FACILITIES & OPERATIONS
ARCHITECTURE, ENGINEERING AND CONSTRUCTION
UNIVERSITY OF MICHIGAN

BuildingName
The Description of the Project
P00000000 0000

SPECIFICATION DIVISION 33
NUMBER SECTION DESCRIPTION

DIVISION 33 UTILITIES

SECTION 334100 - STORM UTILITY DRAINAGE

END OF CONTENTS TABLE

DIVISION 33 UTILITIES
SECTION 334100 - STORM UTILITY DRAINAGE

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 consists of exterior storm sewer piping and includes:
   1. Pipe and fittings.
   2. Backwater valves
   3. Cleanouts
   4. Manholes and catch basins.
   5. Channel
   6. Pipe outlets.

1.3 DEFINITIONS

A. ACI: American Concrete Institute.

B. ANSI: American National Standards Institute.

C. ASTM: American Society of Testing and Materials.

D. AASHTO: American Association of State and Highway Transportation Officials.

E. MDOT: Michigan Department of Transportation.

F. OSHA: Occupational Safety and Health Administration.

G. PSI: Pounds per Square Inch.

H. SDR: Standard Dimension Ratio.

I. U-M: University of Michigan.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes: base sections, riser sections, eccentric and concentric conical top sections, flat slab tops, grade rings with notarized certificating indicating compliance with ASTM C478.
2. [**Catch basins**] [**storm water inlets**] [**and**] [**dry wells**]. Include plans, elevations, sections, details, frames, covers, and grates.
3. Storm Water Detention Structures: Include plans, elevations, sections, details, inlet and outletelevations, structures, design calculations, material certifications.
4. Storm water management structures and systems, including but not limited to water quality units, infiltration structures
5. Pipe connections to manholes, catchbasins, structures.
6. Manhole frame and cover and catch basin frame and grate with notarized certificate indicating compliance with the specified ASTM standard and Class designation
7. Adjustable weir plates and fasteners.

C. Manufacturer Certification: All pipe furnished shall be accompanied by the manufacturer’s certification.

D. Manufacturer’s Performance Certification that shows hydrodynamic separator unit is capable of achieving the specified removal efficiencies per plan and specs.

E. Cut sheets for Contractor layout and staking locations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Storm water management – site specific feature installation checklists, signed and approved by the engineer/Owner site representative

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

D. Handle [**catch basins**] [**and**] [**storm water inlets**] according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify [**Construction Manager**] [**Owner**] no fewer than [**two**] <**Insert number**> days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without [**Construction Manager's**] [**Owner's**] written permission.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

A. Corrugated-Steel Pipe and Fittings: ASTM A 760/A 760M, Type I with fittings of similar form and construction as pipe.

1. Special-Joint Bands: Corrugated steel with O-ring seals.
2. Standard-Joint Bands: Corrugated steel.
3. Coating: [**Aluminum**] [**Zinc**].

2.2 HDPE PIPE AND FITTINGS

A. Storm sewer specified as high density polyethylene (HDPE) shall meet the requirements of AASHTO M294.

B. The pipe hall be corrugated with an integrally formed smooth interior. Joints shall be gasketed water tight joints using water tight sleeves. Sleeves shall be factory installed on one end of the pipe with a factory installed gasket on the opposite end of the pipe.

2.3 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, [Class II-] [Class VI.

1. Integral bell-and-spigot ends and gasketed joints with ASTM C 443, rubber O-ring gaskets.

2. Elliptical pipe shall conform to ASTM C 507.

3. Cement shall conform to ASTM C 150 for types I and II.

4. Outside joints shall be provided with cement mortar collar. Inside joints of sewers larger than 36 inches in diameter shall also have the inside joint pointed with mortar.

5. Lubricants used in joints shall be supplied by the pipe manufacturer and joints shall be coupled in accordance with the manufacturer’s requirements.

6. The following information shall be clearly marked on each length of pipe:
   a. The pipe designation and class.
   b. The name or trademark of the manufacturer.

c. Identification of the manufacturing plant.
d. The date of manufacture.
e. Testing lot number or testing lab stamp.
f. Reinforced concrete pipe with elliptical reinforcement shall be clearly marked on the inside and the outside opposite walls along the minor axes of the elliptical reinforcing.

2.4 BACKWATER VALVES

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

2.5 CLEANOUTS

A. Cleanouts:

1. Manufacturers: Subject to compliance with requirements, [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:
2. Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <**Insert manufacturer's name; product name or designation**> or comparable product by one of the following:
   a.
   b. <**Insert manufacturer's name**>.
3. Casting: Neenah R-7506-D, EJCO 1574 or Engineer approved equal. Casting shall be stamped with “Storm”.

2.6 MANHOLES AND CATCH BASINS

Standard Precast Concrete Manholes:

1. Description: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 inches minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 8-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C 443, rubber O-ring gasket, joints pointed with mortar after installation both inside and outside of the manhole.
8. Resilient Pipe Connectors: ASTM C 923, cast or fitted into manhole walls, for each pipe connection. Neoprene rubber shall

meet ASTM C 443 and have a minimum thickness of 3/8 inch. Pipe clamps shall be of corrosion-resistant steel. Pipe connectors shall be one of the following:

a. Flexible neoprene rubber boot securely clamped into a core-drilled pipe port. Pipe ports shall be core-drilled at the point of manhole manufacture and shall be accurately located within ½ inch of proposed sewer centerline.
b. Self-adjusting mechanical pipe to manhole seal providing resilient flexible and infiltration-proof joint.
c. Flexible rubber wedge firmly secured against a rubber gasket cast into the manhole.
d. Engineer approved equal.

9. Steps: ASTM C 478 injection molded copolymer, polypropylene, encapsulating a ½ inch grade 60 steel reinforcing bar with an impact resistance of 300 ft-lbs and a pull out force resistance of 1500 lbs; cast or anchor steps into sidewalls at 15-inch intervals. Step depth shall be a minimum of 6 inches.
10. Cut pipe so that it does not extend more than 2” into the manhole and patch water tight inside and outside of pipe insert location.
11. Grade Rings: 2-inch reinforced concrete rings or ASTM C 55 grade N-I concrete bricks, 2-inch minimum and 6-inch maximum height, with diameter matching manhole frame and cover. Interior and exterior of the grade rings and brick shall be pointed with mortar to seal the joints.
12. Aggregate Base: Structure shall be placed on a minimum of 6 inches of 21AA stone bedding.

B. Manhole Frames and Covers:

1. Description: Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER” and cast environmental message “DUMP NO WASTE, DRAINS TO WATERWAYS” Use the following manufacturers and models for each structure type:

a. Storm Manhole
    1) Frame
        a) NEENAH NF-16422310 HS-25 loading
        b) East Jordan Company, EJCO heavy duty frame for 1040 cover, minimum HS20 loading
    2) Solid Cover
        a) Neenah, R-1642T474, no vent holes, enviro notice
        b) East Jordan Company, EJCO 1040, Type A1, enviro notice
    3) ADA compliant grate
        a) Neenah NF-23703010, Type "Q" grate, enviro notice
        b) East Jordan Company, EJCO 1040 type M3, enviro notice
    4) Grate, Non ADA compliant
        a) Neenah, NF-23703005 Type “Q” grate, enviro notice
        b) East Jordan Company, EJCO 1040 Type M2, enviro notice
    5) Beehive
        a) Neenah, NF-25610011 beehive grate, enviro notice
        b) East Jordan Company, EJCO 1040, Type 02, enviro notice
b. Storm Catch Basin

1) 7210, Type M1 grate by East Jordan Company, enviro message
2) R-3281-A, Type C grate by Neenah, enviro message.
3) Or Engineer approved equal.

2. Material: ASTM A 48, Class No. 30, gray iron unless otherwise indicated.

2.7 CHANNEL

A. General: Cast-in-place concrete according to ACI 318 and the following:

1. Cement: ASTM C 150, Type II.
2. Fine Aggregate: ASTM C 33, sand.
3. Coarse Aggregate: ASTM C 33, crushed gravel.
4. Water: Potable.

B. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.

1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.

a. Invert Slope: 1 percent through manhole.

C. Ballast and Pipe Supports: Portland cement design mix, 4000 psi minimum, with 0.58 maximum water/cementitious materials ratio.

1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

2.8 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

Riprap Basins: Broken, irregularly sized and shaped, graded stone according to Design detail, or large limestone or river rock boulders. Crushed concrete will not be accepted for rip rap. **EXECUTION**

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 312000 "Earth Moving."

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 manholes for changes in direction and grade.

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 unless deliberate storm water management design.

E. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.
2. Install piping with manufacturer recommended minimum cover or as indicated on the drawings.
3. Install corrugated steel piping according to ASTM A 798/A 798M.
4. Install corrugated aluminum piping according to ASTM B 788/B 788M.
5. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
6. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.
7. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
2. Join corrugated aluminum sewer piping according to ASTM B 788/B 788M.
3. Join ABS sewer piping according to ASTM D 2321 and ASTM D 2751 for elastomeric-seal joints.
4. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
5. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasketed joints.

6. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
7. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 BACKWATER VALVE INSTALLATION

A. Install horizontal-type backwater valves in piping where indicated.

B. Install combination horizontal and manual gate-valve type in piping and in manholes where indicated.

C. Install terminal-type backwater valves on end of piping and in manholes where indicated.

3.5 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.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 6″ deep. Set with tops [**1 inch (25 mm)**] {flush}<**Insert dimension**> above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.6 MANHOLE AND CATCH BASIN INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants according to ASTM C 891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

E. Manholes shall be placed at every change in grade, direction and pipe size as well as at junctions of sewers.

F. All sewer connections shall occur at a manhole.

G. Install aggregate base beneath structure prior to placement of structure.

3.7 CONCRETE PLACEMENT

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

3.8 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping from building with cleanout outside of building.

B. Make connections to existing piping and underground manholes.
   1. Make connections to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

      a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
      b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

   2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

   3. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.

      a. [**Unshielded**] [**Shielded**] flexible couplings for same or minor difference OD pipes.
      b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
      c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.9 Riprap

A. Follow the details and MDOT guidelines for riprap installation, including a minimum depth of 16” or whichever is more stringent.
B. Provide geotextile liner under the riprap with seams overlapped a minimum of two feet and ends staked.
C. Crushed concrete is not to be used as Riprap.

3.10 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to

withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

1. Close open ends of piping with at least [**8-inch- (203-mm-)**] <**Insert dimension**> thick, brick masonry bulkheads or Grade S3 concrete.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
3. Fill abandoned pipe with flowable fill

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:

1. Remove entire abandoned structure unless noted to leave in place on the plans. Remove manhole or structure and close open ends of remaining piping.
2. If indicated to abandon structure in place, remove top of manhole or structure down to at least **36 inches** below final grade. Fill to within roadway cross section with class II sand. Fill remainder with the roadway or restoration cross section.

C. Backfill to grade according to Section 312000 "Earth Moving."

3.11 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. Re-inspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate report for each test.
5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:

    a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.

C. Mandrel Testing
1. All PVC and HDPE storm sewers shall be mandrel tested for deflection by the Contractor.
2. The mandrel shall be a commercially produced, nine fin mandrel, with the pipe diameter, percent deflection and applicable ASTM or ASHTO standard fins.
3. The testing is to take place after the sewers have been in place for a minimum of 30 days. Allow time for corrective action.
4. The mandrel shall be pulled from structure to structure. Any portion of the pipe through which the mandrel passes freely shall be deemed to have passed the mandrel test. Sections of pipe through which the mandrel does not pass freely shall be exposed and examined and corrected.
5. The mandrel is to be construction in accordance with the following table.

Pipe ID	HDPE Mandrel O.D.	SDR PVC Mandrel O.D.
8″	7.54″	7.28″
10″	9.41″	N/A
12″	11.54″	N/A
15″	14.27″	N/A
18″	17.24″	N/A
24″	23.18″	N/A

D. Television Inspection
1. Television inspection shall follow MDOT and City of Ann Arbor Requirements. Television inspection is not required for extensions of existing catch basin leads less than 20 feet. Allow time for corrective action.
2. All sewer lines shall be thoroughly cleaned prior to television inspection.
3. Television inspection shall consist of wetting the invert of the section by pouring clean water in the upstream manhole until it appears in the downstream manhole, and then, after the water has stopped flowing, passing a camera through the section.
4. The camera shall be connected to a monitor and video tape recorder. The tape shall indicate the date, the section tested and the actual distance from the beginning manhole to each tee or wye, and each visible defect. The tape shall be furnished to the Owner’s representative.

E. Sewer Repairs
1. If a sewer repair is required as a result of damaged during construction operations or fails mandrel or television inspection, the Contractor shall expose the sewer pipe and perform the required correction(s).

2. If the repair is required due to the pipe being out of alignment or off grade, the pipe shall be adjusted so as to be placed n proper alignment and grade. Dense graded aggregate material shall be carefully placed under the haunches of the realigned pipe and compacted by the use of a tee bar.
3. If the pipe cannot be satisfactorily realigned or an open joint reset; of if the pipe is cracked, broken, or permanently deflected, the affected pipe shall be removed and replaced with the same pipe material. The pipe to be removed is to be sawed on each side of the damaged section in a neat and workmanlike manner without damage to the adjacent pipe. The replacement pipe section shall fit flush to the remaining pipe at each end. These sawed joints shall be coupled using a Fernco flexible coupling and stainless steel ring. These joints shall be encased to the pipe centerline with concrete one foot on either side of the flexible coupling.

3.12 CLEANING

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

3.13 STORM WATER MANAGEMENT CHECKLISTS

A. Storm water management construction and observation checklists for project specific items are to be completed by the contractor throughout the construction process, observed by the engineer of record, and provided to the Owner/Construction Manager.

B. Storm water management check lists
1. Permeable pavement
2. Bioretention
3. Infiltration basin
4. Infiltration trench

Permeable pavement construction & observation checklist			
Project:			
Location:			
Contractor			
Engineer			
Construction Sequence	**Contractor initial/date**	**Engineer initial/date for completion & compliance**	**Comments**
1. Pre-Construction			
Pre-construction meeting			
Runoff diverted			
Soil permeability verified			
Groundwater elevation verified (if within 3 feet of infiltration elevation)			
Project benchmark established			
Pavement location staked out and roped off			
Temporary erosion and sediment control established			
2. Excavation			
Size and location per plans			
Side slopes stable			
Verify with engineer regarding any soil layer depth adjustments required due to encountered vs. specified soil type and permeability			
Stockpile location not adjacent to excavation area and stabilized with vegetation and/ or silt fence			
3. Geotextile			
Fabric Meets specifications			
Sedimentation/silt is removed from area prior to placement of geotextile			

SESC measures are maintained to avoid sedimentation/silt getting into permeable pavement area			
Placement and downslope overlap (typically 2') conform to specifications and drawings			
Sides of excavation covered with geotextile			
No tears or holes			
Minimal wrinkles, pulled taught and staked			
4. Drain pipe/Overflow drain pipe			
Size, perforations, locations, slope, and outfalls meet specifications and drawings			
Elevation of overflow pipes correct			
Cleanouts installed per plan			
Pipe ends are protected from sediment until connected to outlet			
Interior of pipe clean and pipe tested			
5. Aggregate base course			
SESC measures are maintained to avoid sedimentation/silt permeable pavement area			
Submittal approved/sieve analysis meets specifications			
Arrives on site to meet approved material submittal, for example, no excessive fines, washed, etc.			
Laid or spread (not dumped) with a front - loader to avoid aggregate separation			

Thickness, placement, and compaction meet specifications and drawings			
6. Aggregate choke course			
SESC measures are maintained to avoid sedimentation/silt permeable pavement area			
Submittal approved/sieve analysis meets specifications			
Arrives on site to meet approved material submittal, for example, no excessive fines, washed, etc.			
Laid or spread (not dumped) with a front - loader to avoid aggregate separation			
Thickness, placement, and compaction meet specifications and drawings			
7. Edge Constraints			
Edge constraint curb elevation, placement, and materials meet specifications and drawings			
8. Porous concrete pavement			
SESC measures are maintained to avoid sedimentation/silt permeable pavement area			
Submittal approved			
pre-task meeting for porous concrete with certified installer			
Thickness, elevation and slope conforms to plans and specs			
9. Aggregate setting bed			

SESC measures are maintained to avoid sedimentation/silt permeable pavement area			
Submittal approved			
Thickness, elevation and slope conforms to plans and specs			
10. Permeable interlocking concrete pavers			
SESC measures are maintained to avoid sedimentation/silt permeable pavement area			
Submittal approved			
Meets ASTM standards, as applicable			
Elevations, slope, laying pattern, joint spacing, placement and compaction meet specifications			
11. Jointing sand			
SESC measures are maintained to avoid sedimentation/silt permeable pavement area			
Submittal approved			
Material, installation and compaction meets plans and specs			

Bioretention - construction & observation checklist			
Project:			
Location:			
Contractor			
Engineer:			
Construction Sequence	**Contractor initial/date**	**Engineer initial /date for completion and observed compliance**	**comments**
1. Pre-Construction			
Pre-construction meeting			
Runoff diverted			
Facility area cleared			
Soil tested for permeability			
Project benchmark near site			
Facility location staked and temporarily fenced to prevent traffic/storage compaction			
Temporary erosion and sediment protection properly installed			
2. Excavation			
Lateral slopes within design range and verified by field survey shots			
Soils not compacted during excavation			
Longitudinal slopes within design range and verified by field survey shots			
Stockpile location not adjacent to excavation area and stabilized with vegetation and/ or silt fence			
3. Structural Components			
Stone diaphragm installed per plans, with clean stone, and with approved submittals			
Outlets installed per plans with approved submittals			
Overflow drain pipe and cleanouts installed to grade and clean			
Pretreatment devices and inlets installed per plans with approved submittals			

Soil bed composition and texture conforms to plans and specifications			
Geotextile (if specified) conforms to plans and installed per specifications			
4. Vegetation and soil			
Complies with planting specs			
Topsoil submittals, including soil analysis, approved and meets plans/specs			
Topsoil arriving on site verified it complies with specs in composition and placement, for example, (allowable clay content not exceeded)			
Soil properly stabilized for permanent erosion control			
5. Final Inspection			
Dimensions per plans			
Pre-treatment operational			
Inlet/outlet operational			
Soil/ filter bed permeability verified			
Effective stand of vegetation stabilized			
Construction generated sediments removed			
Contributing watershed stabilized before flow is diverted to the practice			

Infiltration basin - system construction checklist			
Project:			
Location:			
Date:			
Contractor:			
Engineer:			
Construction Sequence	**Contractor initial/date**	**Engineer initial/date for completion and observed compliance**	**Comments**
1. Pre-Construction			
Pre-construction meeting			
Runoff diverted			
Soil permeability verified			
Groundwater elevation verified (if within 3 feet of infiltration elevation)			
Project benchmark established			
Facility location staked and temporarily fenced to prevent traffic/storage compaction			
Temporary erosion and sediment control established			
2. Excavation			
Size and location per plans			
Side slopes stable			
Depth adjusted to soil layer with specified soil type and permeabilityn			
Sub-soil not adjacent to excavation area and stabilized with vegetation and/ or silt fence			
Stockpile location not adjacent to excavation area and stabilized with vegetation and/ or silt fence			
Soil permeability verified at actual location and depth			
3. Embankment			

Verify by survey shots meets grade per plans			
Fill material per specifications			
4. Final Excavation			
Drainage area stabilized			
Sediment/silt removed from facility			
Basin floor tilled			
Facility stabilized			
Area per plans			
Initial depth = feet			
5. Final Inspection			
Pretreatment facility stabilized			
Contributing watershed stabilized prior to flow diversion			
Inlet and outlet operational and clean per plans and specs			

Infiltration trench - construction inspection checklist			
Project:			
Location:			
Date:			
Contractor:			
Engineer:			
Construction Sequence	**Contractor initial/date**	**Engineer initial/date for completion/compliance**	**comments**
1. Pre-Construction			
Pre-construction meeting			
Runoff diverted			
Soil permeability verified			
Groundwater / bedrock verified			
Project benchmark established			
Facility location staked out			
Temporary erosion and sediment control established			
2. Excavation			
Size and location per plans			
Side slopes stable			
Depth adjusted to soil layer with specified soil type and permeability			
Sub-soil not adjacent to excavation area and stabilized with vegetation and/ or silt fence			
Stockpile location not adjacent to excavation area and stabilized with vegetation and/ or silt fence			
3. Filter Fabric Placement			
Fabric per specifications			
Fabric per specifications			
Placed per plan location			
4. Aggregate Material			
Size as specified			
Clean / washed material			
Placed properly			
5. Observation Well			
Pipe size per plans			

Under-drain installed per plans			
Inlet installed per plans			
Pre-treatment devices installed per plans			
6. Vegetation			
Complies with planting specifications			
Topsoil complies with composition and placement in specifications			
Permanent erosion control measures in place			
7. Final Inspection			
Dimensions per plans			
Check dams operational			
Inlet / outlet operational			
Effective stand of vegetation and stabilization			
Contributing watershed stabilized before flow is routed to the facility			

END OF SECTION 334100