

**SECTION 33 40 00
STORM SEWER UTILITIES**

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. References to pressure in this section are gage pressure unless otherwise noted.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section specifies materials and procedures for construction of outside, underground storm sewer systems that are complete and ready for operation. This includes piping, structures, and all other incidentals.

1.2 RELATED WORK

SPEC WRITER NOTE: Retain one of two paragraphs below.

- A. //Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects).//
- B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
- C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA AND SAMPLES: Materials and Testing Report Submittals.
- D. Section 01 42 19, REFERENCE STANDARDS.
- E. Section 01 57 19, TEMPORARY ENVIRONMENTAL CONTROLS: Erosion and Sediment Control.
- F. Section 01 81 13, SUSTAINABLE DESIGN REQUIREMENTS.
- G. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- H. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete Work, Reinforcing, Placement and Finishing.
- I. Section 05 50 00, METAL FABRICATIONS: Fabrication of Steel Ladders.
- J. Section 22 14 00, FACILITY STORM DRAINAGE.
- K. Section 31 20 00, EARTH MOVING: Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with requirements specified in the referenced Applicable Publications. Verify and update the

publication list to that which applies to the project, unless the reference applies to all mechanical systems. Publications that apply to all mechanical systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Association of State Highway and Transportation Officials (AASHTO):
- HB-17-2002.....Standard Specifications for Highway Bridges,
17th Edition
- M190-2004.....Standard Specification for Bituminous-Coated
Corrugated Metal Culvert Pipe and Pipe Arches
- M252-2009.....Standard Specification for Corrugated
Polyethylene Drainage Pipe
- M294-2015.....Standard Specification for Corrugated
Polyethylene Pipe, 300 to 1500 mm (12 to 60
In.) Diameter
- C. American Concrete Institute (ACI):
- 318-2014.....Building Code Requirements for Structural
Concrete and Commentary
- 350-2006.....Code Requirements for Environmental Engineering
Concrete Structures and Commentary
- D. American Society of Mechanical Engineers (ASME):
- A112.6.3-2016.....Floor and Trench Drains
- A112.14.1-2003.....Backwater Valves
- A112.36.2M-1991.....Cleanouts
- E. American Society for Testing and Materials (ASTM):
- A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings
- A242/A242M-2013.....Standard Specification for High-Strength Low-
Alloy Structural Steel
- A536-1984 (R2014).....Standard Specification for Ductile Iron
Castings
- A615/A615M-2016.....Standard Specification for Deformed and Plain
Carbon-Steel Bars for Concrete Reinforcement
- A760/A760M-2015.....Standard Specification for Corrugated Steel
Pipe, Metallic-Coated for Sewers and Drains

A762/A762M-2015.....Standard Specification for Corrugated Steel
Pipe, Polymer Precoated for Sewers and Drains

A798/A798M-2013.....Standard Specification for Installing Factory-
Made Corrugated Steel Pipe for Sewers and Other
Applications

A849-2015.....Standard Specification for Post-Applied
Coatings, Pavings, and Linings for Corrugated
Steel Sewer and Drainage Pipe

A929/A929M-2001(2013)...Standard Specification for Steel Sheet,
Metallic-Coated by the Hot-Dip Process for
Corrugated Steel Pipe

A1064/A1064M-2016.....Standard Specification for Carbon-Steel Wire
and Welded Wire Reinforcement, Plain and
Deformed, for Concrete

B745/B745M-2015.....Standard Specification for Corrugated Aluminum
Pipe for Sewers and Drains

B788/B788M-2009 (R2014).Standard Specification for Installing Factory-
Made Corrugated Aluminum Culverts and Storm
Sewer Pipe

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

C33/C33M-2016.....Standard Specification for Concrete Aggregates

C76-2015a.....Standard Specification for Reinforced Concrete
Culvert, Storm Drain, and Sewer Pipe

C150/C150M-2016.....Standard Specification for Portland Cement

C443-2012.....Standard Specification for Joints for Concrete
Pipe and Manholes, Using Rubber Gaskets

C478-2015.....Standard Specification for Circular Precast
Reinforced Concrete Manhole Sections

C506-2016a.....Standard Specification for Reinforced Concrete
Arch Culvert, Storm Drain, and Sewer Pipe

C507-2015.....Standard Specification for Reinforced Concrete
Elliptical Culvert, Storm Drain, and Sewer Pipe

C828-2011.....Standard Test Method for Low-Pressure Air Test
of Vitrified Clay Pipe Lines

C890-2013.....Standard Practice for Minimum Structural Design
Loading for Monolithic or Sectional Precast
Concrete Water and Wastewater Structures

C891-2011.....	Standard Practice for Installation of Underground Precast Concrete Utility Structures
C913-2008.....	Standard Specification for Precast Concrete Water and Wastewater Structures
C923-2008 (R2013)e1.....	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
C990-2009 (R2014).....	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
C1103-2014.....	Standard Specification for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
C1173-2010 (R2014).....	Standard Specification for Flexible Transition Couplings for Underground Piping Systems
C1433-2016a.....	Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers
C1479-2013.....	Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations
D448-2012.....	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
D698-2012e2.....	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ³ (600 kN-m/m ³))
D1056-2014.....	Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber
D2321-2014e1.....	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
D2661-2014.....	Standard Specification for Acrylonitrile- Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
D3034-2015.....	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
D3350-2014.....	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

- D3753-2012e1.....Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells
- D4101-2014.....Standard Specification for Polypropylene Injection and Extrusion Materials
- D5926-2015.....Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
- F477-2014.....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F679-2015.....Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
- F714-2013.....Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- F794-2003 (R2014).....Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
- F891-2010.....Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe With a Cellular Core
- F894-2013.....Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
- F949-2015.....Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
- F1417-2011a (R2015).....Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air
- F1668-2008.....Standard Guide for Construction Procedures for Buried Plastic Pipe
- F. American Water Works Association (AWWA):
- C105-2010.....Polyethylene Encasement for Ductile-Iron Pipe Systems
- C110-2012.....Ductile-Iron and Gray-Iron Fittings
- C219-2011.....Bolted, Sleeve-Type Couplings for Plain-End Pipe

C600-2010.....Installation of Ductile iron Mains and Their Appurtenances

C900-2007.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution

M23-2002.....PVC Pipe: Design And Installation, Second Edition

G. National Stone, Sand and Gravel Association (NSSGA):

.....Quarried Stone for Erosion and Sediment Control

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 33 40 00, STORM SEWER UTILITIES", with applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.

D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:

1. Include complete list indicating all components of the systems.

2. Include complete diagrams of the internal wiring for each item of equipment.

3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

E. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

F. //Submit training plans and instructor qualifications in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

1.5 QUALITY ASSURANCE

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Handle manholes //catch basins// //stormwater inlets// according to manufacturer's written rigging instructions.

1.7 COORDINATION

- A. Coordinate connection to storm sewer main with the Public Agency providing storm sewer off-site drainage.
- B. Coordinate exterior utility lines and connections to building services up to the actual extent of building wall.

1.8 WARRANTY

- A. Guaranty: Warranty of Construction, FAR clause 52.246-21.
- B. The Contractor shall remedy any defect due to faulty material or workmanship and pay for any damage to other work resulting therefrom within a period of //one year// //two years// from final acceptance. Further, the Contractor will furnish all manufacturers' and suppliers' written guarantees and warranties covering materials and equipment furnished under this Contract.

1.9 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 01, GENERAL REQUIREMENTS (Major NCA Projects) or Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects). O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three ring binder.

All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //____// provided on CD or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized to reduce spare part requirements. Guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.

SPEC WRITER NOTE: Retain one or more of the following paragraphs. If retaining more than one type of pipe, indicate location of each type on Drawings.

2.2 STEEL PIPE AND FITTINGS

- A. Steel pipe and fittings shall be as per //ASTM A760/A760M// //ASTM A762/A762M//.
- B. Type of pipe: //I// //II// //IR// //IIR//.

SPEC WRITER NOTE: If Type I or II is selected, use the following paragraph.

C. //Corrugations: //Annular// //Helical// 68 by 15 mm (2-2/3 by 1/2 inch) corrugations.//

SPEC WRITER NOTE: If Type IR or IIR is selected, use the following paragraph.

D. //Corrugations: Helical 20 by 20 by 191 mm (3/4 by 3/4 by 7-1/2 inch) corrugations.//

E. Internal Coating: Internal coating shall be //fully bituminous coated (AASHTO M190 Type A)// //half bituminous coated, part paved (AASHTO M190 Type B)// //fully bituminous coated, part paved (AASHTO M190 Type C)// //fully bituminous coated, fully paved (AASHTO M190 Type D)// //concrete lined as per ASTM A849// //polymer precoated, part paved (AASHTO M190, Type B modified)// //polymer precoated, fully paved (AASHTO M190, Type D modified)//.

F. Exterior Coating: //Aluminum// //Zinc// //Polymer// //Bituminous// Coated.

G. Gaskets: ASTM D1056, Type 2, //A1// //B3//.

H. Connecting Bands: To be same type and size as the ends of the pipe being connected.

2.3 ALUMINUM PIPE AND FITTINGS

A. Corrugated aluminum pipe and fittings shall be ASTM B745/B745M, Type I with fittings of similar form and construction as pipe.

1. Special joint bands shall be corrugated steel with O-ring seals.
2. Standard joint bands shall be corrugated steel.

2.4 ABS PIPE AND FITTINGS

A. ABS Sewer Pipe and Fittings: Pipe and fittings, DN 80 to DN 150 (NPS 3 to NPS 6) shall conform to ASTM D2661, with ends suitable for solvent cement joints.

2.5 PE PIPE AND FITTINGS

A. Smoothwall PE drainage pipe and fittings, DN 80 to DN 250 (NPS 3 to NPS 10); ASTM F714, DR 21 with smooth waterway for coupling joints.

SPEC WRITER NOTE: Select Paragraph 1 or 2 below. If both types of couplings are required indicate on Drawings location for different couplings.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.

- B. Corrugated PE pipe and fittings, DN 300 to DN 1500 (NPS 12 to NPS 60); AASHTO M294, Type S with smooth waterway for coupling joints. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D3350, minimum cell class 335434C.

SPEC WRITER NOTE: Select Paragraph 1, 2 or 3 below. If both types of couplings are required indicate on Drawings location for different couplings.

1. Silt-tight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
 2. Soil-tight Couplings: AASHTO M252, corrugated, matching tube and fittings.
 3. Water tight joints shall be made using a PVC or PE coupling and rubber gaskets as recommended by the pipe manufacturer. Rubber gaskets shall conform to ASTM F477. Soil tight joints shall conform to requirements in AASHTO HB-17, Division II, for soil tightness and shall be as recommended by the manufacturer.
- C. Profile Wall PE Pipe: Pipe shall comply with ASTM F894, RSC 160 with bell and spigot ends.
1. Profile Wall PE Plastic Pipe Joints: Joints shall be as per ASTM F894, //gasketed// //extrusion weld// type with integral bell.

2.6 PVC PIPE AND FITTINGS

- A. PVC Cellular-Core Pipe And Fittings:
1. Pipe: ASTM F891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
 2. Fittings: ASTM D3034, //SDR 35// //Insert SDR//, PVC socket-type fittings.
- B. PVC Corrugated Sewer Piping:
1. Pipe: ASTM F949, PS46, corrugated pipe with bell-and-spigot ends for gasketed joints.
 2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
 3. Gaskets: ASTM F477, elastomeric seals.
- C. PVC Profile Sewer Piping:
1. Pipe: ASTM F794, Series 46, gravity sewer pipe with bell-and-spigot ends.
 2. Fittings: ASTM D3034, PVC with bell ends.
 3. Gaskets: ASTM F477, elastomeric seals.

D. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D3034, //SDR 35// //Insert SDR//, PVC Type PSM sewer pipe with bell-and-spigot ends.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

E. PVC Gravity Sewer Piping:

1. Pipe and fittings shall be ASTM F679, //PS46// //PS75// //PS115//, PVC gravity sewer pipe with bell-and-spigot ends.
2. Gaskets: ASTM F477, elastomeric seals for gasketed joints.

F. PVC Pressure Piping:

1. Pipe: AWWA C900, //Class 100// //Class 150// //Class 200// PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, //Class 100// //Class 150// //Class 200// PVC pipe with bell ends
3. Gaskets: ASTM F477, elastomeric seals.

2.7 CONCRETE PIPE AND FITTINGS

- A. Non-reinforced concrete sewer pipe and fittings shall be ASTM C14, //Class 1// //Class 2// //Class 3//, with //bell-and-spigot// //tongue and groove// ends and //gasketed joints with ASTM C443, rubber gaskets// //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.
- B. Reinforced concrete sewer pipe and fittings shall be ASTM C76.
 1. //Bell-and-spigot// //tongue and groove// ends and //gasketed joints with ASTM C443, rubber gaskets// //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.

SPEC WRITER NOTE: Retain one of subparagraphs below for DN 300 to DN 3600 (NPS 12 to NPS 144).

 2. Class I: //Wall A// //Wall B//
 3. Class II: //Wall A// //Wall B// //Wall C //
 4. Class III: //Wall A// //Wall B// //Wall C //
 5. Class IV: //Wall A// //Wall B// //Wall C //
 6. Class V: //Wall B// //Wall C //
- C. Reinforced arch culvert and storm drain pipe and fittings shall be ASTM C506, Class //A-III// //A-IV// and //gasketed joints with ASTM C443, rubber gaskets// //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.

- D. Reinforced concrete elliptical culvert and storm drain pipe and fittings shall be ASTM C507, Class //HE III// //HE IV// //VE III// //VE IV// //VE V// //VE VI// and //gasketed joints with ASTM C443, rubber gaskets // //sealant joints with ASTM C990, bitumen or butyl-rubber sealant//.

2.8 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure 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 C443, rubber.
 2. For plastic pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
 3. For dissimilar pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings: Couplings shall be an elastomeric sleeve with //stainless steel shear ring and// corrosion resistant metal tension band and tightening mechanism on each end.
- D. Shielded, flexible couplings shall be elastomeric or rubber sleeve with full length, corrosion resistant outer shield and corrosion resistant metal tension band and tightening mechanism on each end.
- E. Ring-type, flexible couplings shall be elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.9 PRESSURE PIPE COUPLINGS

- A. Couplings: AWWA C219, tubular sleeve coupling, with center sleeve, gaskets, end rings, and bolt fasteners.
- B. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include //1034 kPa (150 psi)// //1380 kPa (200 psi)// //Insert value// minimum pressure rating and ends sized to match adjoining pipes.
- C. Center Sleeve Material: //Carbon steel// //Stainless steel// //Ductile iron// //Malleable iron//.
- D. Gasket Material: Natural or synthetic rubber.
- E. Metal Component Finish: Corrosion resistant coating or material.

2.10 EXPANSION JOINTS AND DEFLECTION FITTINGS

SPEC WRITER NOTES:

1. Expansion joints and deflection fittings in the following paragraphs

are for buried, ductile iron pressure pipe, and other pipe with same diameters.

2. Expansion joints in the following paragraph provides both offset and expansion. Indicate minimum required offset and expansion data on Drawings.

- A. Ductile iron flexible expansion joints: Compound fitting with combination of flanged and mechanical joint ends complying with AWWA C110. Include two gasketed ball joint sections and one or more gasketed sleeve sections, rated for 1724 kPa (250 psi) minimum working pressure and for offset and expansion indicated.

SPEC WRITER NOTE: Expansion joints in the following paragraph provides linear expansion only.

- B. Ductile iron expansion joints: Three piece assemblies of telescoping sleeve with gaskets and restrained-type, //ductile iron// //steel with protective coating//, bell-and-spigot end sections complying with AWWA C110. Include rating for 1724 kPa (250 psi) minimum working pressure and for expansion indicated.

SPEC WRITER NOTE: Fittings in the following paragraph provides deflection only.

- C. Ductile iron deflection fittings: Compound coupling fitting, with ball joint, flexing section, gaskets, and restrained joint ends, complying with AWWA C110. Include rating for 1724 kPa (250 psi) minimum working pressure and for up to 15 degrees of deflection.

2.11 BACKWATER VALVES

- A. Cast Iron Backwater Valves: ASME A112.14.1, gray iron body and bolted cover, with bronze seat.

SPEC WRITER NOTE: Retain one or more of the following subparagraphs. If more than one type is required, show location of each on Drawings.

1. //Horizontal type; with swing check valve and hub-and-spigot ends.//
2. //Combination horizontal and manual gate valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.//
3. //Terminal type; with bronze seat, swing check valve, and hub inlet.//

- B. Plastic backwater valves: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.

2.12 CLEANOUTS

- A. Cast Iron Cleanouts: ASME A112.36.2M, round, gray iron housing with clamping device and round, secured, scoriated, gray iron cover. Include gray iron ferrule with inside calk or spigot connection and countersunk, tapered thread, brass closure plug.

SPEC WRITER NOTE: Retain one or more options in the following subparagraph. If more than one top-loading classification is required, show location of each on Drawings.

1. Top-Loading Classification(s): //Light Duty// //Medium Duty// //Heavy Duty// and //Extra-Heavy Duty//.
2. Pipe fitting and riser to cleanout shall be same material as main pipe line.

- B. Plastic Cleanouts shall have PVC body with PVC threaded plug. Pipe fitting and riser to cleanout shall be of same material as main line pipe.

2.13 DRAINS

- A. Cast Iron Area Drains: ASME A112.6.3, gray iron round body with anchor flange and round //secured// grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated.

1. Top-Loading Classification(s): //Medium Duty// //Medium and Heavy Duty// //Heavy Duty//.

- B. Cast Iron Trench Drains: ASME A112.6.3, 150 mm (6 inch) wide top surface, rectangular body with anchor flange or other anchoring device, and rectangular //secured// grate. Include units of total length indicated and quantity of bottom outlets with inside calk or spigot connections, of sizes indicated.

1. Top-Loading Classification(s): //Medium Duty// //Heavy Duty// //Extra-Heavy Duty// //Medium and Heavy Duty// //Medium and Extra-Heavy Duty// //Heavy and Extra-Heavy Duty// //Medium, Heavy, and Extra-Heavy Duty//.

- C. Steel Trench Drains: ASTM A242/A242M, welded steel plate, to form rectangular body with uniform bottom downward slope of 2 percent toward outlet, anchor flange, and grate.

1. Plate Thicknesses: //3.2 mm (1/8 inch)// //6 mm (1/4 inch)//.
2. Overall Widths: //191 mm (7-1/2 inches)// //313 mm (12-1/3 inches)//.

- D. Grate openings shall be //6 mm (1/4 inch) circular// //10 mm (3/8 inch) circular// //10 by 75 mm (3/8 by 3 inch) slots//.

2.14 ENCASUREMENT FOR PIPING

- A. Material: AWWA C105 //linear low-density polyethylene film of 0.20 mm (0.008 inch)// //high-density, cross-laminated polyethylene film of 0.10 mm (0.004 inch)// minimum thickness.
- B. Form: //Sheet// //Tube//.
- C. Color: //Black// //Natural// //Insert color//.

2.15 MANHOLES AND CATCH BASINS

SPEC WRITER NOTE: Retain one or more of the following paragraphs. If more than one paragraph is selected, show location of each on Drawings.

- A. Standard Precast Concrete Manholes:
1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 2. Diameter: 1200 mm (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: 150 mm (6 inch) minimum thickness for floor slab and 100 mm (4 inch) minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
 5. Riser Sections: 100 mm (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 C990, bitumen or butyl rubber.
 8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
 9. Steps: If total depth from floor of manhole to finished grade is greater than 1500 mm (60 inches). //Individual FRP steps or FRP ladder// //Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP// //ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP//, width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.
 10. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inch) 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 Structures:

1. Description: ASTM C913; designed 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 to prevent flotation.
3. Joint Sealant: ASTM C990, bitumen or butyl rubber.
4. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
5. Steps: If total depth from floor of structure to finished grade is greater than 1500 mm (60 inches). //Individual FRP steps or FRP ladder// //Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP// //ASTM A615/A615M deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D 4101, PP//, width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.
6. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inches) 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.

C. Fiberglass Manholes:

1. Description: ASTM D3753.
2. Diameter: 1200 mm (48 inches) minimum unless otherwise indicated.
3. Ballast: Increase thickness of concrete base as required to prevent flotation.
4. Base Section: Concrete, 200 mm (8 inch) minimum thickness.
5. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
6. Steps: If total depth from floor of manhole to finished grade is greater than 1500 mm (60 inches). //Individual FRP steps or FRP ladder// //Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP// //ASTM A615/A615M, deformed, 15 mm (1/2 inch) steel reinforcing rods encased in ASTM D4101, PP//, width of 400 mm (16 inches) minimum, spaced at 300 to 400 mm (12 to 16 inch) intervals.

7. Adjusting Rings: Reinforced concrete rings, 150 to 225 mm (6 to 9 inch) 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.

D. Manhole Frames and Covers:

1. Description: Ferrous; 600 mm (24 inch) ID by 175 to 225 mm (7 to 9 inch) riser with 100 mm (4 inch) minimum width flange and 660 mm (26 inch) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: //ASTM A536, Grade 60-40-18 ductile// //ASTM A48/A48M, Class 35 gray// iron unless otherwise indicated.

2.16 CONCRETE FOR MANHOLES AND CATCH BASINS

- A. General: Cast-in-place concrete according to ACI 318, ACI 350, and the following:

1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

- B. Concrete Design Mix: 27.6 MPa (4000 psi) minimum, compressive strength in 28 days.

1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 420 MPa (60,000 psi) deformed steel.

- C. Manhole Channels and Benches: Channels shall be the main line pipe material. Include benches in all manholes and catch basins.

1. Channels: Main line pipe material or concrete invert. Height of vertical sides to 3/4 of pipe diameter. Form curved channels with smooth, uniform radius and slope. Invert Slope: Same slope as the main line pipe. Bench to be concrete, sloped to drain into channel. Minimum of 6 inch slope from main line pipe to wall sides.

2.17 POLYMER-CONCRETE, CHANNEL DRAINAGE SYSTEMS

- A. General Requirements for Polymer-Concrete, Channel Drainage Systems: Modular system of precast, polymer-concrete channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling. Include quantity of units required to form total lengths indicated.

B. Sloped-Invert, Polymer-Concrete Systems:

1. Channel Sections:

- a. Interlocking joint, precast, modular units with end caps.
- b. 100 mm (4 inch) inside width and deep, rounded bottom, with built-in invert slope of 0.6 percent and with outlets in quantities, sizes, and locations indicated.
- c. Extension sections necessary for required depth.
- d. Frame: Include gray iron or steel frame for grate.

2. Grates:

- a. Manufacturer's designation "//Heavy// //Medium// Duty," with slots or perforations that fit recesses in channels.
- b. Material: //Fiberglass// //Galvanized steel// //Gray iron// //Stainless steel//.

3. Covers: Solid gray iron if indicated.

4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

C. Narrow-Width, Level-Invert, Polymer-Concrete Systems:

1. Channel Sections:

- a. Interlocking joint, precast, modular units with end caps.
- b. 125 mm (5 inch) inside width and 248 mm (9-3/4 inch) deep, rounded bottom, with level invert and with DN 100 (NPS 4) outlets in quantities, sizes, and locations indicated.

2. Grates:

- a. Slots or perforations that fit recesses in channels.
- b. Material: //Fiberglass// //Galvanized steel// //Gray iron// //Stainless steel//.

3. Covers: Solid gray iron if indicated.

4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.

D. Wide-Width, Level-Invert, Polymer-Concrete Systems:

1. Channel Sections:

- a. Interlocking joint, precast, modular units with end caps.
- b. 200 mm (8 inch) inside width and 350 mm (13-3/4 inch) deep, rounded bottom, with level invert and with outlets in quantities, sizes, and locations indicated.

2. Grates:

- a. Slots or other openings that fit recesses in channels.
- b. Material: //Fiberglass// //Gray iron//.

3. Covers: Solid gray iron if indicated.
 4. Locking Mechanism: Manufacturer's standard device for securing grates to channel sections.
- E. Drainage Specialties: Precast, polymer-concrete units.
1. Large Catch Basins:
 - a. 600 by 300 mm (24 by 12 inch) polymer-concrete body, with outlets in quantities and sizes indicated.
 - b. Gray iron slotted grate.
 - c. Frame: Include gray iron or steel frame for grate.
 2. Small Catch Basins:
 - a. 483 to 600 mm by approximately 150 mm (19 to 24 inch by approximately 6 inch) polymer-concrete body, with outlets in quantities and sizes indicated.
 - b. Gray iron slotted grate.
 - c. Frame: Include gray iron or steel frame for grate.
 3. Oil Interceptors:
 - a. Polymer-concrete body with interior baffle and four steel support channels and two 6 mm (1/4 inch) thick, steel plate covers.
 - b. Steel plate covers.
 - c. Capacity: //530 L (140 gal.)// //757 L (200 gal.)// //984 L (260 gal.)//.
 - d. Inlet and Outlet: //DN 100 (NPS 4)// //DN 150 (NPS 6)//.
 4. Sediment Interceptors:
 - a. 686 mm (27 inch) square, polymer-concrete body, with outlets in quantities and sizes indicated.
 - b. 600 mm (24 inch) square, gray iron frame and slotted grate.
- F. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
- G. Channel Section Joining and Fastening Materials: As recommended by system manufacturer.

2.18 PLASTIC, CHANNEL DRAINAGE SYSTEMS

- A. General Requirements for Plastic, Channel Drainage Systems:
1. Modular system of plastic channel sections, grates, and appurtenances.
 2. Designed so grates fit into frames without rocking or rattling.
 3. Number of units required to form total lengths indicated.

B. Fiberglass Systems:

1. Channel Sections:

- a. Interlocking joint, fiberglass modular units, with built-in invert slope of approximately 1 percent and with end caps.
- b. Rounded or inclined inside bottom surface, with outlets in quantities, sizes, and locations indicated.
- c. Width: //150 mm (6 inches)// //200 mm (8 inches)//.

2. Factory- or field-attached frames that fit channel sections and grates.

- a. Material: //Galvanized steel// //Stainless steel//
//Manufacturer's standard metal//.

3. Grates with slots or perforations that fit frames.

- a. Material: //Fiberglass// //Galvanized steel// //Gray iron//
//Stainless steel//.

4. Covers: Solid gray iron if indicated.

5. Drainage Specialties:

- a. Large Catch Basins: 600 mm (24 inch) square plastic body, with outlets in quantities and sizes indicated. Include gray iron frame and slotted grate.
- b. Small Catch Basins: 300 by 600 mm (12 by 24 inch) plastic body, with outlets in quantities and sizes indicated. Include gray iron frame and slotted grate.

C. PE Systems:

1. Channel Sections: Interlocking joint, PE modular units, 100 mm (4 inches) wide, with end caps. Include rounded bottom, with level invert and with outlets in quantities, sizes, and locations indicated.

2. Grates: PE, ladder shaped; with stainless steel screws.

3. Color: Gray unless otherwise indicated.

4. Drainage Specialties: Include the following PE components:

- a. Drains: 100 mm (4 inch) diameter, round, slotted top; with DN 100 (NPS 4) bottom outlet.
- b. Drains: 200 mm (8 inch) diameter, round, slotted top; with DN 150 (NPS 6) bottom outlet.
- c. Drains: 100 mm (4 inch) square, slotted top; with DN 80 (NPS 3) bottom outlet.
- d. Drains: 200 mm (8 inch) square, slotted top; with DN 150 (NPS 6) bottom outlet.

- e. Catch Basins: 300 mm (12 inch) square plastic body, with outlets in quantities and sizes indicated. Include PE slotted grate 298 mm (11-3/4 inches) square by 28.6 mm (1-1/8 inches) thick.
- D. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
- E. Channel Section Joining and Fastening Materials: As recommended by system manufacturer.

2.19 PIPE OUTLETS

SPEC WRITER NOTE: Detail outlets on Drawings. Delete the following paragraph if piping includes flared outlet fittings and concrete head walls are not required.

- A. Head walls: Cast-in-place reinforced concrete, with apron and tapered sides.
- B. Riprap basins: Broken, irregularly sized and shaped, graded stone according to NSSGA's "Quarried Stone for Erosion and Sediment Control."

SPEC WRITER NOTE: Retain one of three following subparagraphs or insert another grade.

1. Average Size: NSSGA No. R-3, screen opening 50 mm (2 inches).
2. Average Size: NSSGA No. R-4, screen opening 75 mm (3 inches).
3. Average Size: NSSGA No. R-5, screen opening 125 mm (5 inches).
4. Average Size: //Insert size//.

SPEC WRITER NOTE: Retain both following paragraphs to require specific stone sizes.

- C. Filter Stone: NSSGA's "Quarried Stone for Erosion and Sediment Control," No. FS-2, 6 mm (No. 4) screen opening, average size graded stone.
- D. Energy Dissipaters: To be as per NSSGA's "Quarried Stone for Erosion and Sediment Control," No. A-1, 2721 kg (3 ton) average weight armor stone, unless otherwise indicated.

2.20 DRY WELLS

SPEC WRITER NOTE: Retain one of three following paragraphs.

- A. Concrete Well: ASTM C913, precast, reinforced, perforated concrete rings. Include the following:
 1. Concrete Floor: 27.6 MPa (4000 psi) minimum 28 day compressive strength.

2. Cover: Liftoff-type concrete cover with cast in lift rings
 3. Wall Thickness: 100 mm (4 inches) minimum with 25 mm (1 inch) diameter or 25 by 75 mm (1 by 3 inch) maximum slotted perforations arranged in rows parallel to axis of ring
 4. Total free area of perforations: Approximately 15 percent of ring interior surface
 5. Ring construction: Designed to be self-aligning.
 6. Filtering material: ASTM D448, Size No. 24, 20 to 65 mm (3/4 to 2-1/2 inch) washed, crushed stone or gravel.
- B. Manufacture PE side panels and top cover to assemble into 190 L (50 gal.) storage capacity units.
- C. Constructed-in-place aggregate type well: Include the following:
- SPEC WRITER NOTE: Retain subparagraph 1 or 2 below.
1. //Line with clay or concrete bricks.//
 2. //Line with concrete blocks or precast concrete rings with notches or weep holes.//
 3. Filtering Material: ASTM D448, Size No. 24, 20 to 65 mm (3/4 to 2-1/2 inch) washed, crushed stone or gravel.
 4. Cover: Precast, reinforced concrete slab, designed for structural loading according to ASTM C890 and made according to ASTM C913. Include slab dimensions that extend 300 mm (12 inches) minimum beyond edge of excavation. Cast cover with opening for manhole in center.
 5. Manhole: 600 mm (24 inch) diameter, reinforced concrete access lid with steel lift rings. Include bituminous coating over entire surface.

2.21 STORMWATER DISPOSAL SYSTEMS

SPEC WRITER NOTE: Retain one of two following paragraphs.

- A. Chamber Systems:
1. Storage and leaching chambers: Molded PE with perforated sides and open bottom. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
 2. Filtering material: ASTM D448, Size No. 24, 20 to 65 mm (3/4 to 2-1/2 inch) washed, crushed stone or gravel. Include Geotextile

- woven or spun filter fabric, in one or more layers, for minimum total unit weight of 135 g/sq. m (4 oz./sq. yd).
- B. Pipe Systems: Perforated manifold, header, and lateral piping complying with AASHTO M252 for DN 250 (NPS 10) and smaller, AASHTO M294 for DN 300 to DN 1500 (12 NPS to NPS 60). Include fittings, couplings, seals, and filter fabric.

2.22 HEADWALLS

- A. Headwalls: Cast-in-place concrete with a minimum compressive strength of 20 MPa (3000 psi) at 28 days.

2.23 FLARED END SECTIONS

- A. Flared End Sections: Sections shall be of standard design //fabricated from zinc-coated steel sheets conforming to requirements of ASTM A929/A929M// //of reinforced concrete in accordance with DOT standards//.

2.24 PRECAST REINFORCED CONCRETE BOX CULVERT

- A. Precast Reinforced Concrete Box Culvert: Designed for highway loadings with 600 mm (2 feet) of cover or more subjected to dead load only, conforming to ASTM C1433. For less than 600 mm (2 feet) of cover, subjected to highway loading, conform to ASTM C1433.

2.25 RESILIENT CONNECTORS AND DOWNSPOUT BOOTS FOR BUILDING ROOF DRAINS

- A. Resilient connectors and downspout boots: Flexible, watertight connectors used for connecting pipe to manholes and inlets, and shall conform to ASTM C923.

2.26 WARNING TAPE

SPEC WRITER NOTE: Use non-detectable type for cemeteries only.

- A. Standard, 4-Mil polyethylene 75 mm (3 inch) wide tape //detectable// //non-detectable// type, purple with black letters, and imprinted with "CAUTION BURIED STORM SEWER BELOW".

PART 3 - EXECUTION

3.1 GENERAL

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 PIPE BEDDING

- A. The bedding surface of the pipe shall provide a firm foundation of uniform density throughout the entire length of pipe. Concrete pipe requirements are such that when no bedding class is specified, concrete

pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest 1/4 of the outside portion of circular pipe. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall not be more than the length, depth, and width required for properly making the particular type of joint. Plastic pipe bedding requirements shall meet the requirements of ASTM D2321. Bedding, haunching and initial backfill shall be either Class IB or Class II material. Corrugated metal pipe bedding requirements shall conform to ASTM A798/A798M.

3.3 PIPING INSTALLATION

- A. Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping with //900 mm (36 inch)// //1200 mm (48 inch)// //1500 mm (60 inch)// //1800 mm (72 inch)// //Insert dimension// minimum cover as shown on the Drawings.
- C. 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.
 - 1. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
 - 2. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
 - 3. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
 - 4. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
 - 5. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.

6. Do not walk on pipe in trenches until covered by a depth of 300 mm (12 inches) over the crown of the pipe.
 7. Warning tape shall be continuously placed 300 mm (12 inches) above storm sewer piping.
- D. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
 - E. 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.
 - F. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
 - G. Install gravity-flow, nonpressure drainage piping according to the following:
 1. Install piping pitched down in direction of flow.
 2. Install corrugated steel piping according to ASTM A798/A798M.
 3. Install corrugated aluminum piping according to ASTM B788/B788M.
 4. Install ABS sewer piping according to ASTM D2321 and ASTM F1668.
 5. Install PE corrugated sewer piping according to ASTM D2321 with //gasketed joints// //extrusion welded joints//.
 6. Install PVC cellular-core piping, PVC sewer piping, and PVC profile gravity sewer piping, according to ASTM D2321 and ASTM F1668.
 7. Install //non-reinforced concrete// //reinforced concrete// sewer piping according to ASTM C1479.

3.4 REGRADING

- A. Raise or lower existing manholes and structures frames and covers in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, install a temporary cover above the bench of the structure or manhole. The temporary cover shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

SPEC WRITER NOTE: If the project includes connections to existing VA owned manholes, retain the first optional

Article 3. If the project includes connections to existing public utility manholes, retain the second optional.

3.5 CONNECTIONS TO EXISTING VA-OWNED MANHOLES

- A. Make pipe connections and alterations to existing manholes so that finished work will conform as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting, and shaping.

3.6 CONNECTIONS TO EXISTING PUBLIC UTILITY MANHOLES

- A. Comply with all rules and regulations of the public utility.
- B. Backwater Valve Installation: Install //horizontal-type backwater valves// //combination horizontal and manual gate valve// //terminal-type backwater valves// in piping where indicated.
- C. Cleanout Installation:
 1. 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.
 - a. Use Light-Duty, top-loading classification cleanouts in //earth or unpaved foot-traffic// //Insert other// areas.
 - b. Use Medium-Duty, top-loading classification cleanouts in //paved foot-traffic// //Insert other// areas.
 - c. Use Heavy-Duty, top-loading classification cleanouts in //vehicle-traffic service// //Insert other// areas.
 - d. Use Extra-Heavy-Duty, top-loading classification cleanouts in //roads// //Insert area//.
 2. Set cleanout frames and covers in earth in cast-in-place concrete block, //450 by 450 by 300 mm (18 by 18 by 12 inches)// //Insert dimensions// deep. Set with tops //25 mm (1 inch)// //Insert dimension// above surrounding earth grade.
- D. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.7 DRAIN INSTALLATION

- A. Install type of drains in locations indicated.
 1. Use Light-Duty, top-loading classification cleanouts in //earth or unpaved foot-traffic// //Insert other// areas.

2. Use Medium-Duty, top-loading classification cleanouts in //paved foot-traffic// //Insert other// areas.
 3. Use Heavy-Duty, top-loading classification cleanouts in //vehicle-traffic service// //Insert other// areas.
 4. Use Extra-Heavy-Duty, top-loading classification cleanouts in //roads// //Insert area//.
- B. Embed drains in 100 mm (4 inch) minimum concrete around bottom and sides.
- C. Set drain frames and covers with tops flush with pavement surface.
- D. Assemble trench sections with flanged joints and embed trench sections in //100 mm (4 inch)// //Insert dimension// minimum concrete around bottom and sides.

3.8 MANHOLE INSTALLATION

- A. Install manholes, complete with appurtenances and accessories indicated. Install precast concrete manhole sections with sealants according to ASTM C891.
- B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops //75 mm (3 inches)// //Insert dimension// above finished surface elsewhere unless otherwise indicated.
- C. Circular Structures:
1. Precast concrete segmental blocks shall lay true and plumb. All horizontal and vertical joints shall be completely filled with mortar. Parge interior and exterior of structure with 15 mm (1/2 inch) or cement mortar applied with a trowel and finished to an even glazed surface.
 2. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
 3. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.
- D. Rectangular Structures:
1. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base

- section. Structures provided with a base section shall be set on a 200 mm (8 inch) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
2. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
 3. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
 4. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1 to 12 or more than 1 to 6. Bottom slab and benches shall be concrete.
 5. The wall that supports access rungs or ladder shall be 90 deg vertical from the floor of structure to manhole cover.
 6. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
 7. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inch) thick, by 300 mm (12 inch) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.9 CATCH BASIN INSTALLATION

- A. Construct catch basins to sizes and shapes indicated.
- B. Set frames and grates to elevations indicated.

3.10 STORMWATER INLET //AND OUTLET// INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete.
- B. Construct riprap of broken stone.
- C. Install outlets that spill onto grade, anchored with concrete.

- D. Install outlets that spill onto grade, with flared end sections that match pipe.
- E. Construct energy dissipaters at outlets.

3.11 DRY WELL INSTALLATION

- A. Excavate hole to diameter of at least 150 mm (6 inches) greater than outside of dry well. Do not extend excavation into groundwater table.
- B. Install precast, concrete ring dry wells according to the following:
 - 1. Assemble rings to depth indicated, and extend rings to height where top of cover will be approximately 200 mm (8 inches) below finished grade.
 - 2. Backfill bottom-inside of rings with filtering material to level at least 300 mm (12 inches) above bottom.
 - 3. Extend effluent inlet pipe 300 mm (12 inches) into rings and terminate into side of tee fitting.
 - 4. Backfill around outside of rings with filtering material to top level of rings and 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-inside of rings with filtering material to level at least 300 mm (12 inches) above bottom.
 - 3. Extend effluent inlet pipe 300 mm (12 inches) 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 //200 mm (8 inches)// //Insert dimension// below finished grade.
 - 4. Backfill bottom of inside of lining with filtering material to level at least 300 mm (12 inches) above bottom.

5. Extend effluent inlet pipe 300 mm (12 inches) 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.

3.12 CHANNEL DRAINAGE SYSTEM INSTALLATION

- A. Install with top surfaces of components, except piping, flush with finished surface.
- B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.
- C. Embed channel sections and drainage specialties in //100 mm (4 inch)// //Insert dimension// minimum concrete around bottom and sides.
- D. Assemble channel sections with flanged or interlocking joints.
- E. Embed channel sections in //100 mm (4 inch)// //Insert dimension// minimum concrete around bottom and sides.

3.13 STORMWATER DISPOSAL SYSTEM INSTALLATION

SPEC WRITER NOTE: Retain one of two paragraphs below to match systems specified.

- 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.

3.14 CONNECTIONS

- A. Connect //nonpressure, gravity-flow// //force main// drainage piping in building's storm building drains specified in Section 22 14 00, FACILITY STORM DRAINAGE.
- B. Encase entire connection fitting, plus 150 mm (6 inch) overlap, with not less than 150 mm (6 inches) of concrete with 28-day compressive strength of 20 MPa (3000 psi).

- C. 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.
 2. Make branch connections from side into existing piping, DN 100 to DN 500 (NPS 4 to NPS 20). Remove section of existing pipe, install wye fitting into existing piping.
 3. Make branch connections from side into existing piping, DN 525 (NPS 21) or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 75 mm (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, 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.
- D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure-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.
 2. Use pressure-type pipe couplings for force main joints.

3.15 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 //200 mm (8 inch)// //Insert dimension// 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 top of manhole or structure down to at least //900 mm (36 inches)// //Insert dimension// below final grade. Fill to within //300 mm (12 inches)// //Insert dimension// of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 31 20 00, EARTH MOVING.

3.16 IDENTIFICATION

- A. Install green warning tape directly over piping and at outside edge of underground structures.

3.17 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Prior to final acceptance, provide a video record of all piping from the building to the municipal connection to show the lines are free from obstructions, properly sloped and joined.
1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.

3.18 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various

items of equipment shall be performed simultaneously with the system of which each item is an integral part.

- B. Submit separate report for each test.
- C. 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. Air test gravity sewers. Concrete pipes conform to ASTM C924, plastic pipes conform to ASTM F1417, all other pipe material conform to ASTM C828 or ASTM C924, after consulting with pipe manufacturer. Testing of individual joints shall conform to ASTM C1103.
 - 6. Test 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 //1034 kPa (150 psi)// //Insert value//.
 - a. Ductile Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
 - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
- D. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government. Leaks and loss in test pressure constitute defects that must be repaired. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.
- E. //The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//

3.19 CLEANING

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

3.20 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.21 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hour//s// to instruct each VA personnel responsible in the operation and maintenance of units.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

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