

MOBILE AREA WATER AND SEWER SYSTEM

# Section 12

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## Sanitary Sewer Standard Specifications

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### **12.01 SCOPE:**

These general and detailed Specifications form a part of the Contract Documents and shall govern the handling and installation of piping for gravity sewers, lift station force mains, low pressure force mains, and accessories described herein and as shown on the accompanying Plans. See Appendix for Standard Details pertaining to this Section.

### **12.02 WORK INCLUDED:**

The work includes furnishing all material, equipment and performing all labor to construct gravity sewer mains and laterals, lift station force mains, low pressure force mains, manholes, and accessories as indicated on the Plans as may be required to complete the Work ready for operation. The lines shall be laid in strict compliance with the horizontal and vertical control shown on the Plans.

Generally, the Contractor shall clear and grub as necessary, remove as much of pavement as may be necessary; excavate trenches and pits to the required dimensions; excavate bell holes; construct and maintain all required traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or groundwater, guard the site; unload, haul, distribute, and lay the pipe and fittings; connect intercepted laterals to the new sewer and plug dead ends, or rearrange other utility lines where necessary; provide erosion control and have BMP plan; replace all damaged drains, sewers, or other structures; backfill the trench and pits; restore roadway surfaces; remove surplus excavated material and clean the site of the Work.

### **12.03 PIPELINE SYSTEM MATERIALS:**

#### **A. Ductile Iron Pipe Gravity and Force Mains:**

The installation of all ductile iron pipe shall be in accordance with the latest publications by the Ductile Iron Pipe Research Association (DIPRA) and ANSI/AWWA C-600.

Where specifically designated on the Plans or at locations determined in the field, ductile iron pipe shall be used for gravity sewers and force mains. Ductile iron pipe and fittings shall be as hereinafter specified. All piping located inside easements which are outside roadway rights-of-way shall be of ductile iron.

Ductile iron pipe and fittings for gravity sewers and force mains shall have a cement mortar lining conforming to ANSI/AWWA C104/A21.4 and shall have an exterior coating of bitumastic or coal tar. Coating and lining of pipe shall conform to DIPRA Section 51-8.

Cutting of ductile iron pipe shall be by saw, cutter, abrasive wheel or other approved means. In no case shall ductile iron pipe be cut by burning. When cutting ductile iron for jointing to bells, fittings, and valves, the pipe shall be cut square with the centerline of the pipe. Jagged, irregular cuts or cuts at angles to the center line of the pipe will be rejected. The lining of the pipe shall not be damaged by the cutting process. Cut ends and rough edges shall

be ground smooth. For push on joints, the cut end shall be beveled and coated in accordance with the pipe manufacturer's requirements and AWWA C-600.

Marking of ductile iron pipe shall include the pressure rating, metal thickness, net weight of pipe without lining, length of pipe, name of manufacturer and letters "DI" which shall be clearly marked on each length of pipe.

## **1. Ductile Iron Gravity Sewer Pipe**

Ductile iron pipe for gravity sewers shall be mechanical joint or push-on joint conforming to ASTM A746. The minimum wall thickness shall be as specified in ASTM A746 Table 2 for Nominal Thicknesses for Standard Pressure Classes of Ductile Iron Pipe. Extra thickness shall be provided where required by deep cover in accordance with ASTM A746, Table 12, for Type 2 laying condition.

Within easement areas, where the pipe is installed next to or across from a ditch or creek, or other areas with unsuitable soil conditions, restrained joints shall be required, as specified by the Engineer or Owner.

## **2. Ductile Iron Force Main Pipe**

Ductile iron pipe for force mains shall meet the requirements of ANSI/AWWA C151/A21.51 for ductile iron pipe and may be of the bolted/mechanical joint type or push-on type. The minimum thickness shall be as specified in ANSI/AWWA C150/A21.50. Extra thickness shall be provided where required for deep cover in accordance with ANSI/AWWA C150/A21.50.

Restrained joints shall be used in areas where the force main pipe is crossing or adjacent to creeks, or in other soils subject to movement that may result in the separation of non-restrained joints, including areas of potential future erosion.

At locations where air can accumulate in the force main, ductile iron pipe shall be coated with lining as described in the section for corrosion resistance/lining for ductile iron pipe, as required by the Engineer.

## **3. Fittings for Ductile Iron Pipe**

Ductile iron fittings shall be in accordance with either ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. The design pressure rating shall be the same as specified for ductile iron pipe. Mechanical joint fittings shall be used for all pipe types. Fittings shall be manufactured by American, U.S. Pipe, or approved equal.

## **4. Joints for Ductile Iron Pipe**

Joints for ductile iron pipe and fittings shall be mechanical joint, push-on joint, or restrained joint.

Mechanical Joints: MJ for ductile iron pipe shall conform to AWWA C110/ANSI A21.10. Bolts and nuts shall be Tee Head Bolts and nuts of high strength low-alloy steel in accordance with ASTM A 242 to the dimensions shown for AWWA C111/ANSI A21.11. Gaskets shall be constructed in accordance with AWWA C111/ANSI A21.11.

Push-on Joints: Push-on joints for ductile iron pipe shall conform to AWWA C111/ANSI A 21.11. Details of the joint design shall be in accordance with the manufacturer's standard practice, such as American "Fastite", McWane (Clow) "Bell-Tite", U.S. Pipe "Tyton", or approved equal.

Restrained Joints: Restrained joints for ductile iron pipe shall be the push-on type such as American "Fast-Grip" or U.S. Pipe "TR-FLEX" or "Field Lok". Gaskets shall be in accordance with the manufacturer's recommendations and shall be rated to meet the performance requirements of AWWA C111/ANSI A21.11.

Restrained Mechanical Joints: Restrained joint of pipe and fittings shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Restraining glands shall be manufactured of ductile iron conforming to ASTM A536. Ductile iron gripping wedges shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standard mechanical joint bell and tee bolts conforming to ANSI/AWWA C110/A21 and ANSI/AWWA C153/A21, latest revision. Twist off nuts shall be used to insure proper actuating of restraining devices. The mechanical joint restraint device shall have working pressure of at least that of the pipe on which it is used with a minimum safety factor of 2:1. Friction mechanical joint restraint shall be MEGALUG or equal. Previously used MEGALUGS or other Mechanical Joint Restrainers shall not be installed.

### **5. Polyethylene Sheath**

Unless otherwise indicated by soil testing, polyethylene sheath shall be installed on all ductile iron pipes. The exterior of ductile iron pipe shall be covered with a sealed polyethylene sheath in accordance with AWWA Specification C105.

Backfill shall be as specified elsewhere in these Specifications. Care shall be taken not to damage the polyethylene sheath during the backfill operation. Any polyethylene sheath which is damaged shall be replaced or repaired by the Contractor at no additional expense to the Owner.

### **6. Corrosion Resistance/Lining for Ductile Iron Pipe**

When directed by the Engineer, ductile iron pipe and fittings for gravity pipe and force mains shall be interior coated with a lining product selected by the Engineer on a case by case basis.

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**B. PVC Pipe for Gravity and Force Main Pipes****1. PVC Pipe for Gravity Mains**

Unless C900 is specified, all PVC gravity sewer pipe in sizes 4" through 15" shall be SDR 26 and shall meet requirements of ASTM D3034. The pipe shall be made from a compound that meets or exceeds cell classification 12454B as identified in ASTM 1784. Pipe length shall be 14 feet or 20 feet. Integral bells must incorporate locked-in flexible elastomeric gaskets meeting the requirement of ASTM D3212 and F477. Spigot end of pipe shall be beveled. Field cutting of PVC pipe shall be in accordance with manufacturer's recommendations and Unibell PVC Pipe Handbook. Markings on the pipe shall, at a minimum, include the manufacturer's name or trademark, pipe material, nominal pipe size, material designation code, SDR26, and ASTM D1785. All standards shall include latest revisions. Pipe shall be green. Pipe shall be in new condition and no older than 1 year from date of manufacture. Certification shall be provided acknowledging the manufactured date. All pipe deliveries shall include a document that defines all markings on the pipe and the country in which the pipe was manufactured. A dated certification of compliance with these specifications containing an original signature from appropriate representative of manufacturer or vendor shall be provided to the Owner or the Engineer upon delivery of the material to the jobsite.

In easement locations where ductile iron pipe and restrained joints are not necessary or required by the Engineer, the gravity sewer pipe shall be heavy wall PVC C900, green in color, as defined in the PVC Pipe for Force Mains section of these specifications.

**2. PVC Fittings for Gravity Mains**

SDR26 PVC gravity sewer fittings for 4" through 15" diameters shall meet requirements of ASTM D3034. The fittings shall be made from a compound that meets or exceeds cell classification 12454B as defined by ASTM 1784. Integral bells must incorporate locked-in flexible elastomeric gaskets meeting the requirement of ASTM D3212 and F477. Where solvent welded joints are required, such joints shall meet ASTM D2467. Markings on fittings shall be permanent and include, at a minimum, manufacturer's name or trademark, PVC, fitting size(s), SDR26, ASTM D3034 or F679, country where manufactured and manufacture date. Fittings shall be stored indoors until shipped by manufacturer. All standards shall include latest revisions. Fittings shall be white, green or green and white. Fittings shall be in new condition and no older than 1 year from date of manufacture. Certification shall be provided acknowledging the manufactured date. A dated certification of compliance with these specifications containing an original signature from appropriate representative of manufacturer or vendor shall be provided to the Owner or the Engineer upon delivery of the material to the jobsite.

**3. PVC Pipe for Force Mains:**

PVC pipe for force mains shall be provided as shown on the Plans for force mains 4 inches through 12 inches in diameter. PVC pipe shall conform to the requirements of AWWAC900. Color of PVC pipe for sewer force mains shall be green. Pipe shall be continually marked with manufacturer's name, pipe size, pipe material, cell classification, SDR rating, ASTM D2241 classification, and material designation code. Pipe shall be in new condition and no older than 1 year from date of manufacture. Certification shall be



provided acknowledging the manufactured date. All pipe deliveries shall include a document that defines all markings on the pipe and the country in which the pipe was manufactured. A dated certification of compliance with these specifications containing an original signature from appropriate representative of manufacturer or vendor shall be provided to the Owner or the Engineer upon delivery of the material to the jobsite.

Pipe joints shall be integral bell and spigot type with rubber ring sealing gasket. The pipe bell shall be designed to be at least as strong at the pipe wall. Standard lengths shall be 20 feet except that 15 percent of total footage for a particular project may be random lengths of not less than 10 feet each. Each piece of pipe shall be tested by the manufacturer to 600 psi for a minimum of 5 seconds. The bell shall be tested with the pipe.

#### **4. Fittings for PVC Force Mains**

Fittings for PVC Pipe shall be made of ductile iron conforming to ANSI/AWWA C110/A21.10. Ductile iron fittings shall be as specified for ductile iron pipe. Fittings shall be provided with a transition gasket specifically designed to accommodate the outside diameter of the PVC force main. Provide certified test results that fittings meet or exceed these Specifications.

Restrained joint of pipe and fittings shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536. Ductile iron gripping wedges shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standard mechanical joint bell and tee bolts conforming to ANSI/AWWA C110/A21 and ANSI/AWWA C153/A21, latest revision. Twist off nuts shall be used to insure proper actuating of restraining devices. The mechanical joint restraint device shall have working pressure of at least that of the pipe on which it is used with a minimum safety factor of 2:1. Friction mechanical joint restraint or restrained harness shall be MEGALUG or equal.

A gasket system, U.S. Pipe MJ FIELD LOK SERIES PV or equal, shall be used to achieve joint restraint for line sizes 4 inches through 24 inches.

Tapping saddles shall be used for insertion of corporation stops or other outlets for testing of force mains. Corporation stops shall be connected to a tapping sleeve and saddle and shall not be tapped into the PVC wall.

#### **5. Markings for PVC and HDPE Pipe for Force Mains**

- a. **Tracer Wire:** All PVC and HDPE pipe shall be marked using a 14 gauge insulated copper wire buried 3 inches above the top of the pipe then the wire shall be placed over the pipe. Backfill shall be carefully placed to a depth of 3 inches by hand to assure that the wire is secured in place over the pipe. It is the intent of this paragraph to provide means to locate PVC and HDPE pipe using standard pipe location equipment. The wire shall be carried up through the valve boxes and terminated at least 2 feet above the ground line to permit connecting of location equipment. Excess wire at valve boxes

shall be neatly rolled and stored in the valve box.

- b. Marking Tape for PVC and HDPE Pipe shall be provided for all PVC and HDPE force mains. Marking tape shall be green with imprint “Caution: Buried Sewer Line Below”, buried 6 to 12 inches above the top of the pipe. Tape shall be 3 inches wide minimum, made of an inert plastic film resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. The pipe trench shall be backfilled to at least 6 to 12 inches above top of the pipe and the tape shall then be placed flat with imprint up. Backfill shall be carefully placed to a depth of 3 inches over tape by hand to assure that the tape is secured in place over the pipe. It is the intent of this Paragraph to provide a means of identifying and protecting force mains. Marking tape used with PVC and HDPE force mains shall be metalized so that the PVC and HDPE pipe can be located using standard pipe location equipment.
- c. Markings for Directional Drilled Pipe: Refer to Section 20 for marking requirements.

### **C. PVC for Small Diameter Force Mains (Under 4-Inch Diameter):**

Small diameter polyvinyl chloride (PVC) pipe for force mains shall be provided, along with appurtenances, as shown on the Plans. Piping methods shall be as described in one of the two methods described below. For lift station force main specifications, refer to Section 13.

#### **1. Solvent Weld PVC Pipe for Small-Diameter Force Mains**

The rigid PVC compound used in the manufacture of SCH40 pipe must be Type I, Grade I with a cell classification of 12454B as defined in ASTM D1784. The pipe shall be manufactured in strict accordance with ASTM D1785. Markings on the pipe shall, at a minimum, include the manufacturer’s name or trademark, pipe material, nominal pipe size, material designation code, pipe schedule and pressure rating at 73 degrees Fahrenheit, ASTM Designation D1785, and date of manufacture. All standards shall include latest revisions. Pipe shall be green for sewer applications. Pipe shall be in 20 foot lengths. Pipe shall contain solvent weld bell on one end and beveled spigot on the other. Pipe shall be in new condition and no older than 1 year from date of manufacture. All pipe deliveries shall include a document that defines all markings on the pipe and the country in which the pipe was manufactured. A dated certification of compliance with these specifications containing an original signature from appropriate representative of manufacturer or vendor shall be provided to the Owner or the Engineer upon delivery of the material to the jobsite.

- a. Joints of small diameter PVC pipe may be solvent weld type and shall be made in a two-stop process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM Specification D2564, latest edition. Belled end pipe socket dimensions for solvent weld system shall conform to ASTM D2672, latest edition.
- b. Fittings to be installed in conjunction with force mains shall be of the same material and have joints as described in Paragraph 1 of this section. The fittings shall be designed to withstand the same pressures required for the pipe.

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## **2. Push On PVC Pipe for Small-Diameter Force Mains**

PVC pipe shall be Pressure Class 200, SDR 21 pipe manufactured from virgin PVC compound with a cell classification of 12454-B as specified in ASTM Specification D1748, latest edition. Physical dimensions and tolerances of PVC SDR 21 pipe shall meet the requirements of ASTM Specification D2241, Latest edition. Standard lengths shall be 20 feet except that 15 percent of total footage for a particular project may be random lengths of not less than 10 feet each. Coloring of pipe shall be as per Section 12.03 entitled "Materials", Paragraph C entitled "PVC Pipe for Force Mains".

For applications of push-on pipe ending with a stub out connection (i.e., a dead end run line), the last two (2) joints shall be constructed using the glue joint pipe method meeting the specifications described in Section 12.03 entitled "Materials", Paragraph D entitled "Small Diameter Force Mains", Section 1 entitled "Solvent Weld Joints (Glue Joint) PVC Pipe for Small Diameter Force Mains".

- a. Gaskets & Joints: Pipe joints shall be integral bell and spigot type with rubber ring sealing gaskets. Lubricant for making joints shall be non-toxic, and shall be as recommended by the pipe manufacturer. Bells shall be manufactured so that the rubber ring sealing gasket is square to the barrel of the pipe. Gaskets shall be factory installed in the bell end and shall meet the performance requirements of ASTM D 3139 and F 477, latest edition. The bell wall thickness shall be in compliance with ASTM D 3139-84 Section 5.3 (Push-on-Pipe), latest edition and shall be at least as strong as the pipe wall. The ends of the pipe and couplings shall be square to the centerline of the pipe barrel.
- b. Fittings: Ductile iron fittings conforming to the requirements of these specifications shall be used with PVC pipe. Restrained joint mechanical fittings shall be used, as noted in the Appendix, and shall be provided with a transition gasket specifically designed to accommodate the outside diameter of the pipe.

## **3. Ball Valves for Small-Diameter Force Mains**

Ball valves used on small diameter force mains shall be Mueller 300 Ball Straight Service Valves No. B-20200,F.I.P x F.I.P., or approved equivalent.

## **4. Check Valves for Small Diameter Force Mains**

Check valves on force mains smaller than 4 inches shall be of Class 125 Bronze, screw cap, swing type disc (T-pattern) with threaded ends by Kitz, or approved equal. The valve shall be in accordance with MSS SP-80, Type 3 and have a pressure rating of 125 psi for saturated steam/200 psi for no-shock cold water, oil or gas. The check valve shall provide a full-ported passageway when open. Threaded ends shall be in accordance with ANSI B1.20.1. The hinge pin shall be of brass (BS16), the valve body shall be of bronze (B62), and the disc and cap shall be of brass (B283)/bronze (B62). Installation shall be in accordance with the manufacturer's recommendations. Solvent cement shall not contact the inner components of the valve. Valves welded in one position shall be rejected and replaced at the Contactor's expense. All valves shall be fully opened and closed during the final inspection.

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### **5. Valve Boxes**

All buried valve assemblies shall be housed within a rectangular PVC valve box (green cover with "SEWER" marking), 12" deep by Carson Model #1220, or approved equal. Each box shall be sized to house a curb stop, check valve, and connection between them.

### **D. Polyethylene Plastic Pipe (HDPE pipe):**

Polyethylene pipe shall be made from high density polyethylene resin compound which meets ASTM D1248. Dimensions and workmanship shall conform to ASTM F714.

The polyethylene pipe shall be the nominal pipe size and dimension ratio shown on the Plans, or in the Proposal. Installation shall be in accordance with ASTM D2321 or as modified herein.

Color of HDPE pipe shall be green pipe or pipe with green stripe on exterior wall.

Shipping lengths of pipe shall be assembled into one continuous length at the job site by thermal butt-fusion. Fusion machine and fusion machine operator shall be approved by pipe manufacturer. The resultant joint shall be as strong as the intervening lengths.

Butt fusion welding shall be used to join HDPE pipe into one continuous pipeline. Joining of pipe and installation of outlets shall be in accordance with the pipe manufacturer's written recommendations. The pipe manufacturer shall provide the services of a trained representative to instruct the Contractor's forces in the proper techniques for jointing of pipe and the installation of outlets or other items.

Installation of polyethylene pipe in areas where flotation is probable whether on land or a subaqueous location installation shall conform with manufacturer's recommendation.

Polyethylene pipe shall not be crimped in any way during construction.

Fabricated polyethylene bends shall be manufactured by pipe manufacturer.

SDR of fabricated polyethylene bends shall be equal to SDR of connecting pipe.

When connecting polyethylene pipe to a manhole, a seal between the pipe and manhole shall be provided with non-shrink grout. A concrete retainer block shall encase the first segment of HDPE pipe outside of the manhole. The retainer block shall be connected to the manhole wall with epoxy dowels. Refer to standard detail drawings in the appendix.

Deflection of polyethylene pipe after installation and backfilling shall not exceed 7.5 percent for gravity and force main sewer pipe. For definition of how deflection is measured, refer to section entitled, "Deflection Testing of Sewers"

For limitations on acceptable defects in HDPE pipe, refer to Section 20 horizontal directional drilling.

For placement of HDPE pipe bored on open cuts, refer to Section 20.

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**E. Small Diameter HDPE Service Lines for Low Pressure Force Mains (Under 3-inch diameter)**

Small diameter polyethylene (PE) pipe for standard service connection of pressure service lines for existing or proposed grinder station installations and STEP installations shall be provided as shown on the plans. Materials used for the manufacture of polyethylene pipe shall be extra high molecular weight, high density PE 3408 polyethylene resin. The material shall be listed by PPI in PPI TR-4 with a 73° F hydrostatic design basis of 1,600 psi and a 140° F hydrostatic design basis of 800 psi. Pipe shall be of SDR 9 HDPE. PE 3408 shall be used as a cell class and ASTM D2737 shall be used as the ASTM Basis. Pipe shall be green in color and provided in coiled service tubing. Refer to the Appendix for installation detail.

1. Joints of PE service tubing shall be with compression fittings. Compression fittings shall be Mueller 110 Compression Connections No.H-15428, or approved equivalent.
2. Service Saddles for taps of existing or proposed pressure sewer lines required for standard service connections shall be ductile iron with stainless steel straps. Service saddles shall be Smith-Blair 315 Service Saddles, or approved equivalent.
3. Corporation Stops for taps of existing or proposed pressure sewer lines required for standard service connections shall be ball corporation valves. Valves shall be Mueller 300 Ball Corporation Valves No. B-20046 Threaded X Compression, or approved equivalent. Corporation stops shall be connected to tapping sleeve and saddle and shall not be tapped directly to the pipe wall.
4. Curb Stops for required standard service connections of existing or proposed pressure sewer lines shall be Mueller 300 Ball Straight Service Valves No. B-20200,F.I.P x F.I.P., or approved equivalent.
5. Check Valves for required standard service connections of existing or proposed pressure sewer lines shall be Class 125 brass horizontal swing type disc check valves. Valves shall be Kitz Corporation brass threaded swing check valves, or approved equivalent.
6. Valve Boxes for required standard service connections of existing or proposed pressure sewer lines to contain curb stops and check valves shall be green plastic meter boxes with solid green bolt-down lids. Boxes shall be Carson Industries Specification Grade 1220 12" Jumbo, or approved equivalent. Each box shall house a curb stop, a check valve, and connection between them.

**F. Encasement Pipe:**

See Section 17 entitled "Encasement Pipe".

**G. Lateral Services and Connections:**

Lateral locations shall be subject to field verification. The size of the gravity lateral pipe shall be six (6) inches unless otherwise directed by the Engineer. Pipe material shall be SDR 26 PVC or ductile iron with the same quality and material requirements of the mainline pipe. Refer to the standard detail drawings in the Appendix.

HDPE service lines for low pressure force mains shall be 1 ½ inches, unless otherwise

directed by the Engineer. Pipe material shall be green HDPE SDR 9 or ductile iron with the same quality and material. Refer to the standard detail drawings in the Appendix.

The connection of laterals to existing pipe and CIPP pipe shall be by cutting in tees or tee-wyes. When tees or tee-wyes are not acceptable and as directed by the Engineer on a case by case basis, a saddle shall be used. Cutting pipe and joining pipe shall be in accordance with Section 12.03 of these specifications for PVC pipe and Ductile Iron pipe. The tees shall be PVC tee-wyes or ductile iron tees (as specified in the plans) and shall have the same quality material requirements as the mainline pipe. Where sewer laterals are installed on heavy wall PVC C900 pipe mains, the fitting shall be gasketed PVC C900 45° wye.

Refer to the Standard Drawings in the Appendix for details of connecting a new lateral service connection to CIPP.

### **H. Sewer Cleanout Assemblies:**

**Sewer cleanout assemblies shall be 6 inches in diameter, unless required otherwise.** Cleanout installations shall use a threaded plug with a 2" recessed nut. An anti-seize lubricant shall be applied to the cleanout cap threads to prevent seizing in the future. All sewer cleanout assemblies shall have a riser (SDR 26 or ductile iron) and a cast iron hand hole ring and cover. The cleanout hub and plug shall be SDR 35. Cleanout assemblies shall be in accordance with these specifications and standard detail drawings in the Appendix. SDR35 PVC clean-out adapter (hub) and recessed plug shall meet requirements of ASTM D3034. The fittings shall be made from a compound that meets or exceeds cell classification 12454B as defined by ASTM 1784. Adapter shall be for solvent weld connection to SDR26 gravity sewer service pipe. Fittings shall be stored indoors until shipped by manufacturer. All standards shall include latest revisions. Adapter and plug shall be white. Fittings shall be in new condition and no older than 1 year from date of manufacture. A dated certification of compliance with these specifications containing an original signature from appropriate representative of manufacturer or vendor shall be provided to the Owner or the Engineer upon delivery of the material.

### **I. Coupling of Dissimilar Pipes:**

Transitions for dissimilar type pipes up to 16 inch O.D. shall be made by use of a flexible coupling with an adapter bushing and stainless steel shear band and clamps. Transitions from dissimilar type pipes over 16 O.D. shall be made by use of approved adapters specifically designed for this purpose. Joining of dissimilar pipes with concrete collars shall not be permitted except at such places where specifically approved. Refer to the standard detail drawings in the Appendix.

## **12.04 PRECAST MANHOLE:**

Precast concrete manholes shall conform to the requirements of ASTM C-478, latest edition, with a minimum wall thickness of 5 inches. Variations to these requirements are subject to approval in writing from the Owner. Manholes shall not have lifting holes which fully penetrate the wall of the manhole. Size lifting holes and inserts for a precision fit with lifting devices. Lifting inserts shall be accordance with OSHA Standard 1926.704. Precast manholes shall meet or exceed the following requirements in addition to the standard details as shown in the Appendix:

- 
- A. All aggregate shall be made from 97 percent calcareous rocks.
  - B. All Portland Cement shall be Type II or Type V. All concrete shall be a minimum of a 7 bag (658 pound) mix. The maximum allowable tricalcium aluminate content of Portland Cement is 8 percent.
  - C. See Section 12.07 Corrosion Resistance/Lining for New and Existing Precast Manholes.
  - D. Manholes shall be neatly and accurately built of proper materials and in a workmanlike manner. Manholes shall be smooth and free from fractures and honeycombs. Care shall be taken not to damage the manhole sections during handling and installation.
  - E. The cone shaped top section shall be eccentric and the cone and riser sections shall conform to the requirements of ASTM C-478 latest edition and as hereinafter specified. The top section of manholes less than 6 feet in depth shall be flat concrete slabs and shall conform to the requirements of ASTM C-478. Basis of acceptance for flat slab tops shall be either proof of design testing or rational design calculations as described in ASTM C-478, and shall be submitted to the Engineer for review.

Both cone shaped top sections and flat slab tops within the roadways shall be designed to withstand a minimum H-20 wheel loading in accordance with AASHTO requirements.

- F. The minimum nominal diameter of manholes shall be 48 inches for pipe sizes less than 24 inches. The minimum nominal diameter of manholes shall be 60 inches for pipe sizes up to 42 inches and 72 inches for pipe sizes up to 54 inches. The nominal diameter of the top of the manhole cone or flat top shall be 27 inches minimum to 28 inches maximum. Where larger manholes are required, eccentric transition sections may be installed not less than 6 feet above the invert, except where total depth of the manhole will not permit.

The minimum distance between adjacent pipe openings in the manhole wall shall be approximately  $\frac{1}{2}$  pipe diameter or 8 inches, whichever is larger. Refer to the standard detail drawings for detail showing the minimum circumferential clearances required to insure structural stability of the manhole section with multiple incoming/connecting pipes.

- G. New manholes shall be supplied with an approved cast-in flexible manhole pipe connectors (boots) for each pipe cutout or either cored and fitted with a flexible manhole pipe connector (boots). The flexible manhole pipe connector (boot) shall meet ASTM C-923 requirements. The flexible manhole pipe connector (boot) shall be secured to incoming and outgoing pipes with a stainless steel clamp. The clamp shall be tightened to 60-inch pounds of torque or as required by the manufacturer. The connector shall be installed in the manhole wall in accordance with the manufacturer's recommendations.

Existing manholes shall be cored for each pipe cutout and shall be fitted with flexible manhole pipe connectors (boots). The flexible manhole pipe connector (boot) shall meet ASTM C-923 requirements. The flexible manhole pipe connector (boot) shall be secured to incoming and outgoing pipes with a stainless steel clamp and a stainless steel rigid adjustable expansion ring. The clamp shall be tightened to 60 inch pounds of torque or as required by the manufacturer. The connector shall be installed in the manhole wall in accordance with the manufacturer's recommendations. The flexible boot shall be of A-Lok, or approved equal, for new manholes to be cored.

When a new connection is required to an existing brick manhole, the segment of sewer pipe connecting to the brick manhole shall be of ductile iron.

Existing pipes requiring a doghouse manhole or a cast in place manhole may be supplied with a flexible manhole boot connector secured to the pipe with a stainless steel clamp, tightened to 60 inch pounds of torque or as required by the manufacturer. The boot shall be cast in or sealed with non-shrink grout or an approved equal. The boot installed shall be in accordance with the manufacturer's recommendations.

Connection to manhole for HDPE pipe shall be as specified in the Appendix or as directed by the Engineer.

- H. When required, a branch pipe consisting of one segment of ductile iron pipe of the required size shall be installed from manholes to receive either present or future branch lines. Branch lines for future flows shall have an Engineer approved mechanical plug.
- I. The Contractor shall furnish and properly set all cast iron covers and frames in accordance with these standard specifications for the type of manhole application (see Section "Castings").
- J. Grade adjustments shall be provided with precast concrete adjusting rings or approved rubber riser adjusting ring in accordance with these specifications and the standard detail drawings.

The Contractor shall use the fewest number of riser rings necessary to achieve the desired height. Precast concrete adjusting ring stacks not more than 18 inches in total height shall be used to adjust manhole covers and frames to the proper grade. Concrete adjusting ring shall have a tolerance of +/- 3/16 inch from the center of the manhole opening. Adjusting rings shall be joined with non-shrink precision grout having a 28 day compressive strength of 10,000 psi. The surface of the concrete adjusting rings shall be cleaned prior to grouting. A latex based bonding agent shall be applied to all concrete surfaces to be joined with grout. The frame shall be set on adjusting ring in a bed of non-shrink grout and anchored through the manhole wall. Refer to the Standard Detail Drawings for installation.

Rubber riser adjustment ring shall be used for manholes to be located in easements subject to flooding and shall be manufactured by East Jordan Iron Works, or equal. Rubber riser adjusting rings shall not be stacked more than 6" in height, shall be used to provide water-tightness, and to adjust manhole covers and frames to the proper grade. Rubber riser rings shall be adhered to manhole wall and frame with polyurethane sealant/adhesive. Polyurethane adhesive shall be 5/16" – 3/8" thick and 1/2" wide. The adhesive shall be applied on both sides and along both edges of the riser ring. Each bead shall be applied at a distance of 1" from the inner and outer edges of the rubber riser ring, so as to form a double barrier to infiltration. The frame and ring stack shall also have an anchored connection to the manhole wall. Refer to the Standard Detail Drawings for installation.

- K. Joints in riser and cone sections shall be joined with a rubber gasket seal or an approved equal meeting the requirements of ASTM C-443.
- L. All joints in the riser and cone sections shall have an external joint seal installed. The material shall be a minimum of 12" wide and 0.35 mils thick or RUBR-NEK external joint wrap or equal. Wrap shall pass a manhole vacuum test.
- M. Depending on the installation location of the manhole, either a chimney type joint sealer or rubber composite adjustment riser with urethane based mastic, as shown on the Standard Detail



- Drawings, shall be placed on top of the cone section of the manhole before setting the castings to prevent infiltration.
- N. Manhole frames shall be either grouted or bolted to the top of the precast manhole depending on the manhole application used. See Section 12.08 "Castings" and refer to the Standard Detail Drawings in the Appendix.
- O. Manhole riser sections and cone shall have manufacturer installed steps conforming to Section 12.09, entitled "Manhole Steps".
- P. Manhole bottoms shall be either 8 inches thick cast in place concrete or integral with the lower section of riser walls as hereinafter specified.
1. Poured in place bottoms shall be 8 inches thick and shall be not less than 12 inches in diameter larger than the outside section of the riser. The top of the manhole bottom shall be a minimum of 3 inches below the lowest pipe invert. The invert shall be built up with cement grout. Special care shall be taken to assure a good seal around the manhole bottom. The joint between the bottom and walls shall be sealed on the manhole exterior with grout. The invert of a dead end manhole shall extend to the back wall of the manhole.
  2. Bottoms integral with side walls shall be set on a prepared bed of not less than 2 inches of gravel, slag, or crushed stone. The bed shall be accurately shaped to fit the manhole bottom to assure uniform bearing over the entire manhole bottom. The invert of the manhole shall be built up with cement grout as shown on the Board's standard manhole detail.
  3. The invert and flow channels of all manholes shall be neatly and accurately built and so formed as to facilitate the entrance and flow of sewage through them. New manholes shall be provided with a cement concrete channel per standard detail drawings shown in the Appendix. Flow channels for manholes shall consist of smooth, uniform cross sections conforming to the cross section of the pipes so as to provide a minimum of turbulence and avoid deposition of solids. The flow channel shall match the grade of the incoming/outgoing pipe, but in no case shall the slope of the channel be less than the minimum grade for the diameter of the flow channel. The flow channel at the invert shall not be level or have backfall. For the bench and channel, field place 4000 psi (min) concrete. Concrete fill for the bench and channel shall use Type II cement. The concrete bench shall be shaped evenly and sloped two percent (2%) to drain.
- Q. Excavation and backfilling of the precast manholes shall conform to the following:
1. Excavation shall extend to the depth of the rock foundation below the level of the outside bottom of the base slab. If necessary, provide sheeting and shoring excavation.
  2. Backfill the resulting excavation with crushed stone bedding material to a level to receive the structure at the proper elevation. Contractor shall ensure that the resulting foundation meets and exceeds a 95% density.
  3. Place base slab and manhole sections plumb and level. Upon completion of backfill operations, if the manhole is not plumb, then the Contractor shall reset and realign.
  4. During all backfilling operations, the backfill level shall be kept even on all sides of the structure. Exercise every precaution to prevent damage to, or unplanned loading of, the structures and its appurtenances.

5. In the event that the excavation is required to be carried to a depth of several feet below the bottom of the base slab, backfill material approved by the Engineer shall be required.
  6. Bedding shall be crushed stone or gravel meeting the requirements of ASTM Standard C33 "Concrete Aggregates", latest edition, gradation 57. The bedding shall be placed in the excavation from cut bottom to the level of the bottom slab. Thereafter it shall be thoroughly compacted to provide a stable base for the structure. Tamping and, if necessary, additional filling shall be carried on until the Engineer is satisfied that a suitably stable base has been created for the structure.
  7. Backfill of excessive undercut shall not be permitted. As directed by the Engineer or Owner and at the Contractor's expense, any excessive undercut shall be filled with concrete having a minimum compressive strength of 4000 psi.
- R. Anti-Flotation Collars shall be required for all manholes unless otherwise directed by the Engineer. Anti-flotation collars shall be at least 12 inches in diameter larger than the outside sections of the riser.
- S. When it is necessary to install a manhole over an existing sewer main, a precast concrete doghouse manhole shall be installed over the main. A minimum of 8" thick reinforced concrete base shall be poured over a stone base and the doghouse manhole risers set over the existing sewer. The doghouse opening shall be pre-formed by the manufacturer or saw cut to fit the pipe outside diameter plus 6 inches. Oversized cuts shall not be accepted. The joint between the precast manhole and the base shall be sealed both inside and outside with non-shrink grout in accordance with ASTM 1107. The annular space of the precast manhole around the main shall be filled with non-shrink grout and a shelf formed to the springline of the existing main. The crown and top shall be removed once the shelf has been formed and has set sufficiently and all upstream lines tested and approved. The interior walls of a dog house manhole shall be lined with a cement based liner in accordance with Section 19 unless a urethane liner is specified by the Engineer of Owner. Refer to the Appendix for the standard drawing detail.
- T. Drop manholes shall be required for pipes entering a manhole more than 24 inches above the manhole invert. Interior and exterior drop connections are permitted and shall be constructed in accordance with the standard drawing details in the Appendix.
- U. Where new manholes intercept existing laterals, which are connected to existing manholes, the Contractor shall maintain the lateral service until completion of the new sewer segment. The laterals shall then be connected to the new sewer line. The deadend of the laterals plugged at the manhole wall. Under these unique conditions, standard testing methods for the new installed line shall be amended per direction of the Engineer/Owner.
- V. Before installation of any Precast manholes, the following information shall be submitted and approved by the Engineer:
1. Project name and number.
  2. Manhole manufacturer.
  3. Manhole shop drawings including dimensions, materials, and manhole designation numbers.
  4. Gasket manufacturer and specifications.
  5. The name of the independent testing laboratory proposed to certify the manholes.
  6. Written acknowledgment that material certification as required in Section 12.042 will be

provided at project completion

- W. At the time of final inspection for acceptance, manholes shall be of dry condition and inverts shall not be submerged.
- X. Failure to comply with any part of these Specifications shall be reason for rejection of the entire manhole. Any defects shall be remedied by the Contractor immediately. Any manhole section which does not meet these Specifications shall be removed from the job site. Refusal to comply with any part of these Specifications shall be reason for denial or revocation of permission to install precast manholes.
- Y. All new and rehabilitated manholes and manhole components shall be warranted to be free from defects in materials and workmanship for a period of five (5) years from the date of project acceptance. Should a defect occur during this five (5) year period that is attributable to the installation or materials, then this defect shall be repaired within four (4) weeks from the date of defect notification to the Contractor at no additional cost to the Owner.

### **12.05 BRICK MANHOLE AND RISERS:**

In general, brick manholes or risers will not be permitted, unless specifically required by the Engineer. Where brick manholes or risers are desired, complete material and construction details shall be submitted to the Engineer for approval. When a new connection is required to an existing brick manhole, the segment of sewer pipe connecting to the brick manhole shall be of ductile iron.

### **12.06 MANHOLE TESTING:**

#### **A. Laboratory Testing:**

1. Testing of manhole sections shall be performed in accordance with ASTM C-478, latest edition. Testing shall be performed by an Engineer approved independent testing laboratory. The services of a testing laboratory shall be acquired by the manhole supplier to test and stencil each manhole section. The cost of the testing shall be borne by the manhole supplier.

The stencil shall be a certification by the testing laboratory that the manhole section was constructed in compliance with the Board's Standard Specifications for Precast manholes. The stencil shall be a minimum 8.5 in. x 11 in. in size with letters no smaller than  $\frac{3}{4}$  inch high, and painted with permanent paint. The stencil shall be located on the interior of each manhole section. The top of the stencil shall be no more than 6 inches below the top of each precast section. The color of the stencil lettering shall be safety orange. The stencil shall be legible and include the following:

(TESTING LABORATORY NAME) (IDENTIFICATION # OF INSPECTOR)  
CERTIFIES THIS MH SECTION COMPLIES WITH MAWSS STD SPECIFICATION  
SECTION 12.04  
INSPECTED (MONTH/YEAR)

2. Manholes shall be inspected and certified by the supplier's testing laboratory at the supplier's

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warehouse. Only in emergency situations shall the manholes be inspected and certified by the manhole supplier's testing laboratory in the field. Manholes shall not be installed by the Contractor unless the certification is stenciled on the interior of each manhole section. Manholes shall not be certified after installation. Manholes physically damaged during shipment will not be accepted.

3. The manhole supplier shall rotate the testing laboratories it uses for the inspections discussed herein. No single testing laboratory shall be used for more than six (6) months per year for inspecting manholes.
4. The manhole supplier shall obtain a letter of certification from the aggregate supplier that 97% calcareous aggregate is being provided for the production of manholes. The aggregate supplier shall furnish this letter at least quarterly to the manhole supplier. The manhole supplier shall furnish a letter certifying that this same calcareous aggregate is being used in the production of the manholes being furnished.
5. The manhole supplier shall obtain a letter of certification from the cement supplier indicating that Type II or Type V cement is being provided for the production of manholes. The cement supplier shall furnish this Type II or Type V cement certification letter at least quarterly to the manhole supplier.
6. The manhole supplier shall furnish to the Engineer a document at the completion of each project that states the following:
  - a. The project name.
  - b. A summary of manholes provided that includes the diameter, number, and location of each manhole.
  - c. The name of the independent testing laboratory (ies) that certified the manholes.
  - d. The most recent documentation from the aggregate supplier showing that 97% calcareous aggregate was supplied for the manufacture of these manholes.
  - e. Certification from the manhole supplier that the aggregate in item (d) is the same used in producing the manholes.
  - f. The most recent documentation from the cement supplier showing that Type II or Type V cement was supplied for the manufacture of these manholes.
  - g. Certification that all concrete cylinder breaks made during the manufacture of the supplied manholes successfully passed established compressive strength requirements in accordance with the specifications.

Documentation "a" through "g" above shall also be provided to developers and other organizations building sanitary sewer systems with the intention of requesting acceptance of said systems by the Board. This documentation shall be provided to developers or other sewer contractors so that they may submit the documentation to the Engineer for verification.

The manhole supplier shall provide documentation "a" through "g" to the Board.

The Board will not accept projects for which the above documentation cannot be furnished by the sewer contractor’s representative. It shall be the responsibility of the sewer contractor’s representative to obtain said documentation from the manhole supplier and furnish it to the Board prior to the acceptance of the facilities by the Board. The manhole supplier shall maintain the above documentation for a minimum period of three years from the date of the documentation transmittal.

**B. Vacuum Testing:**

1. All new and rehabilitated manholes shall be tested by the Contractor using the vacuum test method. Vacuum testing of manholes and structures shall be performed after curing of linings. Contractor shall control flow, as necessary (including by-passing) to accomplish vacuum testing. Any leakage in the manhole or structure, before, during, or after the test shall be repaired by the Contractor for no additional compensation from the Board.
2. All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole. A vacuum of 10 inches of mercury (Hg) (5.0 psi) shall be measured for the vacuum to drop to 9 inches of mercury (Hg) (4.5 psi). Manholes will be considered to have failed the vacuum test if the time to drop 1 inch of mercury is less than the limits shown in the following table:

**Vacuum Test Timetable**

Depth (feet)	Manhole Diameter – Inches			
	48”	60”	72”	96”
4	10 sec	13 sec	16 sec	19 sec
8	20 sec	26 sec	32 sec	38 sec
12	30 sec	39 sec	48 sec	57 sec
16	40 sec	52 sec	64 sec	76 sec
20	50 sec	65 sec	80 sec	95 sec
+ Each 2’	+5 sec	+6.5 sec	+8.0 sec	+9.5 sec

3. Manhole depths shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 20 feet, add the values listed in the last line of the table for every 2 feet of additional depth.
4. If the manhole or structure fails the vacuum test, the Contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.
5. The Contractor shall furnish to the Owner documentation showing the results of the vacuum test for each manhole.

**12.07 CORROSION RESISTANCE/LINING FOR NEW AND EXISTING PRECAST MANHOLES:**

**A. Urethane-Based Lining–**

When directed by the Owner or Engineer, the following manhole requirements shall be performed for providing corrosion resistance.

All materials incorporated in the work shall be delivered to the work site in new, unopened containers bearing the label of the supplier. The containers shall be handled and stored in compliance with the supplier's recommendations, and in a manner as to adequately protect the contents from damage, deterioration or contamination.

The materials, installation, and testing used for lining existing precast manholes with a urethane-based material shall be as specified in Section 19, Rehabilitation of Manholes, with the following exceptions and additional requirements.

All foreign materials shall be removed from the manholes walls and bench using means and methods as necessary to prepare the surface as recommended by the lining material manufacturer.

Surface preparation and application of urethane-based lining shall be in accordance with the lining manufacturer's requirements.

All existing manholes receiving discharges from a force main shall be lined with a urethane based liner.

### **12.08 MANHOLE FRAME AND COVER (CASTINGS):**

Manhole frames and covers shall conform to the Plans and standard details shown in the Appendix. All castings shall fit the manholes properly.

All castings shall be made of clean, even grain, tough gray cast iron. The quality of iron in the castings shall conform as a minimum to the current ASTM Specification A-48 for Class 30 Gray Iron Castings. Frames and covers shall weigh not less than that shown on the sewer manhole detail sheet in the Appendix. The castings shall be sealed, smooth, true to pattern and free from projections, sand holes or defects and shall properly fit the manhole opening. The portion of the frame and cover which forms the cover seal shall be machined so that no rocking of the cover is possible. The castings for manholes within roadways shall meet a load rating of AASHTO requirements H20 or greater. The covers shall have non-penetrating pick holes and shall prevent infiltration. On paved streets, the frame and cover shall be set flush with and in the plane of the paved surface.

Within easements and as directed by the project plans, bollards shall be installed around the manhole for protection. Standard manhole frame and cover and watertight/boltdown frame and cover shall be in accordance with the standard detail drawings.

All manholes covers shall prevent infiltration and/or be rated watertight. As per the Standard detail drawings, manholes shall have either a standard frame and cover with an O-ring seal in a dove tail groove or a boltdown/watertight frame and cover with a boltdown lid. Standard frame and cover shall be EJIW 1476, or approved equal. Watertight/boltdown frame and cover shall be EJIW V2480-1, or approved equal. Refer to the Standard Drawings for details and installation.

All new manhole castings shall require "MAWSS Sanitary Sewer" (1 1/2" raised lettering and recessed flush) cast into the manhole lid and "MAWSS" (3/4" raised lettering and recessed flush) cast into the frame, as shown in the standard detail drawings.

All manholes except those with Type IIB and IIC frame and cover installations shall be

provided with “Flex- Seal” or “Cretex” or “Ring Seal” or an approved chimney seal equal. The chimney seal shall be installed in new or existing manholes (without rubber ring assembly) to stop infiltration in the chimney area. The chimney seal shall be flexible and allow repeated vertical and horizontal movement due to traffic loading. The chimney seal shall be secured to the manhole cone. The chimney seal shall have a design life of at least 25 years. The chimney seal shall be installed in the manhole in accordance with the manufacturer’s recommendation and shall be warranted for at least 5 years against cracking, leaking, and any other functional failures under normal conditions during the design life.

The required frame and cover will vary based on the type installation for the manhole (Type I-roadway installations; Type II-easement installations). Type I and II frame and covers are further categorized as described below.

#### **Type I Manhole Frame and Cover Installations in Roadway:**

Type IA: Standard Manhole Frame and Cover, installed within the roadway, shall be rated H20 for traffic loads and the finished elevation of the covers shall be flush with pavement. Cover shall have an O-ring seal set in a dove tail groove to prevent infiltration and/or be watertight. Frame shall be set in non-shrink grout for connection to the manhole chimney. Non-shrink grout shall have a minimum 28-day compressive strength that meets or exceeds 10,000 psi. Concrete adjusting rings shall be allowed. Rubber riser adjusting rings shall not be allowed. Installation of the manhole frame and cover shall be in accordance with the Standard Detail drawings.

Type IB: Watertight/Boltdown Frame and Cover, installed within the roadway, shall be rated H20 for traffic loads and the finished elevation of the cover shall be flush with pavement. The cover shall bolt to the frame or be watertight, as per manufacturer. Frame shall connect to the manhole wall with non-shrink grout and anchor bolts. Four type 316 stainless steel anchor bolts with flat washer and nut shall anchor the frame to the manhole wall. Concrete adjusting rings shall be allowed. Rubber riser adjusting rings shall not be allowed. Installation shall be in accordance with the Standard Detail drawings.

#### **Type II Manhole Frame and Covers in Easements:**

Type II A: Standard Manhole Frame and Cover, installed within non-flooding easements, shall be installed in accordance with the Standard detail drawings. Frame shall be connected to the manhole wall with non-shrink grout. Cover shall have an O-ring seal set in a dove tail groove. Concrete riser adjusting rings shall be allowed. Unless directed otherwise by the Owner or the Engineer, bollards shall be installed to protect the manholes within easements and shall be installed in accordance with the standard detail drawings and specifications.

Type IIB: Standard Manhole Frame and Cover, installed within easements subject to flooding, shall be installed in accordance with the Standard Detail drawings. Frame shall connect to the manhole wall with non-shrink grout and anchor bolts. Cover shall have an O-ring seal in dove tail groove. Four type 316 stainless steel anchor bolts with flat washer and nut shall anchor the frame to the manhole wall. Concrete and rubber riser adjusting rings shall be installed. Unless otherwise directed by the Owner or Engineer, bollards shall be installed to protect the manholes within easements and shall be installed in accordance with the standard detail drawings and specifications.

Type IIC: Watertight/Boltdown Manhole Frame and Cover, installed within easements,

shall be installed in accordance with the Standard Detail Drawings. Frame shall have an anchor bolted connection to the manhole wall. Four course-thread type 316 stainless steel anchor bolts with flat washer and nut shall anchor the frame to the manhole wall. Concrete and rubber riser adjusting rings shall be allowed. Unless otherwise directed by the Owner or Engineer, bollards shall be installed to protect the manholes within easements and shall be installed in accordance with the Standard details drawings and specifications.

### **12.09 MANHOLE STEPS:**

Manhole steps shall be steel rods encased in polypropylene plastic and shall be of the type as manufactured by M.A. Industries, Inc., or approved equal. Steps may be type PS-1 or PS-2, for precast manholes and type PS-1-B or PS-2-B for brick manholes. Steps shall conform to the requirements of ASTM C-478. Manhole steps shall be driven into the manhole wall during manufacture to prevent each from “working loose” or “pulling out”. When placing manhole sections, the Contractor shall ensure that steps are aligned. Misalignment of steps shall be cause to reject the manhole and require it to be reset.

### **12.10 DROP CONNECTIONS FOR MANHOLES:**

Where indicated on the Plans or instructed in the field, drop connections shall be neatly and accurately constructed of proper materials and in a workmanlike manner, in strict accordance with the details shown on the Plans. Piping for drop connections shall be ductile iron except where noted otherwise on the Plans.

Pipes entering a manhole more than 24 inches above the manhole invert shall have a drop connection. Drop manholes shall be interior connection or exterior connection, as shown in the standard drawing details in the Appendix.

An acceptable alternate to the above described drop connection is the drop manhole manufactured by Universal Pre Cast, or equal, with lifting eyes and an external drop column poured monolithically with the structure.

### **12.11 CONCRETE FOR MISCELLANEOUS CONSTRUCTION:**

The minimum compressive strength required at 28 days is 3000 pounds per square inch. Field specimens and laboratory tests shall be made in accordance with the standards of the American Society of Testing Materials. The minimum amount of water shall be used to produce a workable mix and shall not exceed 6 U.S. gallons per sack of cement. Slump shall range between 2 and 5 inches.

For concrete used in the construction of pre-cast manholes, refer to Section 12.04.

### **12.12 BRICK:**

Brick shall be clay brick meeting ASTM Specification Number C-32, Grade SM. Brick shall be nominal 2” x 4” x 8” size.



**12.13 GROUT FOR SEWER STRUCTURES:**

Grout for masonry in sewer structures shall be a 1:3 Portland Cement sand mix, provided that hydrated lime or grout mix may be substituted for, not to exceed 10 percent by weight of the cement. Grout for sewer structures shall meet the requirements of ASTM C1107 with a minimum 28 day compressive strength of 10,000 psi.

**12.14 CRUSHED SLAG OR CRUSHED STONE FOUNDATION:**

See Standard Detail in the Appendix for Sewer Pipe Embedment.

**12.15 EMBEDMENT OF PVC PIPE FOR GRAVITY SEWERS:**

- A. Except as modified hereinafter, embedment material for PVC gravity sewer pipe shall be Class I, II, or III material as described in ASTM D2321.

The following table shall be used in determining the material required for embedment of PVC gravity sewer pipe.

**EMBEDMENT FOR PVC GRAVITY SEWER PIPES**

Pipe Depth	Bedding or Foundation	Haunching	Initial Backfill
12' or less	Cl I or II	Cl I or II	Cl I, II, or III

In areas where the existing material is other than as described above, and is not acceptable for use as embedment material, crushed slag or crushed stone, as hereinbefore specified shall be used. Separate payment will be made for crushed slag or crushed stone used for foundation or bedding and haunching under the items of "Crushed Slag or Crushed Stone Foundation" and Haunching for PVC Pipe", respectively. There will be no payment for embedment material when existing material from the excavations is used.

Where significant ground water flow is anticipated, avoid placing coarse, open graded materials above, below, or adjacent to finer materials, unless methods are employed to impede migration. Such methods are the use of an appropriate stone filter or filter fabric along the boundary of the incompatible materials. To guard against loss of pipe support from lateral migration of fines from the trench wall into open-graded embedment materials, it is sufficient to follow the minimum embedment width guidelines in ASTM D 2321, X1.10.

In areas where the pipe is below the water table or expected to be below the water table in the future, and the foundation or bedding material is Class I material, whether existing or as installed, crushed slag or crushed stone shall be used for haunching of the pipe. Separate payment will be made for crushed slag or crushed stone used for haunching of the pipe under the item of "Haunching for PVC Pipe."

- B. Embedment materials for use are classified in Table 1 ASTM 2321 and include a number of processed materials plus the soil types listed under the USGS Soil Classification System (FHA Bulletin No. 373). These materials are grouped into 5 broad categories according to the

suitability for this application:

1. Class I – Angular, 6 to 40 mm (1/4 to 1-1/2 inch), graded stone, including a number of fill materials that have regional significance such as crushed slag, crushed stone and crushed shells are included in this class.
2. Class II – Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 inch), including variously graded sands and gravels containing small percentages of fines, generally granular and non- cohesive, either wet or dry. Soil Type GW, GP, SW, SP are included in this class.
3. Class III – Fine sand and clayey gravels, including fine sands, sand-clay mixtures and gravel- clay mixtures. Soil Types GM, GC, SM and SC are included in this class.
4. Class IV – Silt, silty clays and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil Types MH, ML, CH and CL are included in this class. These materials are not acceptable for bedding, haunching, or initial backfill.
5. Class V - This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 inch) in diameter, and other foreign materials. These materials are not acceptable for bedding, haunching, or initial backfill.

<b>Sieve Analysis for Class I, II, and III Embedment Materials – from Table 1 ASTM2321</b>			
Class	Percentage Passing Sieve Sizes		
	1.5”	No 4	No 200
I	100%	≤10% (open graded); <50% (dense graded)	<5%
II	100%	<50% (GW,GP); >50% (SW,SP)	<5%
III	100%	<50% (GM,GC); >50% (SM,SC)	12%-50%

- A. No embedment, foundation, or backfill materials shall contain trash or debris.

## **12.16 EMBEDMENT OF POLYETHYLENE SEWER PIPE: (FORCE MAIN)**

Embedment of polyethylene sewer pipe shall be used if it becomes necessary to replace a lateral where polyethylene sewer pipe liner is being installed.

Embedment material shall be Class I structural backfill, which shall be angular, 6 to 40 mm (1/4 to 1-1/2 inches), graded stone, including a number of fill materials that have regional significance such as slag, cinders, and crushed stone. Embedment shall be paid for a Class I structural backfill for polyethylene pipe. Separate payment will be made for slag or crushed stone.

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**12.17 EXCAVATION FOR TRENCHES:**

- A. Perform all excavation of every description and of whatever substance encountered to the depth specified on the Plans or as staked in the field.
- B. All excavated material not suitable for filling shall be removed from the site or otherwise properly disposed of.
- C. The trench width may vary with and depend upon the depth of trench and the nature of the excavated material encountered; but in any case shall be of ample width to permit the pipe to be laid and jointed properly and the backfill to be placed and compacted properly. The minimum width of the trench shall be at least 16 inches greater than the nominal diameter of the pipe. The maximum clear width of trench at top of pipe shall not be more than 36 inches greater than the pipe diameter. Where trench is for the installation of rigid pipe (i.e., ductile iron, concrete) the trench width at top of pipe shall not exceed a width of 1.25 times the outside diameter of the pipe plus 12 inches.

The engineer can approve adjustment to the above identified trench width, should field conditions or construction methods warrant a change.

Where damage might result from withdrawing sheeting, the sheeting shall be left in place only when agreed to or requested by the Owner or Engineer.

Movable trench wall supports should not be used below the top of the pipe zone unless approved methods are used for maintaining the integrity of embedment material. Before moving supports, place and compact embedment to sufficient depths to ensure protection of the pipe. As supports are moved, finish placing and compacting embedment.

- D. The bottom of the trench shall be carefully graded, formed and aligned before any pipes are laid.
- E. Where the natural soil at the bottom of the trench makes a satisfactory foundation for the sewer, it shall be shaped to the bottom quadrant of the pipe and slightly hollowed under each bell to allow the body of the pipe to have uniform contact and support throughout its entire length. The bell shall not support the pipe.
- F. Where the bottom of the trench does not make a suitable foundation for the sewer, the trench shall be deepened and backfilled with stone, gravel, or slag and shaped as above. In the unstable soils condition, the backfilling shall extend from 1 to 2 feet above the pipe and to the face of the excavation or shoring material (i.e. full width of the trench).
- G. Place embedment materials by methods that will not disturb or damage the pipe. Work in and tamp the haunching material in the area between the bedding and the underside of the pipe before placing and compacting the remainder of the embedment in the pipe zone. Follow the recommendations for compaction given in ASTM D 2321-Table 2. Before using heavy compaction or construction equipment directly over the pipe, place sufficient backfill to prevent damage, excessive deflections, or other disturbance of the pipe.

The minimum embedment density given in ASTM D 2321, Table 2 "Recommendations

for Installation and Use of Soils and Aggregates for Foundation, Embedment and Backfill” are intended to provide satisfactory embedment stiffness in most installation; actual field conditions may warrant variation to the densities as approved by the engineer.

The minimum depth of cover shall be established by the engineer. In the absence of an engineer review, the following “default” cover recommendations from ASTM 2321 Table 2 shall be used. For Class I, embedment materials, installed to the minimum required densities, shall provide cover of at least 24” or one pipe diameter (whichever is greater). For Class II, embedment materials, installed to the minimum required densities, shall provide cover of at least 36” or one pipe diameter (whichever is greater). At least 48” cover is required before using heavy compaction equipment.

Taken from ASTM 2321 Table 2 are the following recommended compaction methods:

- a. Coarse grained, clean materials, such as crushed stone, gravels and sand, are more readily compacted using vibratory equipment. Vibratory plate tampers work well for coarse grained materials (Class I and Class II).
  - b. Fine materials require kneading and impact force along with controlled water content to achieve acceptable densities. Hand tampers or air driven hand-held impact rammers are suitable for the fine grained materials (Class III and Class IV).
  - c. In trenches, small hand-held or walk behind compactors are required to preclude damage to the pipe and to insure thorough compaction in the confined areas around the pipe and along the trench wall.
- H. The trench shall be dug to the alignment and depth required and only a minimum distance in advance of the pipe laying. The trench shall be so drained that workmen may work therein effectively. It is essential that the discharge from pumps conform to the BMP program or the Contractor’s erosion control plan.

The Contractor shall utilize settling tanks to remove sediment from the discharge water of the dewatering pump prior to discharging into any jurisdictional drainage way or MAWSS facility.

Unless the Contractor can provide test results showing zero fecal coli forms, they shall discharge the water into the nearest existing downstream sanitary sewer manhole at a controlled rate such that the capacity of the existing sewer pipe is not exceeded.

The above discharge requirements can be amended, if the Contractor obtains written permission from the appropriate governmental agency to allow for discharge into their drainage system.

The Contractor shall provide a discharge plan which addresses the above requirements to the Engineer or Owner for approval prior to implementation.

- I. In excavating streets that have been surfaced with shell, sand-clay, clay gravel or other base course, such base material shall be either, stockpiled and kept separate from the earth excavated, or the Contractor shall at his expense, unless paid for in a separate pay item, provide new base of like kind and equal quality.
- J. Excavation for manholes or other structures shall be of sufficient size to leave at least 1 foot in

the clear between their outer surfaces and the embankment, or sheeting which may protect it.

- K. Excessive overcut in depths of manholes shall be backfilled with concrete. Overcut in sewer trench shall be backfilled in accordance with Section 15 entitled "Backfilling." Backfill for correcting overcut conditions shall be at the Contractor's expense.

### **12.18 ESTABLISHING GRADE:**

The Contractor may use laser beam, or other approved method, for establishing grade of sewer. The Contractor shall be entirely responsible for the accuracy of the work and shall provide conventional leveling data and field notes to the Engineer. If laser beam method is used, the Contractor shall check the grade of sewer using a level and rod at 50 feet increments from the manhole from which pipe is being laid and at each manhole and anytime a laser set up is made.

### **12.19 PIPE LINE TOLERANCES:**

- A. The invert at each manhole shall conform to the elevation set forth in the plans. The invert of the center of the flow channel in the manhole shall not deviate from the plans by more than +/- 0.10 ft. A maximum tolerance of the invert shall be established at one tenth of a foot at each manhole shown on the plans. The typical overall line segment between consecutive manholes shall not deviate more than 0.20 feet per typical 400-ft run, or proportionally less based upon the length of run (i.e. 350 ft length of run would equate to 0.175-ft tolerance). Unless prior approval by the owner or engineer has been received, the manhole and effected line segment not within these acceptable tolerances shall be rejected and replaced at the contractor's expense. Flow channels that pond water are unacceptable.
- B. The horizontal alignment of the pipeline shall conform to +/- 1-ft from true alignment shown on the plan. Unless prior approval by the owner or engineer has been received, the line segment not meeting this tolerance shall be rejected and replaced at the contractor's expense.
- C. The Contractor shall make every effort to conform to the plans. The grade as shown on the Plans is that of the invert to which the Work must conform. Any variation from the grade tolerances shall be deemed sufficient reason to cause the Work to be rejected and rebuilt at the Contractor's expense. The Owner reserves the right to make adjustments to the grades and slopes to fit actual field conditions.

The inclining grade of the bottom of the sewer after completion shall be such that after flooding the flood water will drain so that no remaining puddle of water will be deeper than the acceptable sag tolerance noted on the sewer details in the Appendix. Any section of pipe that does not comply with the specifications at any time previous to final acceptance of the work shall be replaced or re-laid at the contractor's expense.

- D. It shall be the Contractor's responsibility to ensure that quality assurance throughout the project is sufficient for compliance with the specifications at the time the project is delivered to the owner.

- E. Pipe, complete in place, shall be tested for sags in accordance with the standard detail drawing in the appendix. The Contractor may make his own sag gauges, measured by the Engineer prior to use for sag testing. Sag Tolerances shall be as noted in the Standard Detail Drawings.
- F. MAWSS will provide one preliminary sag test to the Contractor prior to conducting the final "official" sag test.

### **12.20 LAYING GRAVITY SEWER PIPE AND LATERALS:**

- A. All pipe handling and storage shall be in strict accordance with the pipe manufacturer's requirements.
- B. The pipes and fittings shall be so laid in the trench that after the sewer is completed, the interior surface of the bottom thereof shall conform accurately to grade and alignment. Sewers shall be laid in the direction opposite to the direction of flow with spigot ends of pipe pointing down grade.
- C. While the pipes and fittings are being laid between adjoining manholes in each straight or working section of the sewer, a round circle of light from the finished or other end of the section shall remain constantly in plain view throughout the entire length of such section and shall show the true character and shape of the interior surface of the sewer. The same test shall be applied for each working section after the sewer is completed in all respects and before it is accepted.
- D. Before being set in place, each pipe must be thoroughly cleaned and freed of all dirt, then closely inspected for damage to coatings, walls, bells, gaskets, and ovality. Damaged pipe, gaskets or coating shall not be installed.
- E. The joints between the individual pipes shall in all cases be made watertight.
- F. Pipe shall be laid as close as possible to the exact line and grade shown on the Plans. Alignments shall be accomplished using a laser beam, or other approved method. Constructed line and grade shall be inspected and approved by the Engineer or Owner in accordance with the tolerances set forth in the Pipeline Tolerances Section.
- G. Any debris or dirt which may find entrance into the pipe in making the joint shall be removed by a water jet cleaning or other approved means.
- H. Laterals:
  - 1. Tee-wyes shall be inserted in the sewer lines wherever designated for lateral connection or stubout. All branches thus inserted, unless connected with a lateral, shall be provided with a watertight plug. Installation of tee-wyes shall be such that flow is directed downstream.
  - 2. PVC cleanout double sweep tees on laterals shall have gasket joints on the run sections and solvent weld joint on the branch section. Any glaze on the surfaces to receive the solvent weld cement shall be removed and the surface properly prepared.
  - 3. A cleanout shall be installed at the end of each lateral run for rehabilitation/replacement construction unless otherwise directed by the Engineer. Where there is no existing lateral to

be connected, such as in new developments, cleanouts will not be installed.

4. The Owner cannot always identify active laterals. The contractor shall make a diligent effort to identify every active building lateral and reinstate. The contractor may need to blow smoke up the lateral or dye the lateral from the house once the lateral is excavated to understand what the lateral serves.
5. Where sewer laterals are installed on ductile iron pipe mains within a sewer easement, the tee fitting shall be ductile iron and the section of sewer lateral shall also be ductile iron to the edge of the easement.
6. For a ductile iron lateral, a PVC cleanout assembly shall be installed, as noted above.
7. Where sewer laterals are installed on heavy wall PVC C900 pipe mains, the fitting shall be gasketed PVC C900 45° wye.
8. Connection of service lateral to CIPP sewer mains shall be done in accordance to the standard detail drawing in the Appendix.
9. Connection of service laterals to HDPE sewer mains shall be in accordance with Section 21.04 B, entitled "Service Reconnections".
  - I. Where gravity sewer laterals are being installed in new subdivisions, each lateral shall be marked with a 4" x 4" x 8' treated post. The post shall be placed vertically at the end of the laterals as they are installed, shall extend 4-feet below the ground, and shall be painted green. Where laterals are installed in subdivisions with curb and gutters, each lateral shall be identified with a 3-inch "S" stamp on the curb directly above the lateral.
  - J. In sewers over 8 feet in depth, or whenever instructed, PVC stacks shall be carried up from the tee - wye connection at an angle of 45 degrees with the vertical, and the end shall terminate at the property line and within 4 feet of the ground surface. Where laterals are called for on the Plans, or instructed by the Owner, they shall be laid to the right-of-way line or as the Owner may direct. The ends of the stacks or laterals shall be closed with a cap as specified for wye branches.
  - K. Whenever pipe laying is stopped for the night or for any other cause, the end of the pipe shall be securely closed to prevent the entrance of water, mud, or other obstructing matter, and shall be secured in such manner as to prevent the end pipe from being dislodged by sliding or other movement of the backfilling.
  - L. No pipe shall be laid in water, or when the trench conditions or weather is unsuitable for such work. The Contractor shall remove any water which may be found or may accumulate in the trenches and shall perform all work necessary to keep them clear of water while the foundations are being laid or pipe laying is in progress. Such water removal shall be accomplished by means of a well point system or other approved means. Comprehensive plans for dewatering operations, if used, shall be submitted prior to installation. No extra payment will be made for dewatering unless identified within a separate pay item of work.
  - M. Wherever house laterals are intercepted by the excavation for the new sewer, connection shall be maintained temporarily to the old sewer until the particular section of new sewer is installed, then the house lateral shall be broken and reconnected to the new sewer through a wye, tee or opening which shall have been placed in the sewer for that purpose.

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Should the Contractor elect to install the existing sewer lateral to the new sewer pipe, the Contractor is still obligated to fulfill all testing required for the sewer line segment.

- N. After each pipe is laid, it shall be partly backfilled, confirmed on grade and made secure before the next joint is laid.
- O. Workmen shall not walk or stand upon the newly laid pipe until the necessary backfill has been placed and tamped to prevent the displacement of the pipe.

### **12.21 BACKFILLING:**

See Section 15 entitled "Backfilling."

### **12.22 EROSION CONTROL:**

See Section 16 entitled "Erosion and Property Control", for "Erosion and Property Control", "Clearing and Grubbing," "Topsoil," "Grassing," "Mulching," "Seeding", "Solid Sod", "Riprap", "Blanket for Riprap", "Timber Ditch Checks," "Erosion Control Netting," "Silt Fence" and "Hay Bales."

### **12.23 PUMPING AND BY-PASSING:**

No sewage or solids will be dumped, by-passed or allowed to overflow into streets, streams, ditches, catch basins or storm drains nor will it be allowed to "back-up" upstream to such an extent that homes, businesses, etc., along the sewer are flooded.

When pumping/by-passing is required, the Contractor shall supply the necessary pumps, pipe plugs, conduits and other equipment to divert the flow of sewage from a pumping station, manhole(s) and /or pipe segment(s) where work is to be performed. The by-pass system shall be of sufficient capacity to handle existing flows plus additional flow that may occur during periods of heavy rainfall. It is the Contractor's responsibility to design and provide an adequate size pump(s) as required to pump the existing sewer flow including low and high flow periods and peak Inflow/Infiltration flows. The contractor shall provide a spare bypass pump equal in size for each pump required for all bypassing operations. The spare pump shall be on-site and piped for immediate service during all bypass pumping operations. The spare pump shall be configured to start automatically if initial pump fails or cannot maintain flow level in manhole or wet well.

All pumps shall be fully automatic self-priming units that do not require the use of foot-valves in the priming system. The pumps may be electric or engine driven. All pumps used must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of effluent flows.

The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and by-passing system. The Contractor is responsible for all maintenance of the bypass pumping system to ensure no disruption in the system. The Contractor shall provide any means necessary to provide uninterrupted service on main-line



service. The Contractor shall assure that an overnight bypass will not result in an overflow event.

The removal and replacement of frame, cover, and cone to accommodate by-pass pipe shall be a subsidiary requirement per the installation or the by-pass pumping.

All inflatable plugs and other such devices placed in the sewer for flow restriction shall contain the Contractor's name in permanent markings.

All bypass pumping units used within, or within 1,200 feet of areas zoned residential shall be enclosed in critical level sound enclosures. Sound operating units shall not exceed 68 dBA measured at 25 feet from the unit.

The Contractor shall provide a competent person to continuously watch and maintain the by-pass system for the entire period during which by-passing is necessary. Such onsite observation of the pump shall occur throughout the night if the pump is in operation. The competent person shall have the skills to take immediate action to repair pumps, adjust hoses, connect fittings, keep debris screen clean, or take other actions as may be necessary to keep the by-pass system in operation and prevent the escape of sanitary sewer from the collection system. SCADA monitoring only of the bypass pumping system shall not be acceptable.

All bypass pumping pipe provided shall be in good condition. Repairs made to the bypass pumping pipe by unapproved methods including, but not limited to, "duct" tape shall be unacceptable. The Contractor shall perform leakage and pressure tests on the pipe using clean water prior to installation of the bypass pumping system. The Contractor is responsible for any sanitary sewer discharge to the surface due to hose or pipe failure. Prior to removal of the bypass pumping pipe, the Contractor shall empty all sanitary sewage into the sewer system. Any discharge from air release valves shall be contained.

Where pump discharge lines cross streets or alleys, they shall be covered with wooden or metal ramps designed and installed in such manner that they do not unreasonably impair vehicular traffic traveling said streets or alleys. The Contractor shall submit three (3) copies of a Bypass Pumping Plan to the Engineer for review prior to proceeding with bypassing operations. Bypassing operations shall not commence until a Bypass Pumping Plan has been reviewed by the Engineer. As a minimum, the Bypass Pumping Plan shall contain the following items:

- A. A letter from the Owner stating the computer-modeled peak sanitary sewer flow rates for the pipe segments to be bypassed,

OR

In the event that the pipe segments to be bypassed have not been included in a computer hydraulic model, calculations showing the maximum hydraulic capacity based on the existing pipe diameters and constructed slopes of the bypassed segment.

OR

Flow monitoring data.

- B. Documentation that verifies the bypassing pump(s) ability to convey the maximum expected sanitary sewer flow rate. This documentation shall include the following items:

1. Pump manufacturer's name, model number(s), rated capacity of pump(s), performance curves and pump motor horsepower.
2. Diameter and material of bypass piping (suction and discharge).
3. Hydraulic calculations which confirm the following:
  - a. The proposed size and number of bypassing pump(s) and related pumping facilities that adequately pump the existing sewer flow including low and high flow periods and peak Inflow/Infiltration flows.
  - b. The bypassing pump(s) and bypass pumping pipe (suction and discharge) are of sufficient capacity to overcome the head losses generated by the size, length and material type of the discharge pipe and the topography of the ground between the pumping site and the discharge point.
4. Results from a pump drawdown test(s) performed within six (6) months of the bypass pumping operation shall be provided by the Contractor for each pump to be utilized in this Contract. The Contractor shall ensure that all pump drawdown tests are performed at capacities similar to those which will be encountered during this Contract. Documentation shall be provided including the estimated maximum length and diameter of suction and discharge piping necessary, and the difference in elevation between the pump centerline, the wetwell water surface level, and the point of discharge.

The documentation of the pump drawdown test and calculations of estimated pumping losses shall, as a minimum, include the following:

- a. Written certification that a pump test was performed and the pump was performing within the pump curve ranges and at capacities required during the bypass pumping operation.
  - b. Documentation of the ability of the pump to perform within the pump curve ranges given the anticipated losses due to the following:
    - i. Difference in elevation between the pump centerline and the termination of the discharge piping at the point of discharge (or the highest point in the line);
    - ii. Length and diameter of suction piping;
    - iii. Length and diameter of discharge piping
- C. A bypass pumping schedule consisting of the following:
1. A schematic showing the arrangement and layout of the pumping and bypassing facilities at various stages in the work
  2. Manholes and sewer mains to be utilized in such work along with a schedule showing the tentative dates at which particular manholes and sewer mains will be utilized
  3. A detailed drawing that shows how the discharge hose or piping will be anchored at the discharge point
- D. Emergency and non-working hours telephone numbers for the Contractor's key personnel.

The Contractor shall notify the Engineer a minimum of 48-hours prior to beginning bypassing operations to allow the Engineer to inspect the pumping and bypassing facilities and

verify that said facilities correspond to the reviewed Bypass Pumping Plan. Bypass pumping operations shall not commence until all pumping and bypassing facilities have been inspected and reviewed by the Engineer.

Acceptance of the Bypass Pumping Plan by the Engineer does not alleviate the Contractor from discussing and resolving with the Owner the use and arrangement of any pumping and bypassing facilities well in advance of the time of need for such work and facilities is anticipated.

The Contractor shall be responsible for and shall indemnify and hold the Owner harmless for any sanitary sewer overflow occurring as the result of the work performed. The Contractor is responsible for any sewer discharge to the surface due to failure in bypass hose, piping or other equipment. Any discharge from air release valves shall be contained. The Contractor shall ensure that raw sewage will not spill on the ground or into any bodies of water, channels, or conduits of conveyance of storm water during the performance of this work. Prior to removal of the bypass pumping pipe, the Contractor shall empty all sewage into the sewer system. The Contractor is responsible for and shall indemnify and hold the Owner harmless for any sanitary sewer discharge to the environment due to a failure in the equipment and/or bypassing operation.

In the event of a sanitary sewer overflow, the contractor shall contact the Owner's representative immediately and complete the Contractor Unpermitted Discharge Reporting Form provided by the Owner. If there is a sanitary sewer discharge to the environment due to a failure in the equipment and/or bypassing operation, the Contractor shall reimburse the Owner all costs related in any way to compliance with laws, regulatory requirements, and/or court orders and decrees associated with the overflow or discharge event. The costs include but not limited to water quality monitoring, signage, cleanup, fines, legal fees, claims and reporting. In the event that the peak flows during the bypass pumping operation exceed the projected peak flow figures previously provided by the Owner and a sanitary sewer overflow event occurs when the Contractor's equipment is operating correctly, the Contractor will not be held liable for the sanitary sewer overflow or discharge.

The Contractor shall be held liable for and shall indemnify and hold the Owner harmless for any claims made as a result of the sanitary sewer discharge or sanitary sewer overflow due to a failure in the equipment and/or bypassing operation and shall be responsible for all requirements imposed by the regulatory agencies, In addition, the contractor shall provide notification consisting of one (1) quarter page advertisement published in the Mobile Register within three (3) days of the sanitary sewer overflow. The advertisement shall be written in a manner reasonably designed to inform fully the customers of the Owner. The notice shall be conspicuous and shall not use unduly technical language, unduly small print or other methods which would frustrate the purpose of the notice. The notice shall disclose all material facts regarding the subject including the amount of overflow, when the overflow occurred, any potential adverse health effects, the population at risk, reasonably known methods of mitigation known, and steps being taken to mitigate problems with the bypass pumping operation. Each notice shall contain the name, business address, and telephone number of the Contractor.

No direct payment will be made for pumping and bypassing unless specifically stated.

In some applications with the Owner and Engineer prior approvals, the sewer may be plugged and wastewater contained within the capacity of the collection system. This shall only be done when it has been determined that the system can accommodate the surcharging without any adverse impact.

The sewer line plug shall be inserted into the line at a manhole upstream from the section being removed and replaced or pump station wet well being re-worked. The plug shall be so designed that all or any portion of the operation flows can be released. The sewer line plug shall permanently bear the Contractor's name. During removals and replacement, the flows shall be shut off and monitored or pumped/bypassed, as acceptable to the Owner. After the work tasks have been completed, flows shall be restored to normal.

Where raw sewage flow is blocked or plugged, sufficient precautions must be taken to protect the public health. Upstream flow shall be monitored. The sewer lines shall also be protected from damage. The following occurrences will NOT be allowed:

1. No sewage shall be allowed to back up into any homes or buildings.
2. No sewage shall overflow any manholes, cleanouts or other access to the sewers.
3. Users upstream of the repair area shall be able to use all their water and sewer utilities without interruption

If any of the above occur or are expected to occur, the Contractor shall bypass pump to alleviate one or all of the conditions. Additionally, the Contractor is required to observe the conditions upstream of the plug and be prepared to immediately start bypassing, if needed.

When sewer line flows at the upstream manhole of the line being removed and replaced, in the opinion of the Engineer, as too excessive to plug while the work is being performed; the Contractor shall submit for approval, a written plan and pump/bypass the flow, as previously described in this section.

## **12.24 BRACING:**

See Section 7 entitled "Legal Relations and Responsibility to Public", Paragraph entitled "Bracing".

## **12.25 CREEK CROSSINGS:**

General:

1. Creek crossings shall be constructed in accordance with the standard detail drawings and as shown on the project Plans. Except as hereinafter set forth, all preceding paragraphs shall govern this work.
  2. Any location where the sewer crosses beneath or adjacent to creeks and in aerial installations, restrained joints shall be used.
- A. Creek Crossing Below Streambed
1. The width of trench in the creek bed or across drains shall be 5 feet wider than out-to-out width of all pipes. This trench bottom shall be cleared of rocks, stumps, or other obstructions, and shall be reasonably smooth and level and to the elevations shown. It will be permissible to pre-assemble and lay the individual lines in one piece, provided the trench is shaped in such a manner that the pipe bears full length on the bottom.
  2. The section of lines in the creek bed or across drains shall be backfilled with suitable

material in layers not exceeding 1 foot in depth and shall be spaded or rodded around and between pipes as the backfilling progresses. Rocks or boulders shall not be used in the backfill. Backfill shall be brought to near the bottom of the creek bed and the top of the backfill shall be covered with filter-fabric and rip-rap.

**B. Creek Crossing above Streambed (Aerial)**

1. Timber pile pipe support structures shall be constructed as specified herein in areas designated by the Owner as per the plans and per the standard details as shown in the Appendix.

a. Materials: All timber pile pipe support structure components shall comply with all applicable American Wood Preservers Association (AWPA) standards and Use Categories (UC) for preservative treatment by pressure processes, including but not limited to the following:

- Standard C1 – All Timber Products– Preservative Treatment by Pressure Process
- Standard C2 - Lumber and Timber for Salt Water Use Only
- Standard C3 – Piles
- Standard C14 – Wood for Highway Construction
- Standard C18 – Wood for Marine Construction
- Standard P5- Waterborne Preservatives
- Standard M4 –Care of Preservative –Treated Wood Products
- Use Categories 4B, 4C and 5C

The minimum preservative retentions per AWPAs standards for southern pine timber structure members shall be as follows:

Product/ Application	Waterborne Preservatives – Retention Assay of Treated Wood lb/ft <sup>3</sup>						
	Chromated Copper Arsenate (CCA)	Alk. Copper Quat – Type C (ACQ-C), Am. Copper Quat – Type D (ACQ-D)	Ammon. Copper Quat – Type B (ACQ-B)	Copper Azole- Type B (CA-B)	Copper Azole - Type A (CBA-A)	Ammonia cal Copper Zinc Arsenate (ACZA)	AWPA Use category (UC)
<b>Piles</b>							
Land or Freshwater Use	0.80	NR	NR	NR	NR	0.80	UC4C
Marine Use	1.0 <sup>1</sup>	NR	NR	NR	NR	1.0 <sup>1</sup>	US5C
<b>Structural Cross Members</b>							
Land or Freshwater Use	0.60	0.60	0.60	0.31	0.61	0.60	UC4B
Saltwater Use	2.5	NR	NR	NR	NR	2.50	UC5
NR – Not Recommended, <sup>1</sup> - Dual treatment– 1 <sup>st</sup> treatment to retention indicated, 2 <sup>nd</sup> treatment with 20 lb/ft <sup>3</sup> of Creosote or Creosote solution.							

In accordance with AWPAs Standard M4, all cut, bored, drilled or adzed surfaces of

treated wood shall be field treated with a minimum of two applications of Copper Naphthenate preservative solution. The Copper Naphthenate solution shall contain a minimum of 2 percent copper metal. The preservative solution shall be allowed to completely soak into the wood before applying the next coat. Pile cut-off ends shall be sealed with a galvanized steel sheeting as shown in the Standard Details..

All bolts, nuts, washers, and other fasteners shall be factory hot-dip zinc coated per ASTM A153. Minimum required sizes and dimensions for all timber pile pipe support structure shall be as shown in Appendix on the "Timber Pile Supports for D.I. Sanitary Sewer Pipe" plan sheet.

Piles shall be Southern Pine and shall conform to ASTM D25 and shall be unused, clean peeled, uniformly tapered, one piece from butt to tip.

2. Installation: Timber piles shall be installed to either meet or exceed the compression loads specified by the Engineer. Engineer-approved pile driving equipment shall be used. The minimum penetration for any pile shall be not less than 10 feet into natural ground or below the bottom profile for submerged areas, and shall be not less than 1/3 the length of the pile. When minimum tip elevations are specified by the Contract Documents, the Contractor shall drive piles to the specified depth that satisfies this requirement in addition to the required minimum bearing capacity. Contractor shall ensure that the piles are installed at the same elevation/height and are plumb. The Contractor shall be responsible for providing the lengths of piles necessary to obtain the bearing and penetration required as determined by the geotechnical engineer or from results obtained in driving representative test piles.

## **12.26 INSTALLATION OF FORCE MAINS:**

### A. Pipe Materials

1. Reference Appendix D for the following Piping Specification Sheets
  - a. D-2A- Ductile Iron, below grade force main
  - b. G-4-C900 PVC below grade force main (green)
  - c. G-12-HDPE below grade force main (green stripe)

### B. Horizontal Directional Drilling Installation:

1. The Design Engineer shall develop detailed drawings and specifications for each HDD installation.

- ### C. Pipe Depth and Protection: Force mains shall be constructed to the alignment and depth required. Force mains 16 inches and larger shall have minimum cover of 48 inches, and force mains smaller than 16 inches shall have minimum cover of 30 inches, except where otherwise noted on the Plans. The trench shall be braced and drained so that workmen may work safely therein. The width of the trench shall be at least 12 inches greater than the nominal diameter of the pipe and the maximum clear width of the trench shall be not more than 36 inches greater than the pipe diameter.

- ### D. Pipe Foundation: The trench shall have a flat bottom with bell holes of ample dimensions to

- allow jointing and so the barrel of the pipe will have a bearing for its full width.
- E. Pipe Laying: All pipe, fittings, etc., shall be lowered into the trench by means of derrick, ropes, or other suitable tools, and under no circumstances shall pipe be dropped into the trench. Any defective pipe shall be rejected.
- F. Jointing: Joints shall be installed in strict accordance with the recommendations of the pipe manufacturer.
- G. Thrust Restraint
1. All fittings on ductile iron and C-900 PVC force main piping shall be of restrained design. All changes in pipe direction; i.e., tees, bends, reducers, offsets, wyes, valves, and dead ends, shall be restrained. Concrete thrust blocks shall be used at hydrostatic thrust focus points. A restrained joint piping system should be used in areas that may be disturbed during future construction of other utilities, or may require future modifications of the force main. The restrained joint piping system is preferred for installation in existing rights-of-way or limited width easements. The restrained joint system is also more economical in areas where concrete delivery for thrust blocks may be limited or access is impractical. The Design Engineer shall calculate the hydrostatic thrust forces in order to determine the length of pipe that must be restrained on each side of the thrust force.
  2. Computer Programs Available:
    - a. Ductile Iron Pipe Research Association, Thrust Restraint Design for Ductile Iron Pipe, <http://www.dipra.org>
    - b. EBBA Iron, Inc., The Restrained Length Calculator (RLC), [www.ebaa.com](http://www.ebaa.com)
- H. Thrust Blocks: At changes in horizontal direction, vertical direction and/or at a reduction in the pipe size, concrete thrust blocks having a 28-day compression strength of not less than 3000 psi shall be provided. The trench sides shall be cut vertical and square to receive concrete thrust blocks. The concrete blocking shall be poured against undisturbed earth. Provide bearing area against undisturbed trench wall as indicated in the standard detail drawings-
- I. Retainer Glands: Locked mechanical joint retainer glands of adequate strength to prevent movement shall be used to supplement concrete blocking where noted. Locked mechanical joint retainer glands shall be ductile iron retainer glands equipped with hardened, cupped end set screws. Assembly shall be designed for minimum pressure of 250 psi.
- J. Backfilling: Backfilling shall be as specified in Section 15 entitled "Backfilling".
- K. Valve Boxes for Small Diameter Force Mains (Under 4-inch diameter): A valve box shall be provided for all direct buried shutoff valve assemblies (such as ball valve and check valve assemblies) on force mains and pressure service lines in accordance with details shown on the Plans. Valve boxes shall be cast iron and shall have a nominal 6-inch sliding type shaft. The valve box top shall be set at finished grade and shall be encased with a cast-in-place concrete collar in unpaved areas. Valve boxes shall be supplied with a drop-in cast iron cover marked "PRESSURE SEWER".

The valve assembly shall be underlain with a poured-in-place concrete pad to provide support to the valve box. The valve box shall be supported above the pressure service lines by

means of standard or concrete nominal 2-inch X 4-inch X 8-inch bricks as shown in the details on the Plans. The valve box shall be supported by the bricks such that the valve box does not rest directly on the pressure service line. To prevent shifting during backfilling, the bricks shall be grouted to the concrete pad.

Valve boxes on pressure service lines shall be marked and/or protected by placing two, 4" x 4" x 8' posts, one on each side of the box. The posts shall extend 4-feet below ground level and be painted green.

#### L. Air and Vacuum Valves and Venting for Force Mains

##### 1. Air and Vacuum Valves

- a. Sewage air and vacuum valves shall permit unrestricted passage of air during filling of the force main and unrestricted entry of air into the force main under vacuum condition. Float shall be stainless steel, and valve shall be designed so that the venting mechanism does not come into contact with sewage. Valves shall have NPT inlet and shall be fitted with back flushing device. The valve shall be installed in pit as shown on Plans and per the standard drawings in the Appendix.
- b. Sewage air and vacuum valves, short-bodied version, shall be on the Board's list of materials and approved manufacturers.
- c. The valve shall be fitted to a minimum 18-foot length of ductile iron force main by means of a tapping saddle, Type 316 Schedule 40 stainless steel pipe, and bronze gate valve with hand wheel. Pit shall consist of 36-inch concrete pipe with cast iron cover as shown on Plans. Cover of pit shall be flush with ground. Depth of force main shall be sufficient to install air and vacuum valve.

##### 2. Air and Vacuum Venting

See Appendix D for Valve Specification Sheets for V-240, combination air and vacuum release valve for sewage, and V-241, automatic air release valve for sewage.

#### M. Clean Out Connections

Clean outs shall be constructed in accordance with the Standard Detail Drawings.

#### N. Terminal Discharge

1. Force mains shall enter gravity sewer manholes at the manhole flow invert.
2. Force Mains that enter wet wells shall be provided with a drop connection with air venting. Bottom of drop-inlet shall be equal to the "Lead Pump On" set point elevation of the wet well.

#### O. Hydrostatic Testing and Leakage Test for Force Mains

1. The Contractor shall provide the Owner the following documentation of each force main tested:
  - a. Date of Test



- b. Identification of force main tested or re-tested.
  - c. Identification of force main material and size
  - d. Identification of section tested
  - e. Test pressure
  - f. Remarks: leaks identified (type and location), types of repairs, or corrections made
  - g. Certification by Contractor that the leakage rate measured conforms to the specifications
  - h. Signature of Project Representative witnessing test (either the Owner or Design Engineer)
2. Submit a copy of the test records to the Owner or Engineer upon completion and acceptance of testing. See Appendix "D" for Force Main Pressure and Leak Test Data Sheet.
  3. Pressure and leakage tests will be required on each section of the force main between valves and shall be conducted in accordance with the following standards:
    - a. Ductile Iron = AWWA C600
    - b. PVC = AWWA C605
    - c. HDPE = AWWA C901 and C902
  4. For a simultaneous hydrostatic and leakage test, following installation, a pressure equal to 150 lbs of pressure at highest elevation is applied. The duration of the pressure test is for six (6) hours.
  5. If hydrostatic testing and leakage testing are performed at separate times, follow procedures as outlined in AWWA C605.
  6. In preparation for pressure testing the following parameters must be followed:
    - a. All air must be vented from the pipeline prior to pressurization. This may be accomplished with the use of air release valves or corporation stop valves, vent piping in the testing hardware or end caps, or any other method which adequately allows air to escape the pipeline at high points. Venting may also be accomplished by "flushing" the pipeline in accordance with the parameters and procedures as described in AWWA C605.
    - b. The pipeline must be fully restrained prior to pressurization. This includes complete installation of all mechanical restraints per the manufacturer's instructions and recommendations, whether permanent or temporary to the final installation. This also includes the installation and curing of any and all required thrust blocking. All appurtenances included in the pressure test, including valves, blow-offs, and air release valves shall be checked for proper installation and restraint prior to the beginning of the test.
    - c. Temporary pipeline alignments that are being tested, such as those that are partially installed in their permanent location, shall be configured to minimize the amount of potentially trapped air in the pipeline.
  7. The allowable leakage rate shall be less than the number of gallons per hour determined by the following formulas:

Ductile Iron and PVC  $L = (SD p^{1/2}) \div 133,200$

HDPE  $L = (SD p^{1/2}) \div 133,300$

L=allowable leakage in gallons per hour

S=length of pipe tested in feet

D=nominal diameter on pipe in inches

p = average gauge test pressure maintained during the test in pounds per square inch

P. Marking

1. The contractor shall install the Owner furnished pipeline markers along the full length of the force main, and at each change in direction, as directed by the Owner.

## **12.27 WATER TIGHT TESTING OF SEWERS:**

General:

Infiltration tests may be used in lieu of air test or exfiltration test if contractor can prove that ground water conditions are such that crown of pipe is covered with not less than two feet of water at highest point in section being tested. The test head shall be maintained for not less than 24 hours before a weir measurement is made.

A. Infiltration Testing of Sewers

1. Maximum infiltration for each section of sewer pipe shall not exceed 25gal/mile/day/inch of pipe diameter.
2. Infiltration, exfiltration, or air test may be used to prove compliance with infiltration requirement.
3. Acceptance of air test or exfiltration results will not preclude rejection of work if infiltration is measured or exceeds limitation.
4. All tests to be witnessed by the Owner or Engineer.
5. Infiltration shall be measured with weir at manhole and shall not exceed amounts stated in paragraph B.3.Exfiltration Test.
6. Engineer will require exfiltration or air test if contractor cannot prove to satisfaction of Engineer that ground water conditions are satisfactory.

B. Exfiltration Testing of Sewers

1. Furnish all facilities required to plug pipe sections and fill with water to attain a minimum elevation of water in upstream manhole two feet higher than top of pipe in line being tested, or two feet above existing ground water in trench, whichever is higher elevation.

The exfiltration test will be conducted by filling the portion of the system being tested

with water to a level which will provide a minimum of 2-feet in a lateral connected to the test portion, or in the event there are no laterals in the test portion, a minimum difference of 5-feet between the crown of the highest portion of the drain or sewer and the test level.

2. Maintain water level in manhole at start of test period for one hour.
3. Water added to maintain level (water lost) shall not exceed the following amounts:
  - a. 8" pipe – 0.63 gallon per 100 feet
  - b. 10" pipe – 0.79 gallon per 100 feet
  - c. 12" pipe – 0.95 gallon per 100 feet
  - d. 15" pipe – 1.19 gallon per 100 feet
  - e. 18" pipe – 1.42 gallon per 100 feet
  - f. 21" pipe – 1.66 gallon per 100 feet
  - g. 24" pipe – 1.90 gallon per 100 feet

Allowable leakage may be increased by 5% for each foot of head above water elevation indicated above.

### C. Air Testing of Sewers

#### General:

On all newly constructed sanitary sewer lines, the Contractor shall conduct a line acceptance test using low pressure air. The air test shall be conducted after the pipe has been backfilled and the cost of air testing shall be included in other items of Work.

The Engineer shall be advised at least 48 hours before tests are conducted. These tests shall be conducted at all times in the presence of the Engineer. Should a line which has been previously tested indicate any infiltration, or otherwise appear suspect to the Engineer, the Contractor shall conduct confirmation air tests on the line at no additional cost.

The Contractor shall provide, as required, the proper plugs, weirs, public notification, and other equipment required to perform all tests. Testing of each section of sewer installed shall include the portions of service connections that are to be installed under the contract. If the sewer is in service, the Contractor shall plug the sewer and test in sections after notifying customer to not use facilities.

1. **Procedures (4 Inch to 24 Inch Diameter):** All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.

After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater that may be over the pipe. At least 2 minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The test of that portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back

pressure of any groundwater that be over the pipe) shall not be less than the time shown for the given diameters in the following table:

<u>Pipe Dia. In Inches</u>	<u>Minutes</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

In areas where groundwater is known to exist, the Contractor shall install a ½ inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the groundwater shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig and the 2.5 psig to 7.5 psig. The allowable drop of 1 pound and the timing remain the same). Other methods for determining groundwater level may be used if approved in advance and if results are expected to be accurate in determining the groundwater level.

If the above requirements are not met for the air test, the Contractor shall correct the pipeline and retest until acceptable results are achieved.

2. **Procedures- (30 Inch to 48 Inch Diameter):** All pneumatic plugs shall be seal tested before being used in the actual test installation. When testing sewer lines 30 inch to 48 inch only the pipe joints need to be tested. The joint tester shall be located so that the end elements (inflatable pneumatic rings or plugs) are located on both sides of the joint to be tested. Air shall then be introduced into the plugs to 50 psig. The plugs shall hold against the pressure without bracing and without movement.

The center cavity shall then be pressurized to 3.5 psig. An additional 0.43 psig is added to the 3.5 psig for every foot of water head above the top of the pipeline, to a maximum pressure of 15 psig. Allow pressure to stabilize for approximately 10 – 15 seconds and then turn off the pressure source. If the pressure in the cavity holds or drops less than 1 psig in 5 seconds, the joint shall be found to be acceptable. If the pressure drops over 1 psig, the joint is defective and should be repaired.

When the joint test is completed all pressure must be exhausted from the center cavity and then from the plugs. The joint tester can then be moved to the next joint.

Should the line or joint fail the pressure test, the Contractor shall, at his expense, determine the source of leakage and make repairs as necessary to eliminate leakage. Air

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testing shall be in addition to infiltration tests specified in paragraph entitled "Infiltration".

## **12.28 DEFLECTION TESTING OF SEWERS:**

If in the opinion of the Owner or the Engineer due to the existing soil conditions or other reasons, PVC and HDPE pipe will be subject to the deflection testing with the use of a 7.5% mandrel by the Contractor. Mandrel test is for deflection quality checking only and does not address sags. Refer to Section 12.19.

PVC pipe shall be installed in accordance with ASTM D2321, latest edition. If there is a conflict between the provisions of ASTM D2321 and the Project Specifications, the Project Specifications shall govern as to this conflict. Deflection of PVC and HDPE pipe after installation and backfill shall not exceed 7.5 percent. Pipe found to be deflected more than 7.5 percent shall be replaced at the Contractor's expense.

All PVC and HDPE sewer lines shall be tested by the Contractor and at his expense for diametric deflection using a GO-NO-GO type mandrel or other approved method. The mandrel shall have an outside diameter of not less than 92.5 percent of the pipe inside diameter. This testing shall be accomplished prior to final acceptance, but no sooner than 30 days after completion of placement and densification of backfill. The pipe shall be cleaned and inspected for offsets and obstructions prior to testing.

For all PVC and HDPE pipes 24-inch ID or smaller, a mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded. Prior to use, the mandrel shall be certified by the Engineer or by another entity approved by the Engineer. Use of an uncertified mandrel or mandrel altered or modified after certification will invalidate the test. If the mandrel fails to pass, the pipe will be deemed to be over deflected.

Unless otherwise permitted by the Engineer, any over deflected pipe shall be uncovered and, if not damaged, reinstalled. Damaged pipe shall not be reinstalled, but shall be removed from the Work site. Any pipe subjected to any method or process other than removal, which attempts, even successfully, to reduce or cure any over deflection, shall be uncovered, removed from the Work site, and replaced with new pipe.

The mandrel shall:

1. Be a rigid, nonadjustable, odd-numbered-leg (9 legs minimum) mandrel having an effective length not less than its nominal diameter.
2. Be fabricated of steel, be fitted with pulling rings at each end, be stamped or engraved on some segment other than a runner indicating the pipe material specification, nominal size, and mandrel OD; and be furnished in a suitable carrying case labeled with the same data as stamped or engraved on the mandrel.

The maximum average ID shall be measured in the field prior to installation. For pipe ID's nominally greater than 24 to 36 inches, deflections shall be determined by a method submitted to and approved by the Engineer. Deflection measurement for ID's nominally larger than 36 inches shall be determined using a 1-inch diameter rigid, Agency-certified, non-adjustable metal bar; a minimum-radius rigid template; or by a method approved by the Engineer.

All costs incurred by the Contractor attributable to mandrel and deflection testing, including any delays, shall be borne by the Contractor at no cost to the Agency.

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It is the responsibility of the Engineer to ensure that the test is performed. The Engineer shall provide the Owner written assurance that the test was performed with acceptable results. Reports for mandrel tests shall also be submitted by the engineer for the owner to place in the project file.

### **12.29 REMOVING AND REPLACING PAVEMENT:**

See Section 14 entitled "Removing and Replacing Pavement" and the Standard Detail drawings in the Appendix.

### **12.30 CLEANUP AND MAINTENANCE:**

- A. Immediately upon completion of each individual sewer line or a 1,500' segment of sewer line constructed under the Contract, whichever is less, the Contractor shall begin and prosecute to completion the cleanup or property restoration for this particular line. This shall be done prior to the start of another line segment, unless a written permission is obtained from the Owner. The permission will only be given if the following conditions and situations exist: The Contractor maintains a sufficient cleanup crew on the project at all times, weather permitting;
- B. The progress shall be at least equal to the pipe laying progress on the project.
- C. The cleanup must be maintained not more than one line or 1,500 feet, whichever is least, behind the pipe laying crew. This shall be subject to weather and ground conditions.
- D. Contractor shall not throw trash and debris into excavations.
- E. Conditions permitting, property cleanup and restoration shall begin and be prosecuted to completion on a timely basis as set forth herein. Failure by the Contractor to prosecute and complete property cleanup and restoration on a timely basis will result in the withholding of 15% of the payment due for that part of the completed pipe sewer for which cleanup and property restoration has not been accomplished. This 15% withholding constitutes payment for work not completed. The amount shall be in addition to the retained percentage for work completed. This withholding of 15% will continue on subsequent payment estimates until such time as cleanup and property restoration is in compliance.
- F. Cleanup and restoration of areas and facilities disturbed by construction operations shall be considered an integral part of the excavation work, and no separate payment will be allowed therefore except as herein specified. See Section 10 entitled "Special Provisions", Paragraph entitled "Clean-Up".
- G. Citations made to the Contractor by the Engineer shall be corrected and addressed immediately.

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## **12.31 INTERNAL VIDEO INSPECTIONS:**

It is the intent of this Specification to cover all aspects of internal video inspection of mainline sanitary sewer pipe.

Internal video inspection of sanitary sewer pipe includes the following procedures:

- A. Cleaning and proper disposal of foreign materials for the designated section of pipe.
- B. Performing internal video inspection of designated section of pipe.

### **A. CLEANING OF PIPE:**

Unless directed otherwise in writing, the Contractor shall clean the sanitary sewer main lines in accordance with Section 12.32 CLEANING OF SEWER MAINS, prior to video inspecting the pipe.

### **B. INTERNAL VIDEO INSPECTION:**

1. General – Owner Performed for Final Acceptance. The Owner shall clean and video the sewer lines for acceptance of final work when all work is complete and after final street surfacing is in place. The video performed by the Owner for final acceptance will become the record video that ultimately is stored in the OWNER video library and the basis for acceptance. The Owner will perform the final acceptance video one time at no expense to the Contractor. Any defects in the sewer lines (as determined from the Owner and Engineer's review of the final acceptance video) shall be corrected by the Contractor at the Contractor's expense. After correcting deficiencies, the Contractor shall then re-video the sewer line (at the Contractor's expense) to show that the defects were corrected. All such video will be a subsidiary requirement of the work and no unit pricing will be billed to the Owner for same. All sewer line videos (and re-videos) shall become the property of the Owner.
2. General – Contractor Performed. The Contractor shall clean and video sewer lines prior to final street surfacing as a means of quality control. This quality control video shall be submitted to the Owner and Engineer for review prior to final street surfacing and shall not be considered the final acceptance video. Any defects in the sewer lines (as determined from the Owner and Engineer's review of the quality control video) shall be corrected by the Contractor at the Contractor's expense. After correcting deficiencies, the Contractor shall then re-video the sewer line (at the Contractor's expense) to show that the defects were corrected. The Owner shall pay the Contractor the lump sum bid price for the initial quality control video and said video (and re-video) shall become the property of the Owner.

The Contractor shall furnish a mobile television inspection studio, all television equipment including a pan and tilt color camera and other necessary types of equipment, and all materials, electricity, labor, technicians, etc., as may be needed to perform the closed circuit television inspection of sanitary sewers for the purpose of documenting materials of construction, defects, lateral locations, manhole locations and other physical features of the sewer main. The video inspections, software/equipment, and operator shall be certified in accordance with the latest standards of the National Association of Sewer Service Companies (NASSCO's) Pipeline Assessment and Certification Program (PACP). The Contractor shall provide the PACP Operator Names and Certificate Numbers prior to

performing the video to ensure the operators are up-to-date and have been recertified every three (3) years. The PACP camera operator must also have a minimum of 2 years experience and proof of such experience must also be provided.

3. Camera Requirements: The camera used for this inspection shall be color. The camera head shall be capable of at least 340 degrees axial rotation and 270 degrees lateral swing. The camera shall operate under a minimum scene illumination of 3 lux with a horizontal resolution of no less than 460 lines. Sufficient lighting shall be provided on the camera so that videos will show images that are clear and well illuminated.
4. Inspection Procedures: The internal Inspection shall be performed in one section of sewer at a time between adjacent manholes. The inspection shall be performed by transporting the camera with a mechanical transport device through the section of the sewer along the axis of the pipe. The camera shall travel in the direction of flow or from the upstream manhole to the downstream manhole unless an obstruction in the pipe requires traveling from the downstream manhole to the upstream manhole (reverse setup). In accordance with the PACP standard, the speed of the camera shall be no more than 30 feet/minute. At all lateral connections, defects or changes in material, the camera shall stop, pan, and tilt such that the lateral connection, defect or material change is seen from a perpendicular field of view, and an identification code and description shall be recorded during the video inspection in accordance with PACP standards. Each lateral and defect shall be extensively filmed and described.

The camera operator shall take necessary precautions to prevent “hanging” the camera in the sewer main. If the camera should get stuck in the sewer main, the Contractor will be responsible for removing the camera at his expense and shall make any above and below ground repairs as approved by the Owner. The Contractor shall exhaust all other means to retrieve the camera before excavating. In no case shall the Contractor excavate for camera removal without first informing the Owner of the need to excavate.

The distances measured to defects and laterals shall be referenced or “zeroed” to the center of the manhole at which recording is started and in all subsequent manholes if multiple segments are videoed at the same time. The location within the pipe shall be shown in 0.1-foot increments on the video recording and shall have an accuracy of +/- one (1) foot. Re-videoing of the pipe at no additional cost will be required if the specified accuracy is not met.

The pipe shall be sufficiently dewatered and cleaned so that the full circumference of the pipe can be seen when video inspected unless directed otherwise by the Owner.

Once pipe is cleaned by Contractor, the pipe shall be filled with clean water from the upstream manhole until the clean water is observed at the downstream manhole. This procedure shall be done before video inspection commences.

Prior to video inspecting the pipe, the camera shall be used to video inspect the manhole entered. The manhole video inspection shall include video inspection of the walls and manhole invert.

The manholes on both ends of a line segment being video inspected shall have the lids removed so that ambient light will shine in the pipe from both ends.



When performing a construction video of sewer lines, the Contractor shall follow the steps below:

- a. Fully clean the sewer;
  - b. Remove all cleaning equipment, nozzles, vacuum tubes, etc. from the manholes;
  - c. Inspect every manhole for defects in a dry condition;
  - d. Plug the exiting lines in the manhole immediately upstream of the sewer segment being video inspected so that flow does pass through the segment during video recording. (If time and flow allows, this can be done prior to cleaning.);
  - e. Turn a hydrant on and flow water into the manhole upstream of the segment to be video inspected. (Once water has freely flowed through the pipe and out of the downstream manhole, the line shall be video inspected without cleaning or removal of standing water in the pipe. The purpose of the water is to identify sags in the pipe that may not be evident in a dry condition.);
  - f. Video sewer segment shortly after segment stops draining into downstream manhole. There should be no flowing water in the sewer segment while it is being video inspected.
  - g. Note in the video the footage at the beginning and end of any stagnant/ponding water and identify the maximum depth of the water in terms of % of pipe diameter. Add any comments that may help clarify why the pipe is holding water.
  - h. Note any other defects in the sewer;
  - i. Give special attention to inverts to assure outgoing lines are lower than incoming lines. (Inverts that are submerged cannot be properly inspected)
5. Documentation: Documentation of the internal inspection results shall be as follows:
- a. Inspection Daily Log: The Contractor shall keep a daily log of the television inspection work. The log shall include at a minimum the following:
    - Basin-Name
    - Mini-Basin Name
    - Start Manhole Number
    - End Manhole Number
    - Diameter of Pipe
    - Length of Pipe
    - Date
  - b. Inspection Report: The report shall be provided in PACP Exchange Format, including the additional Owner-required fields as described herein, and shall include snapshots of the defects.

One copy of the record, typed and bound, shall be delivered to the Owner. There shall be no discrepancies between the video recordings and the written report. An extra copy of the inspection detail top view report shall also be provided to the Owner for submittal to the mapping department.

- c. Video Inspection Recordings: The purpose of the video recordings shall be to supply a continuous visual record of the inspection. The video shall be created and documented in accordance with NASSCO's PACP standards. The data shall be provided to the Owner via hard drive or DVD and in PACP exchange format so that the data can be uploaded directly into the Owner's PIPETECH Video Database without manual manipulation by the Owner. The following fields from PACP latest version must be completed in the PACP video header template:

- Surveyor's Name
- Certificate Number
- Inspection Type
- Basin
- Date
- Time
- Street
- City
- Location code
- Upstream Manhole Number
- Downstream Manhole Number
- Direction
- Lining Method
- Date Cleaned
- Flow Control
- Diameter
- Shape
- Material
- Total Length
- Length Surveyed
- Work Order Number
- Additional Information
- Media Label
- Pre-Cleaning
- Weather
- Measurements (U/D)
  - Rim to Invert (Upstream/Downstream)
  - Grade to Invert (Upstream/Downstream)
  - Rim to Grade (Upstream/Downstream)

In addition to the required PACP header fields above, there are four (4) custom fields that are also required: Upstream Mini-Basin Number; Downstream Mini-Basin Number; GIS Facility ID; and Employee ID. GIS facility ID shall be zero if the ID is not available from existing mapping. The employee ID shall be zero. The Contractor shall collect and submit the video data with the required fields listed above so that the data will upload properly into the Owner's PIPETECH Video Database. A copy of the Owner's PACP Template shall be made available to the Contractor. It is the Contractor's responsibility to ensure that all of the required fields are completed and that the data and video can be easily incorporated into the Owner's PIPETECH Video Database without manual manipulation by the Owner. Contractors who have not previously submitted acceptable video data to the Owner in the aforementioned format

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shall provide the Owner with sample data to ensure compatibility with the PipeTech database prior to proceeding with the video inspection project.

Video recorded segments shall be grouped in areas and submitted in sequential order relating to the area designation. The accuracy and completeness of the videos shall be warranted for two (2) years. When the Owner finds inaccuracies in the videos during the two-year warranty period, the Contractor shall re-video the main at no expense to the Owner.

Video recordings shall be submitted on a hard drive or DVD. The hard drive or DVD shall be labeled clearly indicating the date the data was acquired, the designated segment(s) of sewer main(s) contained in the data, the name of the project, the project number, and the name of the Contractor.

- d. Major Defects: It is the responsibility of the Owner to video the sewer line segments for final acceptance after the corresponding street restoration is complete and after the Contractor has performed an Owner approved quality control sewer line video. Prior to final street surfacing, it is the responsibility of the Contractor to provide the Owner with a quality control construction video that clearly shows work that is free of defects and completed in accordance with plans and specifications. The Contractor shall notify the Owner immediately upon discovering a major defect in the sanitary sewer main that will require a point repair or some other corrective action to correct the defect. Major defects include, but are not limited to, caved-in pipe, pipe wall missing, active laterals with major root blockages, any major inflow sources and any other defect that must be repaired immediately to prevent a Sanitary Sewer Overflow, a backup into a building, or a street cave-in. The Contractor shall provide a snapshot of the defect and a map that shows the sanitary sewer main and the location of the defect. Distances from manholes to the defect shall be provided on the map along with a detailed description of the defect. The Contractor shall correct all defective work and re-video inspect to show that the repairs have been properly made and to provide the Owner with accurate video documentation of the sewer.
- e. Sanitary Sewer Manhole Numbers: Prior to proceeding with the quality control construction video inspections of the sanitary sewer lines, the Contractor shall contact the Owner's Construction Inspector assigned to the project to obtain the actual manhole numbers that will be permanently assigned to the manholes in the Owner's GIS. Assumed manhole numbers will not be accepted. The Owner will also provide the mini-basin number that is to be noted in the video header. The GIS Department will develop a manhole numbering scheme based on the proposed plans for the project. If the number of manholes and alignment have changed from that submitted on the proposed plans, then such changes will be provided to the Construction Inspector on a corrected drawing showing the actual alignment and manholes constructed.
6. Warranty: The Contractor warrants the accuracy and completeness of the video recordings for a period of five (5) years. If the Owner determines that the video recording does not meet the requirements as identified herein, the Contractor shall clean and re-video inspect the main segments for which the reporting was faulty at the Contractor's expense.
7. Defective Workmanship: It is the responsibility of the Contractor to provide the Owner with a quality control construction video that clearly shows work that is free of defects and completed in accordance with the plans and specifications. If the work is defective, it must be corrected by the Contractor and then re-video inspected by the Contractor to show the

repairs have been properly made and to provide the Owner with accurate video documentation of the sewer. The additional video work described herein shall be at the Contractor's expense and not be reflected in quantities of video footage charged to the Board.

### **12.32 CLEANING OF SEWER MAINS**

- A. General: The Contractor shall clean the interior of the sewer main sufficiently to allow internal video inspection to detect all deficiencies within the cleaned pipe. The mainline shall be restored to a minimum of 98% of its capacity. The Contractor shall be responsible for hauling and disposal of all debris removed during the cleaning process. All debris/sand within the pipe shall be removed from the downstream manhole of the mainline being cleaned. Washing debris and other material downstream shall not be allowed. The sewer main shall be plugged and bypassed when necessary to effectively clean the main.

The cleaning process shall also include the removal of grease and roots where necessary. Precautions shall be taken to ensure that damage or flooding of public and private property does not occur due to the cleaning process.

- B. Light Cleaning: Sanitary sewer mains with less than 25% of the diameter or less of debris/sand shall require light cleaning and shall be measured on a linear foot basis.
- C. Medium Cleaning: Sanitary sewer mains with 25% to 50% of the diameter of debris/sand shall require medium cleaning and shall be measured on a linear foot basis.
- D. Heavy Cleaning: Sanitary sewer mains with greater than 50% of the diameter of debris/and shall require heavy cleaning and shall be measured on a linear foot basis.

### **12.33 PERMANENT PLUGGING AND ABANDONING SEWER LINES AND MANHOLES:**

- A. General: The plugging of sanitary sewer mains proposed for abandonment or currently abandoned shall provide a permanent, watertight seal. Unless noted otherwise in the contract documents, installation of a sanitary sewer pipe plug shall be submitted under the appropriate pay item for "Concrete Plug for Sewer Pipe".
- B. Plugging of Sanitary Sewer Mains at an Active Manhole: In instances where a sanitary sewer main to be abandoned enters an existing manhole scheduled to remain in service, the end of the pipe shall be plugged with a masonry (brick and mortar) plug. The masonry plug shall have a minimum width of one half of the pipe's nominal diameter. To ensure a watertight seal between the pipe wall and masonry plug, a loop of swellable rubber waterstop material shall be applied around the entire inside circumference at least 4 inches from the end of the pipe prior to installation of the masonry plug. The waterstop material shall be SikaSwell S-2, SiksSwell Profile, or Engineer-approved equivalent. Surface preparation and installation of the waterstop material shall be performed in accordance with the manufacturer's recommendations. Concrete shall be used to reform the invert channel as necessary to match the flow scheme of the mains remaining in service. The Contractor shall rehab the manhole walls to ensure long term seal (5-year warranty).

Once the masonry plug has sufficiently cured, the plugged main shall be exposed by excavation as necessary where indicated on the project plans or directed by the Engineer or Owner in the field. A portion of the pipe shall be removed beginning at a point no more than two (2) feet from the outside wall of the existing manhole. Surrounding soils shall be removed from the top, sides, and bottom of the stubbed out main to provide a minimum of four (4) inches above the top of the pipe so that the pipe stub out is entirely filled with concrete to the masonry plug. The concrete mixture shall have a minimum compressive strength of 3000 psi. The concrete shall be allowed to obtain a suitable amount of hardness, as determined by the Engineer, before the excavation is backfilled.

- C. Plugging Mains 12" Diameter and Larger: In instances where a 12" diameter or larger sanitary sewer main to be abandoned must be severed at a point that is not adjacent to an existing active manhole, the pipe ends remaining after the required portion is severed and removed shall be plugged with a masonry (brick and mortar) plug. Surrounding soils shall be removed from the top, sides, and bottom of the stubbed out main to provide a minimum of four (4) inches of clearance around the pipe to at least 12 inches from the cut end of the remaining pipe. Using the surrounding undisturbed soil as a form, the formed area shall be filled with concrete to a minimum of four (4) inches above the top of the pipe so that the pipe stubout is entirely filled with concrete to the masonry plug. The concrete mixture shall have a minimum compressive strength of 3000 psi. The concrete shall be allowed to obtain a suitable amount of hardness, as determined by the Engineer, before the excavation is backfilled.

For mains abandoned in this manner that are tied into a manhole(s) scheduled to remain in service, the end(s) of the pipe shall require a masonry (brick and mortar) plug as described in Paragraph B above.

- D. Plugging Mains Smaller than 12" Diameter: In instances where a sanitary sewer main smaller than 12 inches to be abandoned must be severed at a point that is not adjacent to an existing active manhole, the Contractor shall fill the area around the end of the severed pipe(s) with concrete as described in Paragraph C above. The concrete mixture shall have a minimum compressive strength of 3000 psi. The concrete shall be allowed to obtain a suitable amount of hardness, as determined by the Engineer, before the excavation is backfilled. The Contractor may elect to use masonry plugs for lines smaller than 12" diameter.

For mains abandoned in this manner that are tied into a manhole(s) scheduled to remain in service, the end(s) of the pipe shall require a masonry (brick and mortar) plug as described in Paragraph B above.

- E. Materials for Filling Abandoned Mains: Unless otherwise noted, all sanitary sewer mains to be abandoned shall be completely filled with an approved material. Flowable backfill meeting the requirements of Section 15 entitled "Backfilling" of these specifications shall be used if noted in the contract documents or if required by local agencies including the City, County, or State. Otherwise, the Contractor may elect to use a clean sand mixture in lieu of flowable backfill. Prior to filling an abandoned pipe with flowable backfill or a clean sand mixture, both ends of the pipe shall be plugged as noted above. Unless noted otherwise in the contract documents, flowable backfill or sand shall be submitted under the appropriate pay item for "Flowable Backfill or Sand for Abandoned Sewer Pipe".
- F. Abandoning Manholes: In instances where a sanitary sewer manhole is to be abandoned, all incoming and outgoing pipes shall be plugged in accordance with the specifications above. Unless directed otherwise by the Owner or Engineer, the manhole casting shall be completely

removed and the remaining manhole section shall be completely filled with flowable backfill. The flowable backfill shall meet the requirements of Section 15 entitled "Backfilling" of these specifications and shall be allowed to obtain suitable hardness, as determined by the Engineer before final backfilling/final surface restoration. After the flowable backfill has achieved sufficient hardness, the excavated area from the top of the remaining manhole section to the existing surface shall be backfilled and restored to match the existing surface conditions, as per detailed drawings.

Where the abandoned manhole is located within the roadway, the existing roadbed shall be neat sawcut and removed. The sawcut shall be perpendicular to the centerline of the roadway and to a distance of no more than two feet from the outside of the casting. For concrete manholes, the top three (3) feet of the manhole section shall then be removed (or broken down inside for brick manholes), the remaining manhole section shall be filled with flowable backfill and allowed to achieve sufficient hardness. After the flowable fill has cured, the excavation shall receive final backfill (of adequate compaction) and a permanent asphalt patch. The final backfill and permanent asphalt patch shall be installed in accordance with the construction requirements of the local authoritative jurisdiction.

Abandonment of manholes and sewer lines shall be in accordance with the standard detail drawings in the Appendix.

### **12.34 PIPELINE MARKERS AND BOLLARDS FOR MANHOLE PROTECTION:**

- A. Pipeline markers: Unless directed otherwise by the Owner or Engineer, pipeline markers shall be installed plumb for sewer lines running through easements in non-residential areas and maintained residential areas. Pipeline markers shall be of PVC with proper decal and shall be installed directly over the pipeline in accordance with the standard drawing details in the Appendix.
- B. Bollards for manhole protection: Unless directed otherwise by the Engineer or Owner, three (3) evenly spaced breakaway bollards shall be installed plumb around and within three (3) feet of the edge of each manhole rim in easements and not under pavement. Bollards located within the right of way shall be of 4" diameter PVC, filled with non-reinforced concrete grout, and shall be of safety yellow color. Bollards on private property shall be of steel pipe, filled with concrete and painted safety yellow with an exterior enamel base paint. Bollards shall be installed in conformance with the standard drawing details in the Appendix.

**END OF SECTION**