not install planting soils so that they over-winter without vegetation. Failure to vegetate the planting soil or allowing partial planting soil installation allows for extensive erosion, compaction, and overall degradation of the planting soil system requiring extensive refurbishment before spring planting.
- E. Soil that is to be stockpiled longer than two weeks, whether on or off site, shall not be placed in mounds greater than six feet high. If soil stockpiles greater than six feet high are to be stored for more than two weeks, the contractor shall break down and disperse soil so that mounds do not exceed the six-foot height restriction or thoroughly mix the stockpile once a month.
- F. Vehicular access to the site is restricted. Prior to construction the Contractor shall submit for approval a plan showing proposed routing for deliveries and site access which shall include, but not limited to equipment movements and staging locations

- G. Soil materials shall be covered at least two weeks prior to installation to prevent excess moisture from saturating the soil stockpile. Test for the moisture content of the soil mix using the gravimetric oven dry method as described in Soil Science Society of America, Methods of Soil Analysis, Part 1, 1986 at least two days prior to soil installation if planting soil moisture content is questionable or at the request of the civil engineer or soil scientist.
- H. Soil materials shall not be handled or hauled, placed or compacted when it is wet, as after precipitation, nor when frozen. Soil shall be handled only when the moisture content is less than 8 percent by volume.
- I. The planting soil shall be mixed in a ball mill or tub mill fitted with proper screening and paddles. Windrowing the materials is not acceptable, as it does not produce uniform mixing of the components.

PART 2 - PRODUCTS

2.1 SOIL LAYERS (HORIZONS):

A. General

- 1. All plant mix material shall fulfill the requirements as specified and be tested to confirm the specified characteristics.
- 2. Samples of individual components of plant mixes in addition to blended plant mixes including mulch materials shall be submitted by the Contractor for testing and analysis to the approved testing laboratory. Include verification testing of on-site sub soils through the QA testing. Comply with specific materials requirements specified.
 - a. No base component material or soil components for plant soil mixes shall be used until certified test reports by an approved agricultural chemist have been received and approved by the Engineer and Soil Scientist.
 - b. If necessary, testing of the soil material components may be requested by the Soil Scientist to facilitate approval of the plant soil mix.
 - c. As necessary, make any and all plant soil mix amendments and resubmit test reports indicating amendments until approved.
- 3. The Engineer and Soil Scientist may request additional testing by the Contractor for confirmation of mix quality and/or plant soil mix amendments at any time until completion if quality control samples deviate from the specifications and initially approved submittals.

B. Planting Soil Supply:

- 1. In the event that any of the soil materials are not available from the supplier or are not in compliance with specifications herein, the Contractor shall obtain material from other suppliers and conduct tests specified herein to provide materials in compliance with these specifications.

2. The Engineer and Soil Scientist shall be notified of all soil mix substitutions or problems with the planting soil supply in order to assist with a smooth delivery and installation.

C. Planting Soils:

1. Soil layer (S3): Planting Soil Drainage Layer consisting of a layer of material with a USDA Texture of coarse sand.
 - a. Soil reaction with a pH between 4.5 – 7.0.
 - b. An estimated saturated conductivity of 10 - 25 cm/hour.
 - c. The S3 layer within the bio-retention swale shall have a, uniformly increasing with depth, penetration resistance of < 250 lbs/in² after installation. No dense layers (+ 50 lbs/in² from background rate) are allowed.
 - d. There shall be no visible organic material present in this layer.
 - e. Material can be a natural sand or finely ground recycled glass meeting the following particle size distribution.

S3 Soil Layer Particle Size Distribution

Particle Size Class	Passing Sieve No	Range in Percent Passing ASTM F 1632-03
fine gravel	10	95 – 100
very coarse sand	18	80 – 95
coarse sand	35	60 - 80
medium sand	60	10 – 40
fine sand	140	8 – 15
very fine sand	270	1 – 10
silt*		1 – 6
clay*		0 – 4
Chemical		
Organic Matter %	ASTM F 1647-02a	<0.25
pH	1:1 Water	4.5 – 7.0

*determined by hydrometer method in ASTM F1632-03.

2. Soil layer (S1): Planting Soil Surface layer. A layer consisting of material with a USDA Texture of sand to loamy sand amended with organic matter (must be tested to meet specs after compost is approved and added).
 - a. The soil specifications shall be that the minimum infiltration rate for planting soil areas stays above 5 cm/hour (2 in/hr) after installation.
 - b. The soil shall have soil moisture content less than 8% by weight for installation.
 - c. The S1 layer shall have a uniformly increasing with depth, penetration resistance of < 120 lbs/in² after installation. No dense layers (+ 25 lbs/in² from background rate) are allowed.
 - d. The particle size distribution shall be:

S1 Soil Layer Particle Size Distribution

Particle Size Class	Passing Sieve No	Range in Percent Passing ASTM F 1632-03
fine gravel	10	95 – 100
very coarse sand	18	90 – 100
coarse sand	35	65 – 85
medium sand	60	30 – 40
fine sand	140	15 – 25
very fine sand	270	9 – 18
silt*		6 – 12
clay*		3 – 6
Chemical		
Organic Matter %	ASTM F 1647-02a	2 – 4%
pH	1:1 water	5.5 – 6.5
EC	1:1 paste	1.5 dS/m
Phosphorous (P)	extract	20 – 100 ppm
Potassium (K)	extract	200 – 600 ppm
Cation Exchange (CEC)	Extract	>8 Meq/100g

*determined by hydrometer method in ASTM F1632-03

D. Organic Amendment:

1. Composted Biosolid and municipal yard waste compost producers shall provide the heavy metal certificate of the material delivered as per EPA and state or local standards. Composted organic matter shall have the following criteria:

Criteria	Test Method	Acceptable Range
Type		brewer's waste, or leaf mulches are also acceptable. Composted municipal waste (chipped, shredded and screened wood, leaves, bark, etc.) alone is not acceptable unless it meets all of the criteria noted
Carbon/Nitrogen Ratio		11:1 – 22:1
Degree of Maturity	Dewer Self Heating <u>or</u>	VI – V
	Solvita Maturity Index <u>or</u>	6 – 8
	CO ₂ Evolution	1.2 % C/day
Foreign Material	Dry wt.	< 1" dia. And < 2% (of total)
Organic Matter %	Dry wt.	25 – 75%
Reaction	1:1 water	5.5 – 8.0
Ammonium	extract	< 200 ppm
Nutrient Content	extract	Contains some nitrogen, phosphorus, potassium, calcium, magnesium, sodium and micronutrients including iron, copper, boron,

		and manganese. Nutrients shall be present in appropriate agricultural and horticultural proportions to prevent ion antagonism.
Heavy Metals	extract	Concentrations of zinc, mercury, cadmium, lead, nickel, chromium, and copper must be below EPA and the state standards for biosolid applications to soils with human activity.

E. Planting Soil Mix Equivalency Table:

1. The mix ratios are rough estimates based on usual components found in the area and their physical properties. Slight adjustments to the mix may be needed to achieve the required planting soil properties.

Layer Designation	Base Material or Equivalent	Second Soil Mix Component	Third Soil Mix Component	Mix Ratio (Volume)
S3 Layer	ASTM C33 Fine Aggregate, non-calcareous Masonry Sand, or fine ground recycled glass	None	None	None
S1 Layer	Approved S3 material	sandy loam*	Approved Compost	3:1:1
		sandy clay loam*	Approved Compost	5:1:1
		loam*	Approved Compost	4:1:1

*USDA soil textures

2.2 SOIL PROFILES

- A. Rain Gardens, Infiltration Tree Trenches, and Infiltration Trenches: This planting soil profile consists of two soil horizons and may include an underdrain filtration gravel bed. The A horizon (S1 layer) of 6 - 8 inches covered with 2-3 inches of specified approved mulch over a 24 inch layer of S3 material. In Infiltration Tree trenches, and Infiltration Trenches it shall be placed on a 50% blend of #1 & #2. The basis for the S1 is the soil mix specified in Part 2. The S3 layer is coarse sand specified in Part 2 of this section.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Pre-Installation Examination Required: The Contractor shall examine previous work, related work, and conditions under which this work is to be performed and shall notify the Owner in writing of all deficiencies and conditions detrimental to the proper completion of this work. Beginning work means the Contractor accepts substrates,

previous work, and conditions. The Contractor shall not place any planting soil until all work in adjacent areas is complete and approved by the Owner.

- B. Planting Soil Preparation: Examine soil and remove foreign materials, stones over 1", and organic debris over 2" in length. Mix-in amendments as required by tests and as approved by the Owner. All preparation and mixing shall be accomplished when the soil moisture content is less than 8 percent by volume.
- C. Coordinate activities with other project contractors so that there is no soil disturbance from traffic or other construction activities subsequent to placement.

3.2 EXCAVATION AND SCARIFICATION

- A. Excavation of the soils shall be accomplished to a depths noted for each soil profile area. All construction debris shall be removed from the planting areas prior to placement of the soil layers. Care shall be taken to avoid working the soil when it has 8 percent moisture content or above.
 - 1. Excavation Depths: (of the subgrade below final grade where applicable)
 - a. All Areas shall be excavated a minimum of 36 inches below final grade or as noted on the drawings for specific locations.
 - 2. Subgrade pitch: The subgrade shall be pitched toward the underdrainage with an average around 1 percent or about 1.25 inches fall per 10 feet or as noted on the drawings.
- B. Scarification of the Subgrade: Scarification must loosen the compacted surface of the subgrade following final rough grade to a depth of 4 to 6 inches prior to the designed soil placement. Scarify the surface of any compacted soil. If the surface is smooth, smeared, or exhibits a shinny appearance it has been compacted and the surface must be loosened.
 - 1. Bare soil areas close to the construction site and areas where traffic was most intense will require deep ripping to a depth of 8 inches with a dozer mounted ripper or other equipment before placing any soil material over them (see drawings). This will reduce effects of perched water within rooting zones, and decrease the likelihood of down slope seeps.
 - 2. Scarify the subgrade after engineered compaction to a depth of 3 to 4 inches. Scarify parallel to the contour of the slope when possible, especially on slopes greater than 4:1. This is to provide teeth to stabilize the sandier soil above.
 - 3. The subgrade should be graded so that water will flow away from foundations, have no depressions, or areas where water can collect within the subsoil to cause internal soil drainage issues for plant roots.
 - 4. Any gravel, shale, asphalt, concrete, or stone should be removed from the subgrade areas if it will fall within 12 inches of the final grade.
- C. Remove all organic and coarse (rocks) fragments over 2 inches in diameter in the topsoil.
- D. If soil is to be placed or renovated, it must be worked at moisture content below field capacity or between 5 and 10 percent moisture content by weight. The soil is too wet if it has clumps or has surfaces with a polished appearance when tillage equipment is used.

1. If planting soil has been kept dry (undercover) and the subgrade is not saturated and the weather has been sunny, installation of the planting soil shall continue not less than 36 hours after a rain event. If the subgrade is considerably saturated (muddy) or has standing water, planting soils shall not be worked until the soil meets moisture standards/dried out.
 2. Never work planting soils when frozen.
- E. Prevention of compacted soils can be accomplished by beginning the work in corners, against walls, or at the center of isolated beds, and progressing outwards towards the borders.
- F. Once planting soils are completely placed, all traffic is prohibited until establishment of the plants and turf. Until complete landscape establishment, traffic should be restricted only to landscape maintenance personnel. Traffic restrictions are typically one growing season to entire landscape establishment and equilibrium.

3.3 MIXING OF PLANTING SOIL

- A. The planting soil shall be mixed in a ball mill or tub mill fitted with proper screening and paddles. Windrowing the materials is not acceptable, as it does not produce uniform mixing of the components.
- B. Mixing of the compost for the S1 layer (topsoil) shall be accomplished in the same manner as the other mixing procedures. The compost shall be moist, but not overly wet. Compost shall not be so wet as to have water squeezed out by hand or so dry as to be easily blown by wind.

3.4 PLACEMENT OF SOIL LAYERS (HORIZONS)

- A. Examination of Subgrade: The subgrade shall be examined by the Contractor prior to the start of soil placement and planting. Any issue shall be noted and related to the Owner in writing prior to acceptance of the subgrade by the Landscape Contractor:
- B. Planting Soil Placement:
1. General Soil Placement Procedures:
 - a. Scarify the subgrade to a depth of 4 to 6 inches.
 - b. Installation of planting soils shall be accomplished with small tracked equipment. Back-blading is strictly forbidden as it will overly compact the delicate planting soil. If planting soil has been kept dry and the subgrade is not saturated, installation of the designed planting soil can continue the day after a rain event, unless the subgrade is considerably saturated or has standing water.
 - c. Where applicable, place the first layer of S3 in one 6 inch lift. Compaction of this lift shall consist of light tamping by the installers foot traffic. No mechanical compaction shall be allowed except where otherwise noted.
 - d. Trees to be planted within existing soils must have a tree pit excavated using the following criteria:

- 1) Tree pits will be excavated three times the width of the rootball with a slight pedestal in the center of the pit to support the rootball.
 - 2) The sides and bottom of the tree pit shall be scarified 2-3 inches prior to planting and backfilling.
 - 3) The lower subsoil backfill shall be the excavated material lightly tamped by foot in and around the rootball. Additional compaction is forbidden.
 - 4) The surface topsoil shall be amended with approved compost at the rate of 1 part compost to 3 parts topsoil then placed and not compacted.
 - 5) Settlement after construction shall be corrected during the warranty period following these specifications.
- e. For large trees within the designed soil profile. Large tree (rootballs around 36 inches tall that would sit on about 4 inches of compacted S3) (for smaller trees see 'e' below) planting shall follow these procedures for handling the planting soils in and around the rootballs.
- 1) Adjust the subgrade overall depth to allow 4 inches of S3 material and so that the root flair of the tree will be 1 to 2 inches above final grade
 - 2) There shall be a pedestal of compacted subgrade under each of the tree planting areas. Compact this area to 95 percent of standard Proctor at below optimum moisture content then lightly scarify the pedestal surface. The tree pedestal shall be slightly higher in elevation than the surrounding subgrade to allow drainage away from beneath the rootball.
 - 3) Place at least 4 inches of S3 material on the pedestal area to allow support for the rootball and assist with tree leveling.
 - 4) Install the 6 to 8 inches of the S1 layer after all plantings have been completed.
- f. Trees with rootballs less than 36 inches tall to be planting in the designed sand based soil shall follow these procedures for soil installation and planting. These trees and large shrubs shall be planted after the S3 layer is installed, but prior to the S1 layer installation.
- 1) Compact a pedestal of S3 material to about 90 percent of Standard Proctor at below optimum moisture then lightly scarify the pedestal surface.
 - 2) The soil depth shall be so that the root flair of the tree will be 1 to 2 inches above final grade.
 - 3) Install the 6 to 8 inches of the S1 layer after all plantings have been completed.
- g. Care shall be taken to maintain the separation between the designed soil layers. Do not mix the S1 or S3 with adjacent layers.
- h. Reducing the amount of compaction to the soils can be accomplished by beginning the work in corners, against walls, or at the center of isolated

- beds, and progressing outwards. This limits the amount of traffic needed for installation on the placed soil.
- i. Planting soils shall never be moved or worked when wet or frozen.
 - j. Penetration resistance shall not exceed 200 lbs/ft² within the S3 and the resistance for the S1 layer shall be less than 120 lbs/ft² except where otherwise noted (under pavement plantings). The planting soil shall be uniformly increasing in density with depth. There shall not be any compacted layers within the soil profile.
 - k. The Contractor shall place barricades as required to prevent any unnecessary compaction of planting soil layers from vehicles, equipment, or pedestrian traffic during construction and vegetation establishment. Any additional compaction of the planting soils must be loosened satisfactorily to meet penetration resistance specifications.
2. Rain Gardens, Infiltration Tree Trenches, and Infiltration Trenches:
- a. The planting soil media shall be mechanically mixed until a homogenous mixture is obtained.
 - b. No other materials or substances shall be mixed or dumped within the planting area that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations.
 - c. Install approved specified stone in the bottom of the basins, install perforated piping if shown on the plans.
 - d. The planting soil media (S3 layer) shall be placed in lifts of 12 to 18 inches, and spread out by means of an excavator bucket or other means to minimize compaction. Placement of the soil media should only occur when it is at the correct moisture content (not wet or dry), and only when there is no precipitation present.
 - e. There shall be no abrupt changes in textural class between layers, as this will inhibit infiltration. NO soil interlayer filter fabric or compact soil zones.
 - f. The planting soil media should be left to settle for at least one storm event before the final lift so that it can be adjusted in the field to correspond to the plan elevations.
 - g. A 3-inch topdressing of approved mulch shall be placed prior to the establishment of vegetation to protect the swale from construction sedimentation. The mulch can be removed after plantings are established.
 - h. If blowing of material is a concern, biodegradable netting can be spread over the surface until the facility has gone through several wetting cycles.
 - i. The gravel and sand layers shall extend across the entire length and width of the areas as designated on the drawings.
3. CONSTRUCTION NOTE: For all utility boxes and structures that will be placed completely within the designed soil shall require compacted pedestals to support the structures.

3.5 PROTECTION AND REPAIRS

A. General:

1. Protect newly graded areas from traffic, freezing and erosion. Keep free of trash, debris or construction materials. Landscape contractor shall be the only personnel allowed on areas where planting soil has been installed.
2. Within the installation warranty period repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or compacted due to subsequent construction operations or weather conditions.
3. Scarify or remove and replace material to a depth as directed by the Owner; reshape and re-compact by only hand tamping at the prescribed moisture content.
4. Where settling occurs, before pavement installation and final soil installation acceptance, backfill with additional approved material, compact to specified rates, and restore any disturbed areas to a condition acceptable to the Owner.

B. Rain Gardens, Infiltration Tree Trenches, and Infiltration Trenches: To ensure proper long-term functionality of the areas, several procedures and scheduling will need to be followed while handling planting soil installation around these areas.

1. Install protective filter socks and erosion controls after excavation and installation of the underdrainage, gravel, and filter fabric to restrict sedimentation of the areas.
2. Do not install the S3 filter sand prior to planting soil installation. Failure to comply will allow excessive sediment to contaminate the filter sand causing decreased functionality.
3. Install the S3 filter sand in conjunction with the application of the S3 layer. Install 3 inches of coarse wood chip mulch to the final surface of the areas to help trap sediment and prevent infiltration of sediment into the filter sand until vegetation establishment. It is highly recommended to install the complete areas in the summer or during several weeks of dry weather to ensure that erosion is kept to minimum.
4. Maintain effective erosion and sediment controls throughout the vegetation establishment period.
5. Vegetate the surrounding catchment areas as quickly as possible.

3.6 POST INSTALLATION MAINTENANCE

A. Where settling occurs, backfill with additional approved material, compact to specified rates, and restore any disturbed areas to a condition acceptable to the Owner.

1. Any post installation changes or amendments to previously approved soils without the Engineer or Soil Scientist's consent are the responsibility of the owner.

- B. Fertilization of planting areas shall be handled after establishment after soil tests have been taken to determine the optimum fertilizer rates.
- C. The following items are the responsibility of the Owner after the guarantee period to ensure the sustainability of the designed soil and plants for the life of site.
 - 1. After one year, collect soil samples in each of the various soil areas and submit them for laboratory testing for fertilizer and liming recommendations.
 - 2. Each “type” of soil and planting area shall be sampled separately, but similar areas can be grouped. For example, areas of designed soil in turf areas, planting beds (flower and shrub), and turf areas of pre-existing plantings shall to be sampled and tested separately. Fertilization and liming needs to be tailored to each area for maximum effect and to reduce over fertilizing and liming and possible contamination of ground water and runoff.
 - 3. Repeat soil sampling for these areas every two years after first sampling and fertilize and lime to test recommendations.
 - 4. Clean and remove sediment build up within all areas on a minimum of a bi-annual basis or less as needed. Removal of sediment on a yearly basis is recommended during the dry summer months so as not to damage/compact the filtration basins.
 - 5. Inspect and clean out all drainage trenches and subsurface infiltration and underdrainage piping annually.

END OF SECTION 329010

SECTION 329200

LAWNS AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary General Conditions, and Division 1 Specification sections apply to work of this Section.

1.2 SUMMARY

- A. This section includes:
 - 1. Permanent seeding for lawn areas

1.3 JOB CONDITIONS

- A. Product Handling:
 - 1. Deliver seeds in vendor's unopened packages bearing labels showing vendor's name and seed analysis by weight.
 - 2. Store all seeds at the site in a cool, dry place.
 - 3. Deliver commercial fertilizer in standard size bags showing weight, analysis, and the name of the manufacturer.

1.4 SUBMITTALS

- A. Topsoil:
 - 1. The Contractor shall provide earth materials to the testing laboratory for analysis and report for each type of topsoil. Topsoil testing shall be performed on random sampling of screened topsoil.
 - 2. Topsoil testing:
 - a. Provide the following topsoil analysis:
 - 1) Sieve Analysis (ASTM C136) with Minus #200 by washing (ASTM C117)
 - 2) Hydrometer Analysis (ASTM D-422)
 - 3) Nutrient Analysis, including organic content and pH
 - b. Test Results:
 - 1) The testing laboratory shall submit written reports of all tests, investigations, and recommendations to the Owner, the Contractor, and the Architect.

- B. Product Data: For each type of product indicated.
- C. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, 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.
- D. Qualification Data: For qualified landscape installer.

PART 2 - PRODUCTS

2.1 SOIL AMENDMENTS

- A. Commercial fertilizer (10-6-4) inorganic or organic containing not less than 10 percent nitrogen, 6 percent available phosphorus, and 4 percent water soluble potash.
- B. High Nitrogen Fertilizer: A slow-release fertilizer with 38 percent nitrogen.
- C. Lime: Natural limestone containing not less than 85 percent of total carbonates, ground so that not less than 90 percent passes a 10-mesh sieve, and not less than 50 percent passes a 100-mesh sieve.
- D. Aluminum Sulfate: Commercial grade.
- E. Peat Humus: FS Q-P-166 with texture and pH range suitable for intended use.
- F. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.
- G. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.
- H. Sand: Clean, washed sand-free of toxic materials.
- I. Perlite: Conforming to National Bureau of Standards PS 23.
- J. Manure: Well-rotted, unbleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials, and containing no chemicals or ingredients harmful to plants.
- K. Topsoil: Shall consist of screened topsoil that meets the following conditions:
 - 1. 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 foreign material.
 - 2. Containing not less than 6 percent, nor more than 9 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 Celsius.

3. Containing a pH value within the range of 5.5 to 7 on that portion of the sample that passes a 1/4 inch sieve.
4. Containing the following gradations:
- 5.

Sieve Designation	<u>% Passing</u>
1"	100%
1/2"	15 - 100%
#10	55-80%
#60	30-55%
#200	20-30%

2.2 SEED MIXTURES

- A. Provide 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. Type I Seed Mix: General Lawn Area Seeding

<u>Amount by Weight</u>	<u>Species or Variety</u>	<u>Purity</u>	<u>Percentage Germination</u>
55% (Min.)	Kentucky Bluegrass Blend	95%	80%
25% (Min.)	Red Fescue	35 - 97%	85%
25% (Max.)	Perennial Rye**	98%	90%

**Two or more of the following varieties: Citation, Derby, Manhattan, Pennfine, and Yorktown II

2.3 MULCH

- A. Wood cellulose fiber mulch with a premixed non-asphaltic tackifier shall be applied at the rate of 2,000 pounds per acre.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or an approved equal:
 1. Conwed
 2. Weyerhaeuser

PART 3 - EXECUTION

3.1 GENERAL

- A. Seed all areas not paved or otherwise specially treated. Restore any lawn areas outside contract limits that have been damaged by the Contractor's operations. The Contractor is

required to provide the Owner with a stand of grasses specified that is reasonably free of weeds and bare spots.

3.2 TOPSOILING

- A. Place topsoil in areas where seeding is to be performed. Place a minimum depth as indicated to the finished grade elevations where shown on the Drawings.
- B. Fine-grade topsoil to eliminate uneven areas and to ensure proper drainage. Maintain finished grade elevations required.
- C. Remove all stones, roots, grass, weeds, or other foreign matter while placing.
- D. Lightly compact the topsoil to ensure its stability.
- E. Topsoil in an unworkable condition due to excessive moisture, frost, or other conditions shall not be placed until it is suitable for placement.

3.3 SEEDING NEW LAWNS

- A. Add ground limestone at the rate recommended by soil analysis.
- B. Add 10-6-4 fertilizer at the rate of 25 pounds per 1,000 square feet and mix into topsoil.
- C. Rake area before seeding to obtain a smooth surface at the proper elevation. Drag area with a wood float to level out minor humps and hollows. Seed bed shall have a smooth friable uniform surface, free of areas ponding water. Seed at the rate of 5 pounds per 1,000 square feet.
- D. Mulch all seeded areas at the rate of 2000 pounds per acre with fiber mulch immediately after seeding. No machine shall be used that leaves ruts in the seed bed. It shall be the contractor's responsibility to add or remove mulch as needed to encourage seed germination and growth.

3.4 RECONDITIONING EXISTING LAWNS

- A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials and equipment, and movement of vehicles. Also recondition existing lawn areas where minor regrading is required.
- B. Provide fertilizer, seed, and soil amendments as specified for new lawns to provide a satisfactory reconditioned lawn.
- C. Provide new topsoil to fill low spots and meet new finish grades.
- D. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
- E. Remove diseased and unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including stone, gravel, and other loose building materials.

- F. Where substantial lawn remains but is thin, mow, rake, aerate if compacted, fill low spots, remove humps, and cultivate soil, fertilize, and seed. Remove weeds before seeding. Apply a seed-bed mulch, if required, to maintain moist condition.
- G. Water newly-planted lawn areas and keep moist until new grass is established

3.5 MAINTENANCE FOR LAWN AREAS

- A. Maintenance shall begin immediately after seeding is completed.
- B. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting to establish a smooth, acceptable lawn, free of eroded or bare areas.
- C. The grass shall be cut whenever the height reaches 3 inches. A minimum of three mowings will be required. In no instance shall the grass be cut lower than 3 inches in height. Excess clippings shall be raked and removed. Should the Contractor fail to maintain the lawn by mowing or other above maintenance procedures, the Owner may hire this work done and backcharge the Contractor.
- D. Watering: Should the seeding/sodding be done during hot, dry weather, the Contractor will be required to provide a portable irrigation system to supply a minimum of 1 inch of water over all seeded areas per week.
- E. Protection: Protection is the responsibility of the Contractor. Contractor shall protect all seeded/sodded areas against trespass and vandalism by temporary fencing or other means.
- F. Maintain lawns until approval by the Architect, but in no case less than the following period:
 - 1. 1 calendar year after completion of seeding.
- G. Final fertilizing: A high-nitrogen fertilizer, as specified above, shall be applied prior to date of Substantial Completion at the rate of 10 pounds per 1,000 square feet.

END OF SECTION 329200

SECTION 330523

HORIZONTAL DIRECTIONAL DRILLING

PART 1 - GENERAL

1.1 DESCRIPTION OF REQUIREMENTS

- A. Provide all necessary tools, materials, labor, supervision and equipment to successfully complete the installation of directionally drilled piping as specified herein and shown on the drawings.
- B. Furnish all items necessary to perform the horizontal directional drilling operation and construct the pipe to the lines and grade shown on the drawings.
- C. Use techniques of creating or directing a borehole along a predetermined path to a specified target location. Use mechanical and hydraulic deviation equipment to change the boring course and use instrumentation to monitor the location and orientation of the boring head assembly along a predetermined course.
- D. Accomplish drilling with fluid-assist mechanical cutting. Use a mixture of bentonite and water or polymers and additives. Use bentonite sealants and water to lubricate and seal the mini-tunnel. Use minimum pressures and flow rates during drilling operation as not to fracture the sub-grade material around and or above the bore.
- E. Utilize small diameter fluid jets to fracture and mechanical cutters to cut and excavate the soil as the head advances forward.
- F. Install an offset section of drill stem that causes the cutter head to turn eccentrically about its centerline when it is rotating for steering. When steering adjustments are required, rotate the cutter head offset section toward the desired direction of travel and advance the drill stem forward without rotation.
- G. Drill a 2-inch to 3-inch diameter pilot hole using the mobile drilling system launched from the surface at an inclined angle. Enlarge the pilot hole with reamers as required.

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO).
- B. Occupational Safety and Health Administration (OSHA).

1.3 DEFINITIONS

- A. CONTRACTOR's Construction Drawings shall be defined as drawings by which the CONTRACTOR proposes to construct, operate, build, etc., the referenced item. Submit Construction Drawings for the sole purpose of providing the sufficient details to verify that the CONTRACTOR's work in progress is in accordance with the intent of the design.

1.4 SUBMITTALS

- A. The CONSULTANT will base the review of submitted details and data on the requirements of the completed work, safety of the work in regards to the public, potential for damage to public or private utilities and other existing structures and facilities, and the potential for unnecessary delay in the execution of the Work. Such review shall not be construed to relieve the CONTRACTOR in any way of his responsibilities under the contract. Do not commence work on any items requiring CONTRACTOR's Construction Drawings or other submittals until the drawings and submittals are reviewed and accepted by the CONSULTANT.
- B. The CONTRACTOR shall:
1. Submit for review complete construction drawings and/or complete written description identifying details of the proposed method of construction and the sequence of operations to be performed during construction, as required by the method of tunnel excavation approved. The drawings and descriptions shall be sufficiently detailed to demonstrate to the CONSULTANT that the proposed materials and procedures will meet the requirements of this specification. Submit arrangement drawings and technical specifications of the machine and trailing equipment (including any modifications), three-year experience record with this type of machine and a copy of the manufacturer's operation manual for the machine.
 2. Submit CONTRACTOR's Construction Drawings for the following items.
 - a. Complete details of the equipment, methods and procedures to be used, including but not limited to primary lining installation, timing of installation in relation to the excavation plan and sequence, bulkheads, etc.
 - b. Grouting techniques, including equipment, pumping procedures, pressure grout types, mixtures and plug systems.
 - c. Method of controlling line and grade of excavation.
 - d. Details of muck removal, including equipment type, number, and disposal location.
 - e. Proposed contingency plans for critical phases and areas of directional drilling, including repair of any existing utilities damaged during construction.
- C. Quality Control Methods. Submit a description of quality control methods at least 10 days prior to the start of directional drilling to the CONSULTANT. The submittal shall describe:
1. Procedures for controlling and checking line and grade.
 2. Field forms for establishing and checking line and grade.
- D. Safety. Submit procedures including, but not limited to, monitoring for gases encountered.
- E. Submit hazardous chemical list as well as all MSDS and technical data sheets.

1.5 DESIGN CRITERIA

- A. Compatibility of Methods.

1. The methods of excavation, lining, and groundwater control shall be compatible.

1.6 JOB CONDITIONS

A. Safety Requirements

1. Perform work in a manner to maximize safety and reduce exposure of men and equipment to hazardous and potentially hazardous conditions, in accordance with applicable safety standards.
2. Whenever there is an emergency or stoppage of work which is likely to endanger the excavation or adjacent structures, operate a full work force for 24 hours a day, including weekends and holidays, without intermission until the emergency or hazardous conditions no longer jeopardize the stability and safety of the work.

B. Air Quality.

1. Conduct directional drilling operations by methods and with equipment, which will positively control dust, fumes, vapors, gases or other atmospheric impurities in accordance with applicable safety requirements.

1.7 PERMITS

- A. Obtain any and all other permits required for prosecution of the work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Refer to Section 334100 Storm Utility Drainage Piping for pipe material.

PART 3 - EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall be responsible for his means and methods of directional drilling construction and shall ensure the safety of the work, the CONTRACTOR's employees, the public, and adjacent property, whether public or private.
- B. Obtain locations of all existing utilities within the horizontal directional drilling project area, whether shown on the plans or not, in coordination with the owners of such utilities. Be responsible for protection of such utilities from damage, and repair of any utilities damaged during or as a result of construction.
- C. Anticipate that portions of the drilled excavation will be below the groundwater table.
- D. Comply with all local, state and federal laws, rules and regulations at all times to prevent pollution of the air, ground and water.

3.2 EQUIPMENT

- A. Diesel, electrical, or air-powered equipment will be acceptable, subject to applicable federal and state regulations.
- B. Any method or equipment that the CONTRACTOR can demonstrate will produce the specified results will be considered.
- C. Employ equipment that will be capable of handling the various anticipated ground conditions. In addition, the equipment shall:
 - 1. Be capable of minimizing loss of ground ahead of and around the machine and providing satisfactory support of the excavated face at all times.
 - 2. Provide a system to indicate whether the amount of earth material removed is equivalent to that displaced by the advance of the machine such that the advance rate may be controlled accordingly.
- D. Provide adequate secondary containment for any and all portable storage tanks.

3.3 DIRECTIONAL DRILLING DATA

- A. Submit daily logs of construction location, progress and events, including observations on the following:
 - 1. Location and elevation of significant soil strata boundaries and brief soil descriptions.
 - 2. Jacking pressures and torsional forces, if applicable.

3.4 CONTROL OF THE TUNNEL LINE AND GRADE

- A. Construction Control.
 - 1. Establish and be fully responsible for the accuracy of control for the construction of the pipeline to be installed, including structures, tunnel line and grade.
 - 2. Establish control points sufficiently far from the tunnel operation so as not to be affected by construction operations.
 - 3. Maintain daily records of alignment and grade and submit three copies of these records to the CONSULTANT. However, the CONTRACTOR remains fully responsible for the accuracy of his work and the correction of it, as required.
 - 4. Check control for the bore alignment against an above ground undisturbed reference at least once each hour and once for each 50 feet of tunnel constructed, or more often as needed or directed by the Consultant.

3.5 DISPOSAL OF EXCESS MATERIAL

- A. Where such effort is necessary, cost for groundwater control during the course of the tunnel work shall be included in the unit contract price for the work.

- B. Dewatering required during the course of the project to lower water table, to remove standing water, surface drainage seepage, or to protect ongoing work against rising waters or floods shall be considered incidental to the work being performed.

END OF SECTION 02300

SECTION 334100

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe and fittings.
 - 2. Cleanouts.
 - 3. Catch basins.
 - 4. PVC Drain Inlet and Riser Structures.

1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Catch basins, stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle catch basins and drop inlets according to manufacturer's written rigging instructions.

PART 2 - PRODUCTS

2.1 HDPE PIPE AND FITTINGS

- A. Corrugated perforated and solid HDPE Drainage Pipe and Fittings NPS 3 to NPS 10 (DN 80 to DN 250): AASHTO M 252M, Type S, with smooth waterway for coupling joints.

1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
 - B. Corrugated HDPE Pipe and Fittings NPS 12 to NPS 60 (DN 300 to DN 1500): AASHTO M 294M, Type S, with smooth waterway for coupling joints.
 1. Silttight Couplings: PE sleeve with ASTM D 1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
- 2.2 PVC PIPING AND FITTINGS
- A. Pipe: ASTM D 1785, Schedule 80 PVC, with plain ends for solvent-cemented joints.
 - B. Fittings: ASTM D 2467, Schedule 80 PVC, socket type.
- 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
- A. Pipe and Fittings: ASTM A 74, Extra-Heavy class.
 - B. Gaskets: ASTM C 564, rubber.
- 2.4 CLEANOUTS
- A. Cast-Iron Cleanouts:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Josam Company.
 - b. Smith, Jay R. Mfg. Co.
 - c. Watts Water Technologies, Inc.
 2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
 3. Top-Loading Classification(s): Heavy Duty.
 4. Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.
 5. Cleanouts shall have locking covers.
- 2.5 CONCRETE
- A. Portland Cement Design Mix: Refer to section 321313 Site Concrete.
 1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.
- 2.6 LIQUID APPLIED WATERPROOFING MEMBRANE

A. Products: Subject to compliance with requirements, provide one of the following, or an approved equal:

1. Sonoshield HLM 5000
2. Tremco Tremproof 201/60
3. Sika Sikalastic 450

2.7 CATCH BASINS

A. Standard Precast Concrete Catch Basins:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Base Section: 8-inch minimum thickness for floor slab and 5-inch minimum thickness for walls and base riser section.
3. Riser Sections: 5-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
4. Top Section: flat-slab-top type
5. Joint Sealant: ASTM C 990, butyl rubber.
6. Steps: Individual FRP steps or FRP ladder, 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 catch basin to finished grade is less than 60 inches.
7. Pipe Connectors: ASTM C 923 (), resilient, of size required, for each pipe connecting to base section.
8. Frame and grate per detail.
9. Waterproofing: Liquid applied waterproofing membrane.

2.8 PVC DRAIN INLET AND PVC RISER STRUCTURE

- A. PVC riser structures with domed ductile iron grates, and heavy duty H-25 as noted on plans.
- B. PVC catch basins utilizing heavy duty H-25 covers shall be installed per manufacturer's specifications and backfill requirements.
- C. Where applicable, PVC catch basin weirs shall be custom manufactured stainless steel. The weirs shall be fabricated and mounted by the PVC catch basin manufacturer to the catch basin, and anchored on the bottom and sides with stainless steel anchor bolts. All seams with the PVC catch basin shall be water tight.
- D. Where applicable, PVC catch basin filter baskets shall be Nyloplast "Catch-It" filter baskets or approved equal.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section 312010 "Earth Moving Outside Building."

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install fittings for changes in direction.
- D. 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.

3.3 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 cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 - 1. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Set cleanout frames and covers in earth and pavement in cast-in-place concrete block, 24 inch square by 12 inches deep.

3.4 CATCHBASIN INSTALLATION

- A. Construct structures to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.
- C. Waterproofing:
 - 1. Comply with manufacturer's installation instructions.
 - 2. Prepare concrete structure prior to applying waterproofing by broom cleaning and hosing with water. Remove all loose material and chip and patch as required to achieve a smooth surface for waterproofing. Surface shall be clean and dry before applying waterproof membrane.
 - 3. Cure waterproof membrane 24 to 48 hours prior to further installation.

3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

3.6 IDENTIFICATION

- A. Materials and their installation are specified in Division 31 Section "Earth Moving Outside Building." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
 - 1. Use detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.7 FIELD QUALITY CONTROL

- 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 reports for each system inspection.
 - 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. 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 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. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic 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.

3.8 CLEANING

- A. Clean interior of piping of dirt and superfluous materials. Flush with potable water.

END OF SECTION 334100