

## SECTION 33 41 00

### STORM UTILITY DRAINAGE PIPING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  1. Pipe and fittings.
  2. Nonpressure transition couplings.
  3. Pressure pipe couplings.
  4. Expansion joints and deflection fittings.
  5. Backwater valves.
  6. Cleanouts.
  7. Drains.
  8. Encasement for piping.
  9. Manholes.
  10. Channel drainage systems.
  11. Catch basins.
  12. Stormwater inlets.
  13. Stormwater detention structures.
  14. Pipe outlets.
  15. Dry wells.
  16. Stormwater disposal systems.

##### 1.03 STANDARDS

- A. American Society For Testing and Materials (ASTM)
  1. A185 – Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
  2. A615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  3. A760 – Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
  4. A798 – Installation of Corrugated-Steel Pipe for Sewers and Other Applications
  5. A929 – Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
  6. C76 – Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
  7. C443 – Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
  8. C478 – Precast Reinforced Concrete Manhole Sections
  9. C913 – Precast Concrete Water and Wastewater Structures
  10. C1479 – Installation of Reinforced Concrete Pipe
  11. C990-01A – Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
  12. D1056 – Flexible Cellular Materials-Sponge or Expanded Rubber
  13. D2306 – Annular Corrugated Profile Wall Polyethylene pipe and Fittings for Gravity Flow Storm Sewer and Subsurface Drainage Applications
  14. D2321 – Installation of Thermoplastic Pipe for Sewer/Gravity-Flow Applications
  15. D3034 – Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
  16. D3212 – Joints for Drain and Sewer Plastic Pipes Using Elastomeric Seals
  17. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
  18. F794 – Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
  19. F949 – Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
  20. F2418 – Polypropylene (PP) Corrugated Wall Stormwater Collection Chambers
  21. F2306 – Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings

22. F2562 – Steel Reinforced Thermoplastic Ribbed Pipe
23. C1504 - Precast Steel Reinforced Three Sided Concrete Structures
- B. American Association of State Highway and Transportation Officials (AASHTO)
  1. M36 – Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
  2. M198 – Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
  3. M252 – Corrugated Polyethylene Drainage Tubing
  4. M274 – Aluminum-Coated (Type 2), for Corrugated Steel Pipe
  5. M288 – Geotextile Specification for Highway Applications
  6. M294 – Corrugated Polyethylene Pipe.
  7. M36 – Metallic Coated Corrugated Steel Culverts and Underdrains
  8. M43 – Sizes of Aggregate for Road and Bridge Construction
  9. M190 – Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
  10. M199 – Standard Specification for Precast Reinforced Concrete Manhole Sections
  11. AASHTO LRFD Bridge Design Specifications Sections 3 & 12
- C. American Water Works Association (AWWA)
  1. C110 – Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in (75 mm through 1200 mm), for Water and Other Liquids (revision of ANSI/AWWA C110/A21.10-93)
  2. C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
  3. C151 – Ductile-Iron Pipe, Centrifugally Cast, for Water
- D. American Concrete Institute (ACI)
  1. 301 – Structural Concrete for Buildings, Specifications for
  2. 318 –Building Code Requirements for Structural Plain Concrete

#### **1.04 SUBMITTALS**

- A. The General Contractor and the Subcontractor shall execute the Conformance Submittals at the end of this section:
  1. Storm Drainage Conformance Submittal
- B. Product Data: For each type of product indicated.
- C. Shop Drawings:
  1. Manholes: Include plans, elevations, sections, details, frames, and covers.
  2. Catch basins stormwater inlets and dry wells. Include plans, elevations, sections, details, frames, covers, and grates.
  3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, and concrete design-mix reports.
- D. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.
- E. Field quality-control reports.
- F. Project Record Drawings: Accurately record as-built locations of pipe runs, connections, catch basins, cleanouts, top elevations and invert elevations. Identify and describe unexpected variations of subsurface conditions and location of any utilities encountered.

#### **1.05 QUALITY ASSURANCE**

- A. All costs associated with re-inspection due to failures shall be paid for by the Contractor at no additional expense to the Owner. Owner reserves the right to direct any inspection that is deemed necessary. Contractor shall provide free access to site for inspection activities.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store plastic, pipe, and fittings in direct sunlight with the exception of Corrugated High Density Polyethylene Pipe and Fittings.
- B. All pipe shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe. Pipes and chambers shall not be rolled or dragged over gravel or rock during handling. The Contractor shall take necessary precautions to ensure the method used in lifting or placing the pipe or chambers does not induce stress fatigue in the pipe or chamber and the lifting device used uniformly distributes the weight of the pipe or chamber along the axis or circumference. Storage of pipe on the job shall be in accordance with the pipe manufacturer's recommendations.

- C. Protect pipe, pipe fittings, and seals from dirt and damage.
- D. Damage to Pipe or Chambers:
  1. Each length of pipe or chamber shall be inspected for defects and cracks before carefully being lowered into the trench.
  2. Bituminous coated pipe shall be handled with special care and repair of damaged coating shall conform to AASHTO M190.
  3. Pipe or chambers which are defective from any cause, including damage caused by handling, storage or any other reason as determined by the Owner to be not repairable, shall be unacceptable for installation and shall be replaced at no cost to the Owner and as directed by the Owner.
  4. Pipe or chambers that are damaged or disturbed through any cause prior to acceptance of the work shall be repaired, realigned or replaced as directed by the Owner at no expense to the Owner.
- E. Handle manholes according to manufacturer's written rigging instructions.
- F. Handle catch basins and stormwater inlets according to manufacturer's written rigging instructions.

### 1.07 PROJECT CONDITIONS

- A. Removal/Relocation of Existing Utilities: The Contractor shall be responsible for removal and/or relocation of existing utilities, whether shown or not shown on the drawings, at locations where conflicts occur with proposed storm drainage improvements. Removal and relocation shall be at no additional cost to the Owner.
- B. 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 Owner no fewer than seven days in advance of proposed interruption of service.
  2. Do not proceed with interruption of service without Owner's written permission.

## PART 2 - PRODUCTS

### 2.01 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

- A. Pipe: ASTM A 716, for push-on joints.
- B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
- C. Compact Fittings: AWWA C153, for push-on joints.
- D. Gaskets: AWWA C111, rubber.

### 2.02 ALUMINIZED PIPE AND FITTINGS

- A. Aluminized Steel Type 2 Corrugated Steel Pipe 2 (CMP):
  1. Pipe shall meet requirements of ASTM A929 or AASHTO M 274 or ASTM A760
  2. Minimum gauge shall be 16 gauge for pipe diameters 10-24 inches, 14 gage for diameters 30-48 inches. Stormwater detention systems only: 12 gage for diameters 54-96 inches and 10 gauge for diameters 102 inches and larger, but not less than the diameter indicated on the drawings.
  3. Each pipe shall be clearly marked to show the class or gauge, date of manufacture and name or trademark of the manufacturer.
  4. Joints shall be fully corrugated 10" wide outside collars or coupling bands of aluminized steel angles riveted near the ends and bolted through angles to draw the bands tight for silt-tight designations. Additionally, a 7 "wide by 3/8" thick one piece continuous neoprene gasket per ASTM D1056 shall be provided at watertight designations.
  5. Maximum permitted diameter for CMP storm drainage piping is 48"
  6. CMP larger than 48" diameter is allowed for subsurface stormwater detention systems only.
- B. Aluminized Steel Type 2 Spiral Ribbed Pipe (Type IR)
  1. Pipe shall meet the requirements of ASTM A929 and AASHTO M274 or ASTM A760 with 3/4" x 3/4" x 7-1/2" continuous external ribs in accordance with the applicable requirements of AASHTO M-36 or ASTM A760 such as "Ultra-Flo" by Contech or approved equal.

2. Minimum gauge shall be 16 gauge for pipe diameters 10-24 inches and 14 gauge for diameters 30-48 inches, but not less than the diameter indicated on the drawings.
3. Each pipe shall be clearly marked to show the class or gauge, date of manufacture and name or trademark of the manufacturer.
4. Joints shall be fully corrugated 10" wide outside collars or coupling bands of aluminized steel angles riveted near the ends and bolted through angles to draw the bands tight for silt-tight designations. Additionally, a 7 " wide by 3/8" thick one piece continuous neoprene gasket per ASTM D1056 shall be provided at watertight designations
5. Pipe sizes, gages and corrugations shall be as shown on the project plans.
6. Maximum permitted diameter is 48"

### **2.03 HDPE PIPE AND FITTINGS**

- A. Steel Reinforced Thermoplastic Ribbed Smooth Interior Pipe
  1. Pipe lengths shall be joined on site using bell and spigots reinforced with steel that is fully encased in a pressure rated high density polyethylene and shall be watertight to an internal water pressure of 15 psi when tested in accordance with ASTM D3212.
  2. Gaskets shall meet the requirements of ASTM F477
  3. Maximum Diameter shall be 48"
- B. High Density Polyethylene Pipe (HDPE) Smooth Interior Pipe:
  1. Pipe and Fittings: Shall conform to AASHTO M252 and M294 and/or ASTM F2360 unless otherwise shown on the Drawings.
  2. Gaskets: Rubber gaskets shall meet requirements of ASTM F477 with joints conforming to AASHTO M294, watertight designations
  3. Maximum permitted diameter is 48".
  4. See drawings for bedding details.
  5. HDPE Pipe shall be NTPEP Certified.
  6. Approved Manufacturers:
    - a. Advance Drainage Systems, Inc., 3300 Riverside Drive, Columbus, Ohio 43221 (614) 457-3051
    - b. Hancor, Inc., 401 Olive Street, Findlay, Ohio 45840 (888) 367-7473
    - c. Lane Enterprises, Inc. (for Type S Lok-Tite Pipe) 3905 Hartzdale Drive, Suite 514, Camp Hill, PA 17011 (717) 761-8175
    - d. Quality Culvert, Inc., 25726 County Road 561, Astatula, FL 34750 (800) 881-1100

### **2.04 PVC PIPE AND FITTINGS**

- A. PVC Cellular-Core Piping:
  1. PVC Cellular-Core Pipe and Fittings: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
  2. Fittings: ASTM D 3034, SDR 35, PVC socket-type fittings.
- B. PVC Corrugated Sewer Piping:
  1. Pipe: ASTM F 949, and ASTM F 794 PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
  2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
  3. Gaskets: ASTM F 477, elastomeric seals with joints conforming to ASTM D3212
  4. Approved Manufacturers:
    - a. Contech "A2000", 1001 Grove Street, Middletown, OH 45044

### **2.05 CONCRETE PIPE AND FITTINGS**

- A. Reinforced-Concrete Pipe and Fittings: ASTM C 76 (ASTM C 76M).
  1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C 443 (ASTM C 443M), rubber gaskets or sealant joints with ASTM C 990 (ASTM C 990M), bitumen or butyl-rubber sealant for silt-tight designations.
  2. Class III, unless otherwise indicated on the Drawings.

## **2.06 NONPRESSURE TRANSITION COUPLINGS**

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Concrete Pipes: ASTM C 443 (ASTM C 443M), rubber.
  - 2. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  - 3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on the Drawings.
- D. Shielded, Flexible Couplings:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings
- E. Ring-Type, Flexible Couplings:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings

## **2.07 DRAINS**

- A. Sub Drains:
  - 1. Shall be perforated PVC or HDPE unless otherwise indicated on the Drawings. Installation shall be as shown on the drawings.

## **2.08 CLEANOUTS AND PLUGS**

- A. Installation shall be as shown on the details and at locations shown on the drawings.
- B. All cleanouts shall have a 2' x 2' x 6" thick concrete apron.

## **2.09 ENCASEMENT FOR PIPING**

- A. Standard: ASTM A 674 or AWWA C105.
- B. Material: Linear low-density polyethylene film of 0.008-inch (0.20-mm) minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black.

## **2.10 MANHOLES**

- A. Standard Precast Concrete Manholes:
  - 1. Description: ASTM C 478 (ASTM C 478M) and AASHTO M199, precast, reinforced concrete, of depth indicated, with provision for sealant joints. Heavy-duty traffic rated in accordance with Department of Transportation Standards in which project is located.
  - 2. Diameter: 48 inches (1200 mm) minimum unless otherwise indicated.
  - 3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required preventing flotation.
  - 4. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
  - 5. Riser Sections: 4-inch (102-mm) 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 990 (ASTM C 990M), bitumen or butyl rubber.
  - 8. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
  - 9. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, 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 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.
- B. Designed Precast Concrete Manholes:
1. Description: ASTM C 913; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
  2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required preventing flotation.
  3. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
  4. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
  5. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, 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 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
  6. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope.
- C. Manhole Frames and Covers:
1. Description: As shown on the Drawings, otherwise provide ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (102-mm-) minimum width flange and 26-inch- (660-mm-) diameter security bolted cover.
  2. Material: ASTM A 536, Grade 60-40-18 ductile iron unless otherwise indicated.

## 2.11 BEDDING AND BACKFILL MATERIAL

- A. Bedding material shall be as specified by trenching and bedding details shown on the drawings.
- B. Where the foundation material is found to be of poor supporting value or of rock, the Owner may make minor adjustments in the location of the pipe to provide a more suitable foundation. Where this is not practical, the foundation shall be conditioned by removing the existing foundation material by undercutting to the depth as directed by the geotechnical engineer and backfilling with either a suitable local material secured from unclassified excavation or borrow excavation at the nearest accessible location along the project, or foundation conditioning material consisting of crushed stone or gravel or a combination of sand and crushed stone or gravel approved by geotechnical engineer as being suitable for the purpose intended. The selection of the type of backfill material to be used for foundation conditioning will be made by the geotechnical engineer.

## 2.12 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:
  1. Cement: ASTM C 150, Type II.
  2. Fine Aggregate: ASTM C 33, sand.
  3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.
- B. Portland Cement Design Mix: (28 day compressive strength) 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.
  1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
  2. Reinforcing Bars: ASTM A 615/A 615M, Grade 40 or 60 (420 MPa) deformed steel.
- C. Manhole, Catch Basin and Storm Inlet Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi (27.6 MPa) 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 unless otherwise detailed on the Drawings.
  2. Benches: Concrete, sloped to drain into channel.
    - a. Slope: 4 percent unless otherwise detailed on the drawings..
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 185/A 185M, steel, welded wire fabric, plain.
  2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

## 2.13 CATCH BASINS

- A. Standard Precast Concrete Catch Basins:
1. Description: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, heavy duty (H20), of depth indicated, with provision for sealant joints.
  2. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 6-inch (150-mm) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
  3. Riser Sections: 6-inch (150-mm) minimum thickness, 48-inch (1200-mm) diameter, and lengths to provide depth indicated.
  4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
  5. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
  6. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
  7. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, 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 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
  8. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- B. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.
1. Joint Sealants: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
  2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 225-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and grate.
  3. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, 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 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
  4. Pipe Connectors: ASTM C 923 (ASTM C 923M), resilient, of size required, for each pipe connecting to base section.
- C. Grate and Frame: Per details shown on the drawings. Provide hood with stencil or casting "Dump No Waste – Drains to Waterways" or equal. Provide local casting if required. Provide 6 inch thick rectangular concrete apron, with 18 inch minimum width measured from the edge of structure frame to the end of the concrete apron, around all structure frames located in asphalt pavement areas. Provide saw cuts from each corner of the concrete apron to the frame of the structure as shown on the plan.
1. Rectangular Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, heavy duty (H20) structural loading. Include flat grate with small square or short-slotted drainage openings.
    - a. Size: 24 by 24 inches (610 by 610 mm) minimum unless otherwise indicated.
    - b. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2. Round, Manhole Type Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, heavy duty (H20) structural loading. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter flat grate with small square or short-slotted drainage openings.
  - a. Grate Free Area: Approximately 50 percent unless otherwise indicated.

#### **2.14 STORMWATER INLETS**

- A. Curb Inlets: Made with vertical curb opening of materials and dimensions according to the details shown on the Drawings.
- B. Gutter Inlets: Made with horizontal gutter opening of materials and dimensions according to the details shown on the Drawings. Include heavy-duty frames and grates.
- C. Combination Inlets: Made with vertical curb and horizontal gutter openings of materials and dimensions according to the details shown on the Drawings. Include heavy-duty frames and grates.
- D. Frames and Grates: Heavy duty and according to the details shown on the Drawings.

#### **2.15 STORMWATER DETENTION STRUCTURES**

- A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed according to ASTM C 890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
  1. Ballast: Increase thickness of concrete as required preventing flotation.
  2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch (150- to 229-mm) total thickness, that match 24-inch- (610-mm-) diameter frame and cover.
  3. Steps: Individual FRP steps; FRP ladder; or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP, 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 16-inch (400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 42 inches (1050 mm).
- B. Corrugated Aluminized Steel Detention Systems:
  1. Piping shall comply with AASHTO M36 for diameters 12"-144"
  2. The material shall be Aluminized Steel Type 2 conforming to AASHTO M274
  3. All fittings shall be reinforced per ASTM A998
- C. Precast Concrete Three Sided Detention Systems:
  1. Precast Concrete Detention Structures shall be manufactured per ASTM C1504
  2. Concrete shall be 4,000 psi mix and reinforcing steel shall have a minimum yield strength of 600 ksi
- D. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch (102-mm) minimum width flange, and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

#### **2.16 PIPE OUTLETS**

- A. Head Walls: Construction shall be according to details shown on the drawings. Headwalls shall be cast-in-place reinforced concrete, with apron and tapered sides unless otherwise indicated.
- B. Riprap Aprons: Broken, irregularly sized and shaped, graded stone according to Department of Transportation specifications for the state in which the project is located or by using NSSGA's "Quarried Stone for Erosion and Sediment Control". Unless otherwise shown on the drawings the median stone size used shall be 6 inches (150 mm). Riprap apron will be constructed of stone shaped according to the detail on the Drawings with an underlayment of medium weight non-woven geotextile fabric.
  1. Average Size: NSSGA No. R-6, screen opening 6 inches (150 mm).
- C. Concrete Lined Channels: Construction shall be in accordance with details shown on the drawings.
- D. Flared-End Sections: Shall meet Department of Transportation standards for the state in which the project is located unless otherwise indicated on the drawings.



## 2.17 DRY WELLS

- A. Description: ASTM C 913, precast, reinforced, perforated concrete rings. Include the following:
1. Floor: Cast-in-place concrete.
  2. Cover: Liftoff-type concrete cover with cast-in lift rings.
  3. Wall Thickness: 4 inches (102 mm) minimum with 1-inch (25-mm) diameter or 1-by-3-inch- (25-by-76-mm-) maximum slotted perforations arranged in rows parallel to axis of ring.
    - a. Total Free Area of Perforations: Approximately 15 percent of ring interior surface.
    - b. Ring Construction: Designed to be self-aligning.
  4. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.
- B. Description: Manufactured PE side panels and top cover that assemble into 50-gal. (190-L) storage capacity units.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
  2. Side Panels: With knockout ports for piping and seepage holes.
  3. Top Cover: With knockout port for drain.
  4. Filter Fabric: As recommended by unit manufacturer.
  5. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.
- C. Description: Constructed-in-place aggregate type. Include the following:
1. Lining: Concrete blocks or precast concrete rings with notches or weep holes.
  2. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.
  3. Cover: Precast, reinforced-concrete slab designed for structural loading according to ASTM C 890 and made according to ASTM C 913. Include slab dimensions that will extend 12 inches (300 mm) minimum beyond edge of excavation, with bituminous coating over entire surface. Cast cover with opening for manhole in center.
  4. Manhole: 24-inch- (610-mm-) diameter, reinforced-concrete access lid with steel lift rings. Include bituminous coating over entire surface.

## 2.18 STORMWATER DISPOSAL SYSTEMS

- A. Chamber Systems:
1. Chambers shall meet the requirements of ASTM F2418 and meet the safety factors recommended by Section 12.12 of the AASHTO LRFD Bridge Design Specifications. Loads for design shall be calculated in accordance with Section 3 of the AASHTO LRFD Bridge Design Specifications.
  2. The chamber manufacturer shall provide design data in accordance with ASTM F2418. Installation shall be in accordance with the details shown on the Drawings.
  3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Advanced Drainage Systems. 4640 Trueman Blvd., Hilliard, Ohio 43026 (800) 433-7473
    - b. CULTEC, Inc. 878 Federal Road, PO Box 280, Brookfield, CT 06804 (800) 4-CULTEC.
    - c. Hancor Inc. 401 Olive Street, Findlay, OH 45840 (800) 848-3546.
    - d. StormTech LLC. 20 Beaver Road, Wethersfield, CT 06109 (888) 892-2694
  4. Storage and Leaching Chambers: Chamber rows shall provide continuous, unobstructed internal space with no internal support panels in order to provide ease of access for inspection and maintenance. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
  5. Geotextile: Shall be enclosed in geotextile fabric for sediment capture and maintenance. Fabric shall be located per manufacturer's details.
    - a. Geotextile woven or spun filter fabric, in one or more layers, for minimum total unit weight of 4 oz./sq. yd. (135 g/sq. m).
    - b. Fabric between chamber bottom and the stone foundation shall be AASHTO M288 Class 1 woven for stabilization and filtration.
    - c. Fabric between the top of the chamber and the embedment stone shall be AASHTO M288 Class 2 non-woven for separation.

6. Filtering Material: ASTM D 448, Size No. 24, 3/4- to 2-1/2-inch (19- to 63-mm) washed, crushed stone or gravel.
- B. Pipe Systems:
1. Perforated manifold, header, and lateral piping complying with AASHTO M 252M for NPS 10 (DN 250) and smaller, AASHTO M 294M for NPS 12 to NPS 60 (DN 300 to DN 1500). Include proprietary fittings, couplings, seals, and filter fabric.
  2. 360 Degree Perforated Aluminized Steel Type 2 Recharge/Detention System conforming to AASHTO M274. All fittings to be reinforced per ASTM A998
  3. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Advanced Drainage Systems. 4640 Trueman Blvd., Hilliard, Ohio 43026 (800) 433-7473
    - b. Hancor Inc. 401 Olive Street, Findlay, OH 45840 (800) 848-3546.
    - c. CONTECH Construction Products, Inc. 9025 Centre Pointe Drive, West Chester, Ohio 45069 (336) 854-2177

### **PART 3 - EXECUTION**

#### **3.01 EARTHWORK**

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

#### **3.02 PIPING INSTALLATION**

- A. Locations and Arrangements: Contractor shall install all drainage structures, pipe and chambers in the locations shown on the drawings and/or as approved by the Owner. Pipe shall be of the type and sizes specified on the drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, on prepared foundation, 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. Lap joint pipes shall be laid with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.
- C. Install chambers in accordance with manufacturer's guidelines. Rows of chambers shall be laid out using spacers or appropriate measurements and markings to ensure proper spacing between rows for proper backfill and compaction as specified by the manufacturer.
- D. Manholes, catch basins and drain inlets shall be constructed as soon as the pipe laying reaches the location of the structures. If the Contractor continues pipe installation without making provisions for completion of the structures the Owner shall have the authority to stop the pipe installation until the structure is completed.
- E. Any structure which is miss-located or oriented improperly shall be removed and reconstructed at its proper location, alignment and orientation without cost to the Owner.
- F. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing storm drainage is indicated.
- G. Precast drainage structures shall be assembled in accordance with the manufacturer's instructions to form a sound structural unit.
- H. Cast-in-Place drainage structures shall be installed in accordance with the details or referenced specifications shown on the drawings. Concrete shall comply with the requirements of this section.
- I. Solid concrete brick masonry structures shall be installed in accordance with the details or referenced specifications shown on the drawings. Only solid masonry units may be used. Minimum wall thickness shall be 8 inches and minimum bottom slab thickness shall be 6 inches and extended a minimum of 6 inches outside the structure.
- J. Fittings and Connections: Pipe connections to drainage structures shall be made so that the pipe does not project beyond 3 inches inside the wall of the drainage structure and shall be grouted as necessary to make smooth and uniform surfaces on the inside of the structure. Connection

material shall not include large stone, broken block or other deleterious material. Bottom invert connections shall be constructed of concrete form smooth to provide a bench between pipe inverts unless otherwise detailed on the plans.

- K. 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.
- L. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro-tunneling.
- M. Install gravity-flow, non-pressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow.
  - 2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
  - 3. Install piping with 24-inch (610-mm) minimum cover.
  - 4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 6. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
  - 7. Install corrugated steel piping according to ASTM A798 and 798M.
  - 8. Install HDPE piping according to pipe manufacturer's installation guidelines for heavy duty drainage applications and ASTM D 2321.
  - 9. Install PVC profile gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
  - 10. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- N. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless cast-iron soil pipe and fittings.
  - 3. Ductile-iron pipe and fittings.
  - 4. Expansion joints and deflection fittings.

### **3.03 PIPE JOINT CONSTRUCTION**

- A. Join gravity-flow, nonpressure drainage piping according to the following:
  - 1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  - 2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  - 3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
  - 4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
  - 5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
  - 6. Join corrugated steel sewer piping according to ASTM A 798/A 798M.
  - 7. Join HDPE pipe according to ASTM D 2321
  - 8. Join PVC cellular-core piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
  - 9. Join PVC corrugated sewer piping according to ASTM D 2321 for elastomeric-seal joints.
  - 10. 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.
  - 11. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
  - 12. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
  - 13. Join dissimilar pipe materials with nonpressure-type flexible couplings.

### **3.04 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.

### **3.05 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 cast-in-place concrete, 24 by 24 by 6 inches (600 by 600 by 150 mm) deep. Set with tops flush with adjacent grade. At pavement areas and at roads set frames and covers with tops flush pavement surface.

### **3.06 DRAIN INSTALLATION**

- A. Install type of drains in locations indicated.
  - 1. Use Heavy-Duty, top-loading classification drains in vehicle service areas.
- B. Install drains according to details on the plans and manufacturer's installation requirements..
- C. Fasten grates to drains if indicated.
- D. Set drain frames and covers with tops flush with pavement surface.
- E. Assemble trench sections with flanged joints.

### **3.07 MANHOLE 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 (76 mm) above finished surface elsewhere unless otherwise indicated.

### **3.08 CATCH BASIN INSTALLATION**

- A. Construct catch basins to sizes and shapes indicated.
- B. Frames, Grates and Hoods
  - 1. Set frames and grates to elevations indicated.
  - 2. Firmly embedded in mortar approximately 1 inch thick and aligned to fit the top section of the structure.
  - 3. Brick set in mortar used to adjust the frame to finished grade shall be limited to no more than four (4) courses for precast structures and have a minimum wall thickness of eight (8) inches.

### **3.09 STORMWATER INLET AND OUTLET INSTALLATION**

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.
- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.
- E. Construct energy dissipaters at outlets, as indicated.

### **3.10 MODIFICATION OF EXISTING STRUCTURES**

- A. General: The Contractor shall alter, reconstruct and/or convert existing structures where and as shown on the drawings, and/or as approved by the Owner. Alterations shall be performed with the same type, grade and quality material as used in the original construction unless otherwise indicated on the drawings or approved by the Owner.
- B. Damage to Existing Structures: The Contractor shall exercise care during all alterations, reconstructions or conversions so as not to damage any portion of the existing structures or pipe to remain. Any damage caused by the Contractor shall be repaired by the Contractor at its own expense and to the satisfaction to the Owner.

### **3.11 ROOF DRAINS AND LEADERS**

- A. The site Contractor shall install roof downspout leaders as shown on the drawings to within five (5) feet of the building limits. If work by others is complete then the Contractor shall complete the connection. If future connections will be required by others, the Contractor shall install plugging and material apparatus as necessary to protect and mark the location of its work.
- B. All roof drain leader piping connections shall utilize watertight prefabricated fittings and drainage structures.

### **3.12 DRY WELL INSTALLATION**

- A. Excavate hole to diameter of at least 6 inches (150 mm) greater than outside of dry well. Do not extend excavation into ground-water table.
- B. Install precast, concrete-ring dry wells according to the following:
  - 1. Assemble rings to depth indicated.
  - 2. Extend rings to height where top of cover will be approximately 8 inches (203 mm) below finished grade.
  - 3. Backfill bottom of inside of rings with filtering material to level at least 12 inches (300 mm) above bottom.
  - 4. Extend effluent inlet pipe 12 inches (300 mm) into rings and terminate into side of tee fitting.
  - 5. Backfill around outside of rings with filtering material to top level of rings.
  - 6. Install cover over top of rings.
- C. Install manufactured, PE dry wells according to manufacturer's written instructions and the following:
  - 1. Assemble and install panels and cover.
  - 2. Backfill bottom of inside of unit with filtering material to level at least 12 inches (300 mm) above bottom.
  - 3. Extend effluent inlet pipe 12 inches (300 mm) into unit and terminate into side of tee fitting.
  - 4. Install filter fabric around outside of unit.
  - 5. Install filtering material around outside of unit.
- D. Install constructed-in-place dry wells according to the following:
  - 1. Install brick lining material dry and laid flat, with staggered joints for seepage. Build to diameter and depth indicated.
  - 2. Install block lining material dry, with staggered joints and 20 percent minimum of blocks on side for seepage. Install precast concrete rings with notches or weep holes for seepage. Build to diameter and depth indicated.
  - 3. Extend lining material to height where top of manhole will be approximately 8 inches (203 mm) below finished grade.
  - 4. Backfill bottom of inside of lining with filtering material to level at least 12 inches (300 mm) above bottom.
  - 5. Extend effluent inlet pipe 12 inches (300 mm) into lining and terminate into side of tee fitting.
  - 6. Backfill around outside of lining with filtering material to top level of lining.
  - 7. Install manhole over top of dry well. Support cover on undisturbed soil. Do not support cover on lining.

### **3.13 CONCRETE PLACEMENT**

- A. Place cast-in-place concrete according to ACI 318 and ACI 350R..
- B. No concrete or masonry shall be placed when the temperature is below 40 degrees Fahrenheit, or when indications are for lower temperatures within 24 hours, unless protection of concrete and masonry is approved by the Owner. Damage to the structure because of freezing shall be corrected by the Contractor at the Contractor's sole expense and to the satisfaction of the Owner.

### **3.14 STORMWATER DISPOSAL SYSTEM INSTALLATION**

- A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill according to chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.
- B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, according to piping manufacturer's written instructions.

### 3.15 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Connect force-main piping to building's storm drainage force mains specified in Division 22 Section "Facility Storm Drainage Piping." Terminate piping where indicated.
- C. Compliance with Existing Facilities:
  - 1. Connections made into existing drainage facilities shall be performed in accordance with the requirements of the Owner of the facility. Construction within a public right-of-way will conform to all requirements of the regulatory authority having jurisdiction. The Contractor will be required to comply with all such requirements, including securing all required permits and paying all associated costs related to securing the permits. Costs associated with connections shall be included in the Contract Sum.
  - 2. The contractor shall make all required connections of the proposed drainage facilities into existing drainage facilities where a d as shown on the drawings and/or as approved by the Owner.
- D. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
  - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20 (DN 100 to DN 500). Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
  - 3. Make branch connections from side into existing piping, NPS 21 (DN 525) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches (76 mm) 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 (150 mm) of concrete for minimum length of 12 inches (300 mm) 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 (20.7 MPa) unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  - 4. 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.
- E. Connect to sediment interceptors specified in Section "Sanitary Sewer."
- F. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
  - 1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. 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.
  - 2. Use pressure-type pipe couplings for force-main joints.

### 3.16 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-) thick, brick masonry bulkheads.

2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
  1. Remove manhole or structure and close open ends of remaining piping.
  2. Remove and backfill manhole locations as recommended in the geotechnical report and as indicated on the Drawings.
  3. If not indicated in the geotechnical report or on the Drawings, remove top of manhole or structure down to at least 36 inches (915 mm) below final grade. Fill to within 12 inches (300 mm) of top with stone, rubble, or gravel. Fill to top with concrete.
- C. Backfill to grade according to Division 31 Section "Earth Moving."

### 3.17 IDENTIFICATION

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

### 3.18 PROTECTION AND CLEANING

- A. The Contractor shall maintain all pipe and chamber installations and drainage structures in a condition such that they will function continuously and shall be kept clean of silt, debris and other deleterious substances until the project has achieved final acceptance.
- B. The Contractor shall use all erosion and sediment control measures necessary to assure construction sediments (or other pollutants) do not reach stormwater pipe and/or chamber installations.

### 3.19 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project (See 3.20 Post Installation Inspection).
  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 exceeding 5%.
    - 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 in Section 3.20.
  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.
    - b. Option: Test plastic piping according to ASTM F 1417.
    - c. Option: Test concrete piping according to ASTM C 924 (ASTM C 924M).
  6. Force-Main Storm Drainage Piping: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig (1035 kPa).

- a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
- b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- 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.

### **3.20 POST INSTALLATION INSPECTIONS**

- A. Upon completion of the work and before final acceptance by the Owner, the entire drainage system shall be subject to a final inspection in the presence of the Owner and/or the Project Engineer. The work shall not be considered complete until all requirements for line, grade, cleanliness, workmanship and final inspections have been completed. Final inspection of the completed pipe installations will be performed after the embankment and/or trench fill is in place and all non-asphalt bases and/or sub-grades have been completed for at least 30 days.
- B. Second Final Post Installation Inspection: (If required for the Project) The Owner shall require a second final post installation inspection.
  - 1. Final post installation inspections (if required) shall be conducted no sooner than 2 months before the end of the one year warranty.
  - 2. Final post installation inspections shall utilize a video camera and laser profiler/deflectometer or a video camera and go-no-go Mandrel. Lasers shall be calibrated to the pipe diameter as shown on the construction plans.
- C. Initial and final post installation inspections shall be performed and reported, at the Contractor's expense, by a National Association of Sewer Service Companies (NASSCO) Certified Pipe Inspector. Reports of storm pipe assessments shall be submitted to the Project Engineer for review and appraisal.
- D. The initial and post installation inspection report shall include: a copy of all video taken (if required), pipe location identification, equipment used for inspection, inspector name, deviation from design grade, deviation from line, deflection of pipe system, inspector notes, condition of joints, condition of pipe wall (e.g. Distress, cracking, wall damage dents, bulges, creases, tears, holes, etc...), ovality and flow capacity.
- E. For RCP: seal cracks having a width greater than .010 inches. Repair or replace pipes exhibiting spalls or de-lamination.
- F. For CMP and HDPE: initial and post installation inspection deflection shall not exceed 5%; final post installation (warranty) deflection shall not exceed 7%. Replace locations where deflections exceed these requirements; re-rounding of pipe is not allowed.

### **3.21 CLEANING**

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

**END OF SECTION 334100**



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**CONFORMANCE SUBMITTAL  
SECTION 334100 – STORM UTILITY DRAINAGE PIPING**

Project Location \_\_\_\_\_  
(City, State)

General Contractor: \_\_\_\_\_  
(Company Name, Phone Number)  
\_\_\_\_\_  
(Address)

Sub-Contractor: \_\_\_\_\_  
(Company Name, Phone Number)  
\_\_\_\_\_  
(Address)

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The following products have been selected (check one box) for use in this project from the list of acceptable products specified:

Concrete Pipe, ASTM C76, Butyl mastic joint sealant ASTM C990-01a for silt-tight designations or rubber gaskets meeting the material and joint configuration requirements of ASTM C443 for watertight designations:

- Tongue and Groove RCP, Class \_\_\_\_\_  
 Bell and Spigot RCP, Class \_\_\_\_\_

High Density Polyethylene (HDPE) Pipe, AASHTO M252, M294, Rubber Gasket Joints ASTM F477, silt-tight or watertight designations as specified:

- ADS Pipe  
 Hancor Pipe  
 Type S Lok-Tite Pipe  
 Quality Culvert Pipe  
 DuroMaxx  
 All underground connections will be made with pre-fabricated HDPE fittings

Polyvinyl Chloride (PVC) Pipe, Rubber Gasket Joints ASTM F477:

- PVC Pipe, ASTM D3034, SDR 35  
 Corrugated PVC Pipe, Contech “A2000”  
 All underground connections will be made with pre-fabricated PVC fittings

Aluminized Steel Type 2 Corrugated Steel Pipe (CMP), AASHTO M274 or ASTM A929, silt-tight or watertight designations as specified:

- Aluminized Steel Type 2 Corrugated Steel Pipe

Aluminized Steel Type 2 Spiral Ribbed Pipe (Type IR), AASHTO M274 or ASTM A929 and AASHTO M36 or ASTM A760, silt-tight or watertight designations as specified:

- Aluminized Steel Type 2 Spiral Ribbed Pipe (Type IR) such as “Ultra Flo” by Contech or approved equal

Ductile Iron Pipe (DIP), AWWA C151, Fittings AWWA C110, Gaskets AWWA C111:

- DIP

Stormwater Collection Chambers ASTM F2418

- StormTech  
 Hancor  
 CULTEC  
 StormTech by ADS

Stormwater Detention or Recharge System

- Aluminized Steel CMP Detention by CONTECH
- 360 Degree Perforated CMP Detention/Recharge by CONTECH
- Precast Concrete Detention System

Drainage Boxes (Must be pre-cast unless approved by Owner):

- Pre-cast Concrete, per specifications by:  DOT # \_\_\_\_\_,  City # \_\_\_\_\_,  Other \_\_\_\_\_
- Cast-in-place Concrete, per specifications by:  DOT # \_\_\_\_\_,  City # \_\_\_\_\_,  Other \_\_\_\_\_
- Solid Concrete Brick Masonry, per specifications by:  DOT # \_\_\_\_\_,  
 City # \_\_\_\_\_,  Other \_\_\_\_\_

Cast Iron Frames, Grates, and Hoods:

- Manhole lids, per specifications by:  DOT # \_\_\_\_\_,  City # \_\_\_\_\_,  Other \_\_\_\_\_
- Curb Inlets, per specifications by:  DOT # \_\_\_\_\_,  City # \_\_\_\_\_,  Other \_\_\_\_\_
- Drop Inlets, per specifications by:  DOT # \_\_\_\_\_,  City # \_\_\_\_\_,  Other \_\_\_\_\_

Detention Pond As-built Survey:

- I recognize that an as-built survey of all detention ponds and structures shall be completed prior to project acceptance in accordance with Section 017300 – Field Engineering and Surveying

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I represent to Owner/City/Engineer that the products selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the contract documents. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and specifications. Immediately or as directed by Owner the work shall be completed without additional cost to the Owner and / or the contract.

Sub-Contractor:

\_\_\_\_\_  
(Signature of the Authorized Agent of the Sub-Contractor) Date  
\_\_\_\_\_  
(Print Name of the Authorized Agent of the Sub-Contractor)

General Contractor:

\_\_\_\_\_  
(Signature of the Authorized Agent of the General Contractor) Date  
\_\_\_\_\_  
(Print Name of the Authorized Agent of the General Contractor)

**TRENCH DRAIN CONFORMANCE SUBMITTAL**  
**SECTION 334100 – STORM UTILITY DRAINAGE PIPING**

Project Location \_\_\_\_\_  
(City, State)

General Contractor: \_\_\_\_\_  
(Company Name, Phone Number)  
\_\_\_\_\_  
(Address)

Sub-Contractor: \_\_\_\_\_  
(Company Name, Phone Number)  
\_\_\_\_\_  
(Address)

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**Product Verification:**

**The trench drains installed in this store will meet the product guidelines of Section 334100-2.13 “POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS”**

**Trench Drain Manufacturer & Model Number:** \_\_\_\_\_

**Grate Model Number:** \_\_\_\_\_

**Trench Drain Manufacturer & Model Number:** \_\_\_\_\_

**Grate Model Number:** \_\_\_\_\_

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**General Contractor’s Affidavit:**

I represent to Owner that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the project specification. If noncompliance is discovered the General Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and Owner specifications. The work shall be completed immediately as directed by Owners without additional cost to Owner and/or the contract.

General Contractor: \_\_\_\_\_  
(Signature of the Authorized Agent of the General Contractor) (Date)

\_\_\_\_\_  
(Print Name of the Authorized Agent of the General Contractor)

**Sub-Contractor’s Affidavit:**

I represent to Owner that the product selected will be installed in compliance with the applicable codes for the authorities having jurisdiction and in accordance with the project specification. If noncompliance is discovered the Sub-Contractor shall make or cause to be made all necessary corrections to meet the applicable codes and owners specifications. The work shall be completed immediately as directed by owner and/or the General Contractor without additional cost to owner and/or the contract.

Sub-Contractor: \_\_\_\_\_  
(Signature of the Authorized Agent of the Sub-Contractor) (Date)

\_\_\_\_\_  
(Print Name of the Authorized Agent of the Sub-Contractor)