

**SECTION 33 30 00
SANITARY SEWERAGE UTILITIES**

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. Outside, underground sanitary sewer system, complete, ready for operation, including all gravity flow lines, pressure (force) lines, manholes, wet well, grinder pit, flexible expansion joint vault, cleanouts, frames, covers, structures, appurtenances, and connections to new building and structure, service lines, existing sanitary sewer lines, and existing sanitary structures, and all other incidentals.

1.2 RELATED WORK:

- A. Maintenance of Existing Utilities: Section 01 00 00, GENERAL REQUIREMENTS.
- B. Excavation, Trench Widths, Pipe Bedding, Backfill, Shoring, Sheeting, Bracing: Section 31 20 11, EARTH MOVING (short form).
- C. Concrete Work Reinforcing, Placement and Finishing; Section 03 30 00, CAST-IN-PLACE CONCRETE.
- D. Protection of Materials and Equipment: Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. Sanitary Sewer Pumping Facilities, Division 22, PLUMBING
- F. Emergency Wastewater Storage Tank: Section 13 60 00, Emergency Wastewater Storage Tank
- G. Horizontal Directional Drilling (HDD): Section 13 70 00 Utility Horizontal Directional Drilling

1.3 QUALITY ASSURANCE:

- A. Products Criteria:
 - 1. Multiple Units: When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
 - 2. Nameplates: Nameplate bearing manufacturer's name, or identifiable trademark, including model number, securely affixed in a conspicuous place on equipment, or name or trademark, including model number cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.
- B. Comply with the rules and regulations of the Public Utility having jurisdiction over the connection to Public Sanitary Sewer lines and the extension, and/or modifications to Public Utility Systems.

1.4 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturers' Literature and Data: Submit the following as one package:
 - 1. Pipe, Fittings, and, Appurtenances.
 - 2. Jointing Material.
 - 3. Manhole and Structure Material.
 - 4. Frames and Covers (including dimensions).
 - 5. Steps and Ladders.
 - 6. Gate and Plug Valves.
 - 7. Valve Boxes.
 - 8. Air Release Valves.
 - 9. Drop Bowl and Hood
 - 10. Rod attachment plates, rods, and pipe clamps
 - 11. Pipe straps.
 - 12. Grinder and rail system.
 - 13. Watertight pipe boots
 - 14. Grinder Pit Hatch
 - 15. Flexible Expansion Joint
 - 16. Flexible Expansion Joint Vault Access Hatch
- C. Shop Drawings:
 - 1. Shop Drawings of all precast items shall be submitted for approval.
 - 2. Complete shop drawing of grinder pit including, but not limited to, bar screen, grinder, concrete benching, and grinder rail system.
 - 3. Complete shop drawing of flexible expansion joint vault.
- D. Work Plans: Submit the following work plans to the COR for review and approval.
 - 1. Trenchless Technology Work Plan:
 - Submit proposed method and procedures for installing the new sewer pipe between MH34 and MH35 using a trenchless technology as indicated on the drawings.
 - 2. By-Pass Piping and Pumping Plan:
 - Submit proposed method and procedures for temporary by-pass pumping and piping during all forcemain bridge work. Submittal shall include a plan drawing displaying location and anchoring of by-pass piping.

1.5 APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - A48/A48M-03.....Gray Iron Castings

A536-84(2004).....Ductile Iron Castings
 A615/A615M-06.....Deformed and Plain Carbon-Steel Bars for
 Concrete Reinforcement
 A625/A625M-03.....Tin Mill Products, Black Plate, Single Reduced
 A746-03.....Ductile Iron Gravity Sewer Pipe
 C12-06.....Installing Vitrified Clay Pipe Lines
 C76-05b/C76M-05b.....Reinforced Concrete Culvert, Storm Drain and
 Sewer Pipe
 C139-05.....Concrete Masonry Units for Construction of Catch
 Basins and Manholes
 C150-05.....Portland Cement
 C425-04.....Compression Joints for Vitrified Clay Pipe and
 Fittings
 C478-06a/C478M-06a.....Precast Reinforced Concrete Manhole Sections
 C700-05.....Vitrified Clay Pipe, Extra Strength, Standard
 Strength, and Perforated
 C828-03.....Low-Pressure Air Test of Vitrified Clay Pipe
 Lines
 C857-95(2001).....Minimum Structural Design Loading for
 Underground Precast Concrete Utility Structures
 D698-00ae1.....Laboratory Compaction Characteristics of Soil
 Using Standard Effort (12,400 ft-lbf/ft³ (600
 kN-m/m³))
 D2321-05.....Underground Installation of Thermoplastic Pipes
 for Sewers and Other Gravity-Flow Applications
 D2412-02.....Determination of External Loading
 Characteristics of Plastic Pipe by Parallel-
 Plate Loading
 D2992-01.....Practice for Obtaining Hydrostatic or Pressure
 Design Basis for Fiberglass (Glass-Fiber-
 Reinforced Thermosetting-Resin) Pipe and
 Fittings
 D3034-04a.....Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe
 and Fittings
 D3212-96a (2003) e1.....Joints for Drain and Sewer Plastic Pipes Using
 Flexible Elastomeric Seals
 D3261-03.....Butt Heat Fusion Polyethylene (PE) Plastic
 Fittings for Polyethylene (PE) Plastic Pipe and
 Tubing

- D3350-05.....Polyethylene Plastics Pipe and Fittings
Materials
- D4101-05a.....Polypropylene Injection and Extrusion Materials
- F477-02e1.....Elastomeric Seals (Gaskets) for Joining Plastic
Pipe
- F679-06.....Poly (vinyl chloride) (PVC) Large-Diameter
Plastic Gravity Sewer Pipe and Fittings
- F714-05.....Polyethylene (PE) Plastic Pipe (SDR-PR) Based on
Outside Diameter
- F794-03.....Poly (Vinyl Chloride)(PVC) Ribbed Gravity Sewer
Pipe and Fittings Based on Controlled Inside
Diameter
- F894-05.....Polyethylene (PE) Large Diameter Profile Wall
Sewer and Drain Pipe
- F949-03.....Poly (Vinyl Chloride) (PVC) Corrugated Sewer
Pipe with Smooth Interior and Fittings
- C. American Water Works Association (AWWA):
- C105/A21.5-05.....Polyethylene Encasement for Ductile Iron Pipe
Systems
- C110/A21.10-03.....Ductile-Iron and Gray-Iron Fittings for Water
- C111/A21.11-00.....Rubber Gasket Joints for Ductile Iron Pressure
Pipe and Fittings
- C115-99.....Flanged Ductile-Iron Pipe with Threaded Flanges
- C116-03.....Protective Fusion-Bonded Epoxy Coatings for the
Interior and Exterior Surfaces of Ductile Iron
Pipe and Gray Iron Fittings for Water Supply
Service
- C151-/A21.51-02 Ductile-Iron Pipe, Centrifugally Cast for Water
- C153-00 Ductile-Iron Compact Fittings for Water Services
- C508-01.....Swing Check Valves for Waterworks, 2 inches (50
mm) Through 24 inches (600 mm) NPS
- C509-01.....Resilient Seated Gate Valves for Water-Supply
Service
- C515-01.....Reduced-Wall, Resilient-Seated Gate Valves For
Water Supply Service
- C512-04.....Air Release, Air/Vacuum, and Combination Air
Valves for Waterworks Service
- C550-05.....Protective Epoxy Interior Coatings for Valves
and Hydrants

- C600-05.....Installation for Ductile-Iron Water Mains and Their Appurtenances
- C605-94.....Underground Installation of Polyvinyl (PVC) Pressure Pipe and Fittings for Water
- C900-97Polyvinyl Chloride (PVC) Pressure Pipe, 100 mm (4 inches) Through 300 mm (12 inches) for Water Distribution
- C905-97.....Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 350 mm through 1,200 mm (14 Inches through 48 Inches), for Water Transmission and Distribution
- C906-99.....Polyethylene (PE) Pressure Pipes and Fittings, 100 mm through 1575 mm (4 Inches through 63 Inches), for Water Distribution
- D. American Association of State Highway and Transportation Officials (AASHTO):
 - M198-05.....Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealants
- E. Uni-Bell PVC Pipe Association:
 - Uni-B-6-98.....Recommended Practice Low Pressure Air Testing of Installed Sewer Pipe

PART 2 - PRODUCTS

2.1 PIPING:

- A. Gravity Flow Lines (Pipe and Fittings):
 - 1. Polyvinyl Chloride (PVC):
 - a. Pipe and Fittings, 100 to 375 mm (4 to 15 inches) in diameter, shall conform to ASTM D3034, Type PSM, SDR 35 Pipe and fittings shall have elastomeric gasket joints providing a watertight seal when tested in accordance with ASTM D3212. Gaskets shall conform to ASTM F477. Solvent welded joints shall not be permitted.
 - b. Pipe and fittings, 450 to 900 mm (18 to 36 inches) in diameter, shall be solid wall or have a corrugated or ribbed exterior profile and a smooth interior. Pipe shall conform to the following:
 - 1) Pipe and fittings shall conform to ASTM F949 corrugated sewer pipe with a smooth interior. The corrugated outer wall shall be fused to the smooth interwall at the corrugation valley. Pipe and fitting shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe

stiffness of 350 kPa (50 psi) at 5 percent deflection, when tested in accordance with ASTM D2412. Corrugation shall be perpendicular to the axis of the pipe to allow gaskets to be installed on field cut sections of pipe without the requirement for special fittings.

- 2) Ribbed wall PVC pipe and fittings shall conform to ASTM F794 ribbed sewer pipe with smooth interior pipe and fittings shall have a smooth bell, elastomeric joints conforming to ASTM D3212, and shall have a minimum pipe stiffness of 320 kPa (46 psi) when tested in accordance with ASTM D 2412, at 5 percent vertical deflection. Joints shall not leak at 7.6 m (25 feet) of head under 5 percent deflection.
 - 3) Solid wall pipe and fittings shall conform to ASTM F679, SDR 35 pipe and fittings shall gaskets conforming to ASTM F477, and shall be able to withstand a hydrostatic pressure of 345 kPa (50 psi).
2. Ductile Iron Pipe (DIP) for Sanitary Sewer: Shall conform to ASTM A746, thickness Class 51 unless otherwise shown or specified. Unless otherwise shown on drawings, joints on pipe and fittings shall be push-on style and conform to AWWA C110 and AWWA C111, rated for 1.03 MPa (150 psi). Exterior coating shall be approximately 0.025 mm (1 mil) asphaltic coating as specified in ASTM A746. Interior lining shall be a catalyzed coal tar epoxy, having a minimum thickness of 0.60 mm (24 mils), a permeability rating of 0.13 perms, direct impact rating of 11.3 Nm (100 in-lbs), an abrasion resistance of 20 liters of sand per mil, and dielectric strength of 250 volts per mil. Pipe and fittings shall be polyethylene encased with 0.20 mm (8 mil) polyethylene sheeting per AWWA C105. Color of polyethylene encasement shall be green.

B. Pressure (Force) Lines (Pipe and Fittings):

1. All pipe and fittings used in the construction of force mains shall be rated for a minimum of 1035 kPa (150 psi).
2. Ductile Iron: Pipe shall conform to AWWA C151 and C111 with polyethylene lining. Flange joints shall conform to AWWA C115. Lining shall be heat-fused mechanical bond polyethylene having a dielectric strength of 250 volts per mil when fully cured. Lining shall be holiday tested in accordance with AWWA C116. The lining shall be a minimum of 1 mm (40 mil) in the barrel of the pipe, and a minimum of 0.25 mm (10 mil) on the bell and spigot area of the pipe. The lining shall be repaired at all field cuts per the manufacturer's

- recommendations. Joints shall be conformed to AWWA C116. Pipe shall be polyethylene encased per AWWA C105.
3. Ductile iron fittings shall comply with AWWA C110 and AWWA C111. Fittings shall be flanged or mechanical joint as indicated on the drawings. Fittings shall be polyethylene line, as specified for ductile iron pipe. Ductile iron fittings shall be polyethylene encased per AWWA C105.
 4. High Density Polyethylene (HDPE) pipe and fittings shall be manufactured from PE 3408, high density, extra high molecular weight polyethylene meeting the requirements of ASTM D3350. Pipe shall be manufactured in accordance with ASTM F714, and shall be Class 160 (DR 11). Molded fittings shall be manufactured in accordance with ASTM D3261 and subject to the test required under ASTM D3261. Fabricated fittings shall be made by heat fusion jointing of machined shapes cut from pipe, sheet stock, or molded fittings. Molded and fabricated fittings shall be rated for a minimum working pressure equivalent to the pipe. Joints shall be heat fusion butt joints, flange adapters, or mechanical couplings.
 - a. Flange adapters shall have adequate through-bore length to be clamped in a butt fusion jointing machine without the use of a stub-end holder. The sealing surface of the flanged shall be machined with a series of V-shaped grooves to restrain the gasket against blow out. Back-up rings and flange bolts shall be rated equal to or greater than the mating pipe. All flange adapters shall be equipped with a stainless steel internal pipe stiffener.
 - b. Mechanical couplings shall be sleeve style, restrained coupling. The sleeve and gland shall be epoxy coated and lined and rated for the pressure of the mating pipe. Coupling shall be supplied with stainless steel pipe stiffeners to be installed within the pipe.

2.2 JOINTING MATERIAL:

A. Gravity Flow Lines:

1. Ductile Iron Pipe: Push-on or mechanical joints, AWWA C111, AWWA C110. Flange joints shall comply with AWWA C115. Flange joints shall only be used in vaults or above-grade.
2. Polyvinyl Chloride (PVC) Pipe (Gravity Use): Joints, ASTM D3212. Elastomeric gasket, ASTM F477.

B. Pressure (Force) Main:

1. All joints indicated on the drawings as being "restrained" shall be fully restrained and capable of restraining 50 percent above all

loads acting on the joint, but not less than 1035 kPa (150 psi). Thrust blocks shall not be permitted.

2. Ductile iron pipe and fittings, mechanical or push-on, conforming to AWWA C110 and C111. Restrained joints shall meet the following requirements:
 - a. Push-on joints shall be restrained by a mechanical locking slot cast integrally in the bell of the pipe or fitting. The spigot shall have a retainer weldment or band. Locking segments, placed in the slots in the bell, shall form a mechanical restraint and prevent the opening of the joint.
 - b. Mechanical joint restraint shall be incorporated into the design of the follower gland. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull-out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly and the flexibility of the joint shall be maintained after burial. The joint restraint ring and its wedging components shall be made of Grade 60-42-10 ductile iron conforming to ASTM A536. The wedges shall be 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 standardized mechanical joint bell conforming to AWWA C111 and AWWA C153 of the latest revision. Torque limiting twist-off nuts shall be used to insure proper actuation of the restraining wedges. The gland shall be specifically designed for the type of pipe (DIP or PVC) connected to the fitting.
4. High Density Polyethylene (HDPE) pipe and fittings shall be fusion butt welded, flanged, or mechanical couplings as recommended by the manufacturer. HDPE restrained joints shall be limited to fusion welded. Transition from HDPE to ductile iron shall be as indicated on the drawing with the use of a fused MJ Adapter that includes stainless steel stiffener, extended t-bolts and nuts, gasket, and ductile iron gland.

2.3 MANHOLES AND VAULTS:

- A. Manholes and vaults shall be constructed of precast precast reinforced concrete rings, precast reinforced sections, or cast-in-place concrete. The manholes and vaults shall be in accordance with State Department of Transportation or State Roads Commission standard details, and the following:

1. Precast Reinforced Concrete Rings: Rings or sections shall have an inside diameter as indicated on the drawings, and shall be not less

- than 1200 mm (48 inches) in diameter. Wall thickness shall conform to requirements of ASTM C76, except that lengths of the sections may be shorter as conditions require. Tops shall conform to ASTM C478. Top section shall be eccentric cone type. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
3. Precast Reinforced Concrete Manhole Risers and Tops: Design, material and installation shall conform to requirements of ASTM C478. Top sections shall be eccentric. Steps on inside wall shall be in the same plane from bottom of structure to manhole cover.
 4. Flat top manhole tops shall be reinforced concrete and used where indicated on the drawings.
 5. Vaults: Reinforced concrete, as indicated on the plans, or precast reinforced concrete. Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C857.
 6. Mortar:
 - a. Precast Reinforced Concrete Ring and Riser Structures: By volume, 1 part of Portland cement and 2 parts sand. Water in mixture shall produce a stiff, workable mortar, but shall not exceed 21 L (5-1/2 gallons) per sack of cement.
 7. Flexible sealing compound shall be packaged in extruded preformed shape, sized to completely fill the joint between precast sections, and form permanently flexible watertight seal. The sealing compound shall be non-shrink and meet AASHTO M198.
 8. Frames and covers shall be gray cast iron conforming to ASTM A48. The frame and cover shall be rated for HS20-44 loading, have a studded pattern on the cover, and the words "sanitary sewer". The studs and the lettering shall be raised 8 mm (5/16 inch). The cover shall be a minimum of 600 mm (24 inches) in diameter and shall have four 19 mm (3/4 inch) vent holes and two lifting slots. The bearing surface of the frame and cover shall be machine finished. The cover shall fit firmly on the frame without movement when subject to traffic.
 9. Manhole steps shall be polypropylene plastic coated on a No. 4 deformed rebar conforming to ASTM C478, Polypropylene shall conform to ASTM D4101. Steps shall be a minimum of 406 mm (16 inches) wide and project a minimum of 178 mm (7 inches) away from the wall. The top surface of the step shall have a studded non-slip surface. Steps shall be placed at 300 mm (12 inch) centers.

10. Ladders, brackets and hardware shall be constructed of welded aluminum, rails shall be 10 mm (3/8 inch) by 63 mm (2-1/2 inches) spaced a minimum of 400 mm (16 inches) apart. Rungs shall be 35 mm (1-3/8 inches) in diameter and have a non-slip surface. Standoffs shall offset the ladder 180 mm (7 inches) from the wall. The ladder assembly shall be rated for a minimum of 2200 N (500 pounds).
11. Concrete for precast sections shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel, rated for AASHTO HS20-44 loading with 30 percent impact, and conform to ASTM C857.

2.4 CONCRETE:

Concrete shall have a minimum compressive strength of 4,000psi at 28 days. The cement shall be Type III conforming to ASTM C150. Concrete shall conform with the provisions of Division 03 of these specifications.

2.5 REINFORCING STEEL:

Reinforcing steel shall be deformed bars, ASTM A615, Grade 60 unless otherwise noted.

2.6 SEWERAGE WET WELL:

- A. Provide a precast manhole wet well of the size indicated on the drawing. Wet well shall include all items required for a complete and functional wet well.
- B. Precast manhole shall meet the requirements of 2.3 and in addition shall meet the following:
 1. The wet well shall be constructed to resist uplift forces generated by a water table 2 feet above that indicated within the geotechnical investigation (report available upon request) of the ground surface. The unit weight of soil shall be appropriate for that determine during the geotechnical investigation. Factor of safety shall be 2.
 2. The wet well shall be constructed to resist all soil pressures.
 3. The wet well shall be constructed to prevent groundwater from entering the structure. All connections shall be watertight.
 4. Coat the outside of the wet wall with bituminous dampproofing material, two coats.
 5. The wet well manufacturer shall have a minimum of 5 years prior experience with precast concrete structures of a similar size and configuration.
 6. Two holes of the size indicated shall be provided within flat top slab for frames and covers. Contractor shall supply frames and covers as indicated on drawings.

- C. Pipe and fittings shall be ductile iron with flange joints.
- D. All pipe supports and hardware shall be stainless steel.
- E. Level switch/indicator shall be as indicated within Section 22 13 36. Sewage control elevations are indicated on the drawings.
- F. Drop bowl, hood, and drop pipe shall be as indicated on drawings.
- G. Concrete benches shall be installed as indicated on the drawings.

2.7 CONCRETE PROTECTIVE COATING:

Concrete coating for the interior of wet wells shall consist of an epoxy blended filler sealer, and a cross linked epoxy phenolic cured, resistant protective coating.

2.8 PLUG VALVES:

- A. Cast Iron Eccentric Plug Valves suitable for wastewater service with pressures up to 250 psig (1725 kPa).
- B. Plug Valves shall be quarter-turn, non-lubricated, eccentric type with resilient faced plug.
- C. The valves shall be designed, manufactured and tested in accordance with American Water Works Association Standard ANSI/AWWA C517.
- D. Connections:
 - 1. Flanged valves shall have flanges with drilling to ANSI B16.1, Class 125.
 - 2. Mechanical Joint valves shall fully comply with ANSI/AWWA C111/A21.11.
 - 3. Joints: Shall be as indicated on drawings. If not indicated, end of valve shall accommodate, or be adapted to, pipe furnished.
- E. Design:
 - 1. Port areas of not less than 100% of pipe area shall be supplied on all valves.
 - 2. The valve seat shall be a welded overlay of 95% pure nickel applied directly to the body on a pre-machined, cast seating surface and machined to a smooth finish.
 - 3. Shaft seals shall consist of V-type packing in a fixed gland with an adjustable follower designed to prevent over compression of the packing and to meet design parameters of the packing manufacturer. Removable, slotted shims shall be provided under the follower flanges to provide for adjustment and prevent over tightening.
 - 4. Permanently lubricated, radial shaft bearings shall be supplied in the upper and lower bearing journals. Thrust bearings shall be provided in the upper and lower journal areas.
 - 5. Both the packing and bearings in the upper and lower journals shall be protected by a Grit-Guard™ "drip tight" Buna-N shaft seal located

on the valve shaft to minimize the entrance of grit into the bearing journal and shaft seal areas.

6. The interior and exterior of the valve shall be coated with an NSF/ANSI 61 approved fusion bonded epoxy.

F. Materials

1. The valve body and cover shall be constructed of ASTM A126 Class B cast iron for working pressures up to 175 psig (1200 kPa). The words "SEAT END" shall be cast on the exterior of the body seat end.
2. The plug shall be of one-piece construction and made of ASTM A126 Class B cast iron or ASTM A536 Grade 65-45-12 ductile iron and fully encapsulated with a resilient facing per ASTM D2000-BG and ANSI/AWWA C517 requirements.
3. Radial shaft bearings shall be constructed of self-lubricating type 316 stainless steel. The top thrust bearing shall be Teflon. The bottom thrust bearing shall be Type 316 stainless steel. Cover bolts shall be corrosion resistant with zinc plating.

G. Actuators

1. 6 in. (150 mm) and smaller valves shall be equipped with a 2 inch square nut for direct quarter turn operation. The packing gland shall include a friction collar and an open position memory stop. The friction collar shall include a nylon sleeve to produce friction without exerting pressure on the valve packing.
2. When specified, 8 in. and larger valves shall include a totally enclosed and sealed worm gear actuator with position indicator (above ground service only) and externally adjustable open and closed stops. The worm segment gear shall be ASTM A536 Grade 65-45-12 ductile iron with a precision bore and keyway for connection to the valve shaft. Bronze radial bearings shall be provided for the segment gear and worm shaft. Alloy steel roller thrust bearings shall be provided for the hardened worm.
3. All gear actuators shall be designed to withstand, without damage, a rim pull of 200 lb. on the handwheel and an input torque of 300 foot pounds for nuts.
4. Buried service actuators shall be packed with grease and sealed for temporary submergence to 20 feet of water. Exposed worm shafts shall be stainless steel.
5. Shall turn counterclockwise to open.

- #### H. Eccentric Plug Valves shall be Series #5600R (Flanged) or 5700R (Mechanical Joint) as manufactured by Val-Matic® Valve & Mfg. Corporation, Elmhurst, IL. USA or approved equal.

2.9 GATE VALVES:

- A. AWWA C509, resilient seated gate valves rated for 1360 kPa (200 psi) WSP, reduced-wall resilient seated gates valves may be supplied in accordance with AWWA C515. Asbestos packing is prohibited. The interior and exterior of the valve shall be epoxy coated for AWWA C550.
- B. Operation:
 - 1. Shall turn counterclockwise to open.
 - 2. Underground: 50 mm (2 inch) nut for socket wrench operation.
 - 3. Above Ground and In Pits: Handwheels.
- C. Joints: End of valve shall accommodate, or be adapted to, pipe furnished.

2.10 VALVE BOXES:

- A. Cast iron extension box with screw or slide-type adjustment and flared base. Minimum thickness of metal shall be 5 mm (3/16 inch). Box shall be of such length as will be adapted, without full extension, to depth of cover required over pipe at valve location.
- B. Cast the word "SEWER" on the cover.
- C. Provide one "T" handle socket wrenches, of 1 ¼" round stock long enough to extend 600 mm (2 feet) above top of deepest valve box.

2.11 AIR RELEASE VALVE:

- A. Valves shall be combination air release and vacuum valve with a single body. The valves shall be rated for 1025 kPa (150 Psi) working pressure, and conform to AWWA C512. Valve shall be provided with threaded connections, and be mounted on a full opening ball valve which shall isolate the valve from the system.
- B. Valve shall be adequate for wastewater applications.
- C. Valve body shall be cast iron.
- D. Interior and exterior of valve shall be coated with fusion bonded epoxy.
- E. Floats and operating mechanism shall be 316 stainless steel.
- F. Non-clog design, Val-Matic or approved equal.

2.12 FORCEMAIN CLEANOUTS:

Forcemain cleanouts shall be as indicated on the drawings.

2.13 WARNING TAPE:

Standard, .1mm (4Mil) polyethylene 76 mm (3 inch) wide tape detectable type, green with black letters and imprinted with "CAUTION BURIED SEWER LINE BELOW".

2.14 GRINDER PIT:

- A. Grinder pit shall be as indicated on drawing and included, but not be limited to, precast manhole, grinder, grinder rail system, concrete bench, bar screen and access hatch, and control.

B. Grinder:

1. Adequate for flow up to 490 GPM.
2. Stainless steel cutters.
3. Provided with custom stainless steel frames and guide rails for easy installation and removal from precast manhole. Grinder shall be removable without entering manhole.
4. Controller shall be remote mountable and be within a NEMA-4x enclosure. Provide integral 0 - 60 second adjustable on-time delay relay interface in motor control circuit. Coordinate staggered time delay setting with the electrical contractor. Provide summary alarm contact consisting of a form c set of dry auxiliary relay contacts for remote monitoring of all local alarm /monitoring controller functions.
5. Motors shall be explosion proof, submersible, 5 HP, and shall be rated for 208 volts, 60cycle, 3 phase service.
6. Provide motor temperature switch in the motor assembly to prevent overheating and motor damage.
7. 1 year limited warranty.
8. Grinder shall be Muffin Monster Model 30005-0012 or approved equal.

C. Bar screen shall be as indicated on the drawings.

D. Access hatch shall be as indicated on the drawings.

2.15 FLEXIBLE EXPANSION JOINT:

- A. Flexible expansion joints on the suction side of the pump station piping shall be Flex-Tend flexible expansion joints Model 406F20 by EBAA Iron or approved equal.
- B. Flexible expansion joints for pump station suction side piping shall be adequate for direct burial applications.
- C. Flexible expansion joints for bridge crossings shall be Ex-Tend expansion joints Model 206M0 by EBAA Iron or approved equal.

2.16 FLEXIBLE EXPANSION JOINT VAULT:

- A. Flexible expansion joint vault shall be cast in place concrete and be provided with an access hatch as indicated on the drawings.
- B. Contractor shall provide all items indicated on drawings for a complete vault unit.
- C. Concrete shall have a minimum compressive strength of 35 MPa (5,000 psi) at 28 days, ASTM A615, Grade 60 reinforcing steel.
- D. Dowel top slab to pump station foundation wall with rebar.
- E. Other layout of vault will be considered. If alternate layout is desired, provide detailed drawings indicating change during submittal process.

PART 3 - EXECUTION**3.1 BUILDING SERVICE LINES AND OTHER SEWER PIPES:**

- A. Install sanitary sewer service lines to point of connection within approximately 1500 mm (5 feet) outside of buildings.
- B. All existing service lines and sewer pipes shall be reconnected to new manholes or sewer main within the replacement areas, even if not indicated on the drawings, at no additional cost to VA.

3.2 ABANDONED MANHOLES STRUCTURES AND PIPING:

- A. Manholes and Structures Outside of Building Areas: Remove frame and cover, cut and remove the top of an elevation of 600 mm (2 feet) below finished grade. Fill the remaining portion with compacted gravel or crushed rock or concrete.
- B. Manholes and Structures with Building Areas: Remove frame and cover and cut and remove the top to an elevation of 600 (2 feet) below the finish floor elevation, and completely fill the structure with 21 MPa (3,000 psi) concrete.
- C. Piping under and within 1500 mm (5 feet) of building areas shall be abandoned in place and completely filled with 21 MPa (3000 psi) concrete.
- D. Piping outside of building areas shall have all ends of the piping at the limit of the abandonment and within structures and manholes, plugged with concrete, and abandoned in-place.
- E. The Contractor shall comply with all OSHA confined space requirements while working within existing manholes and structures.
- F. When the limit of the abandonment terminates in an existing manhole to remain, the flow line in the bench of the manhole to the abandoned line shall be filled with concrete and shaped to maintain the flowline of the lines to remain.

3.3 REGRADING:

- A. Raise or lower existing manholes and structures frames and covers, cleanout frames and covers and valve boxes in regraded areas to finish grade. Carefully remove, clean and salvage cast iron frames and covers. Adjust the elevation of the top of the manhole or structure as detailed on the drawings. Adjust the elevation of the cleanout pipe riser, and reinstall the cap or plug. Reset cast iron frame and cover, grouting below and around the frame. Install concrete collar around reset frame and cover as specified for new construction.
- B. During periods when work is progressing on adjusting manholes or structures cover elevations, the Contractor shall install a temporary cover above the bench of the structure or manhole. The temporary cover

shall be installed above the high flow elevation within the structure, and shall prevent debris from entering the wastewater stream.

- C. The Contractor shall comply with all OSHA confined space requirements when working within existing structures.

3.4 CONNECTIONS TO EXISTING VA OWNED MANHOLES:

- A. During construction of new connections to existing manholes, it shall be the sole responsibility of the Contractor to maintain continued sanitary sewer service to all buildings and users upstream. The contractor shall provide, install, and maintain all pumping, conveyance system, dams, weirs, etc. required to maintain the continuous flow of sewage. All temporary measures required to meet this requirement shall be subject to the review of the COR.
- B. Core existing structure, install pipe at the design invert. Install an elastomeric gasket around the pipe, and grout the interstitial space between the pipe and the core.
- C. The bench of the manhole shall be cleaned and reshaped to provide a smooth flowline for all pipes connected to the manhole.
- D. Connections and alterations to existing manholes shall be constructed so that finished work conforms as nearly as practicable to the applicable requirements specified for new manholes, including concrete and masonry work, cutting and shaping.

3.5 PIPE SEPARATION:

- A. Horizontal Separation - Water Mains and Sewers:
 - 1. Existing and proposed water mains shall be at least 3 meters (10 feet) horizontally from any proposed gravity flow and pressure (force main) sanitary sewer or sewer service connection.
 - 2. Gravity flow mains and pressure (force) mains may be located closer than 3 meters (10 feet) but not closer than 1.8 m (6 feet) to a water main when:
 - a. Local conditions prevent a lateral separation of ten feet; and
 - b. The water main invert is at least 450 mm (18 inches) above the crown of the gravity sewer or 600 mm (24 inches) above the crown of the pressure (force) main; and
 - c. The water main is in a separate trench separated by undisturbed earth.
 - 3. When it is impossible to meet (1) or (2) above, both the water main and sanitary sewer main shall be constructed of push-on or mechanical joint ductile iron pipe. The pipe for the sanitary sewer main shall comply with the specifications for pressure (force) mains, and the water main material shall comply with Section 33 10 00, WATER

UTILITIES. The sewer shall be pressure tested as specified for pressure (force) mains before backfilling.

B. Vertical Separation - Water Mains and Sewers at Crossings:

1. Water mains shall be separated from sewer mains so that the invert of the water main is a minimum of 600 mm (24 inches) above the crown of gravity flow sewer or 1200 mm (48 inches) above the crown of pressure (force) mains. The vertical separation shall be maintained within 3 meters (10 feet) horizontally of the sewer and water crossing. When these vertical separations are met, no additional protection is required.
2. In no case shall pressure (force) sanitary main cross above, or within 600 mm (24 inches) of water lines.
3. When it is impossible to meet (1) above, the gravity flow sewer may be installed 450 mm (18 inches) above or 300 mm (12 inches) below the water main, provided that gravity sewer main is cased with a HDPE butt fused pipe. Pressure (Force) sewers may be installed 600 mm (24 inches) below the water line provided the sewer forcemain is cased within a HDPE butt fused pipe. The casing pipe shall extend at least 10-feet on either side of the crossing.
4. The required vertical separation between the sewer and the water main shall extend on each side of the crossing until the perpendicular distance from the water main to the sewer line is at least 3 meters (10 feet).

3.6 GENERAL PIPING INSTALLATION:

- A. Lay pipes true to line and grade. Gravity flow sewer shall be laid with bells facing upgrade. Pressure (force) mains shall have the bells facing the direction of flow.
- B. Do not lay pipe on unstable material, in wet trench or when trench and weather conditions are unsuitable for the work.
- C. Support pipe on compacted bedding material. Excavate bell holes only large enough to properly make the joint.
- D. Inspect pipes and fittings, for defects before installation. Defective materials shall be plainly marked and removed from the site. Cut pipe shall have smooth regular ends at right angles to axis of pipe.
- E. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely to prevent entrance of storm water, dirt or other substances.
- F. Lower pipe into trench carefully and bring to proper line, grade, and joint. After jointing, interior of each pipe shall be thoroughly wiped or swabbed to remove any dirt, trash or excess jointing materials.

- G. Do not lay sewer pipe in same trench with another pipe or other utility. Sanitary sewers shall cross at least 600 mm (2 feet) below water lines.
- H. Do not walk on pipe in trenches until covered by layers of bedding or backfill material to a depth of 300 mm (12 inches) over the crown of the pipe.
- I. Warning tape shall be continuously placed 300 mm (12 inches) above sewer pipe
- J. Install gravity sewer line in accordance with the provisions of these specifications and the following standards:
 - 1. Ductile Iron Piping: AWWA C111 and C600.
 - 2. Vitrified Clay Piping: ASTM C12.
 - 3. Polyvinyl Chloride (PVC) Piping: ASTM D2321.
 - 4. High Density Polyethylene (HDPE) Piping: Comply with manufacturer's recommendations with.
- K. Installation of Pressure (Force) Mains:
 - 1. Sections of piping listed on the drawings shall be fully restrained using approved joint restraint devices. Joint restraint devices shall be installed in accordance with the manufacturer's recommendations. For devices with twist of nuts, the twist of nuts shall be placed on top of the fitting for the COR's inspection. The Contractor shall torque test all bolts, set screws, identified by the COR.
 - 2. Thrust blocks shall not be permitted.
 - 3. Install pressure (force) mains in accordance with the provisions of these specifications and the following standards:
 - a. Ductile Iron Piping: AWWA C111 and C600.
 - b. High Density Polyethylene (HDPE) Piping: Per manufacturer's recommendations.

3.7 MANHOLES AND VAULTS:

- A. General:
 - 1. Circular Structures:
 - a. Precast reinforced concrete rings shall be installed true and plumb. The joints between rings and between rings and the base and top, shall be sealed with a preform flexible gasket material specifically manufactured for this type of application. Adjust the length of the rings so that the eccentric conical top section will be at the required elevation. Cutting the conical top section is not acceptable.
 - b. Precast reinforced concrete manhole risers and tops. Install as specified for precast reinforced concrete rings.

- c. Shall be set on a washed stone leveling course as indicated on the drawings.
2. Rectangular Structures:
 - a. Reinforced concrete structures shall be installed in accordance with Division 03, CONCRETE.
 - b. Precast concrete structures shall be placed on a 200 mm (8 inch) reinforced concrete pad, or be provided with a precast concrete base section. Structures provided with a base section shall be set on 200 mm (8 inches) thick aggregate base course compacted to a minimum of 95 percent of the maximum density as determined by ASTM D698. Set precast section true and plumb. Seal all joints with preform flexible gasket material.
3. Do not build structures when air temperature is 0 degrees C (32 degrees F), or below.
4. Invert channels shall be smooth and semicircular in shape conforming to inside of adjacent sewer section. Make changes in direction of flow with a smooth curve of as large a radius as size of structure will permit. Make changes in size and grade of channels gradually and evenly. Construct invert channels by one of the listed methods:
 - a. Forming directly in concrete base of structure.
 - b. Building up with brick and mortar.
5. Floor of structure outside the channels shall be smooth and slope toward channels not less than 1:12 (1-inch per foot) nor more than 1:6 (2 inches per foot). Bottom slab and benches shall be concrete.
6. The wall that supports access rungs or ladder shall be 90 degrees vertical from the floor of structure to manhole cover.
7. Install steps and ladders per the manufacturer's recommendations. Steps and ladders shall not move or flex when used. All loose steps and ladders shall be replaced by the Contractor.
8. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.

3.8 SEWER AND MANHOLE SUPPORTS, CONCRETE CRADLES:

Reinforced concrete as detailed on the drawings. The concrete shall not restrict access for future maintenance of the joints within the piping system.

3.9 WET WELLS:

- A. Install the wet well on a 200 mm (8 inches) compacted aggregate base course.
- B. Set precast units level and plumb. Install sealant between all precast.
- C. Core openings for pipe penetrations and seal with watertight pipe boot, kor-n-seal or approved equal.
- D. Grout all joints and depressions in the vault. Install concrete protective coating per the manufacturer's recommendations. The final coating shall be applied in two coats, providing a minimum thickness .15 - .20 mm (6-8 mils) dry film thickness per coat.
- E. Set at location indicated on drawing.
- F. Suction line pipe and fittings entering within the wet well shall be poly lined ductile iron pipe.
- G. All pipe penetrations through the walls of the wet well shall be sealed water tight.
- H. Install manhole frames and covers on a mortar bed, and flush with the finish pavement. Frames and covers shall not move when subject to vehicular traffic. Install a concrete collar around the frame to protect the frame from moving until the adjacent pavement is placed. In unpaved areas, the rim elevation shall be 50 mm (2 inches) above the adjacent finish grade. Install a 200 mm (8 inches) thick, by 300 mm (12 inches) concrete collar around the perimeter of the frame. Slope the top of the collar away from the frame.
- I. Drop bowl and hood, drop pipe, and supports shall be installed as recommended by the manufacturer.
- J. Install concrete fillets within wet well as indicated on the drawing.

3.10 DRY WELL AND VAULTS:

- A. Install precast reinforced concrete vaults on a 200 mm (8 inches) compacted aggregate base course. The floor, walls, and top shall be level and plumb.
- B. Vaults shall be sized as indicated on the drawings. Orientate vault and internal piping, valves and appurtenances to provide access to all valves and appurtenances for operation and maintenance of the equipment.
- C. Paint interior of dry well and vaults with two (2) coats of alkyd enamel masonry paint.

3.11 CLEANOUTS:

- A. Shall be installed as indicated on the drawings.

3.12 SETTING OF GATE VALVES AND PLUG VALVES:

- A. Avoid setting valves under pavement except where shown on the drawings.
- B. Clean valve interior before installation.
- C. Set valve plumb, restrain ends of valves when indicated on the drawing.
- D. Set valve box cover flush with the finished grade. Valve box shall be centered over the operating nut.

3.13 SETTING OF AIR RELEASE VALVES:

- A. Set valves in vault with adequate space for maintenance of the valve. The vault shall have a solid floor to prevent all sanitary blowoff from being absorbed into the soils.
- B. Valves shall be set plumb and supported to the vault. Maintain accessibility to the isolation valve on the air valve line.
- C. Install the valve after the completion of testing of the pressure (force) main.

3.14. GRINDER PIT:

- A. Install the grinder pit on a 200 mm (8 inches) compacted aggregate base course.
- B. Set precast units level and plumb. Install sealant between all precast.
- C. Core openings for pipe penetrations and seal with watertight pipe boot, kor-n-seal or approved equal.
- D. Grout all joints and depressions in the vault. Install concrete protective coating per the manufacturer's recommendations. The final coating shall be applied in two coats, providing a minimum thickness .15 - .20 mm (6-8 mils) dry film thickness per coat.
- E. Set at location indicated on drawing.
- F. All penetrations through the walls of the grinder pit shall be sealed water tight.
- G. Cast access hatch within top slab.
- H. Install concrete bench and channel within grinder pit as indicated on the drawing.
- I. Install bar screen within grinder pit.
- J. Grinder, framing, and rails shall be installed as recommended by the manufacturer. Grind shall be removable without entering grinder pit.
- K. Test grinder for proper operation. A technical representative shall provide one (1) trip and at least four (4) hours on-site to verify proper installation and operation and provide training to VA staff on proper maintenance.

3.15 INSPECTION OF SEWERS:

Inspect and obtain the COR's approval. Thoroughly flush out before inspection. Lamp test between structures and show full bore indicating

sewer is true to line and grade. Lip at joints on the inside of gravity sewer lines are not acceptable.

3.16 TESTING OF SANITARY SEWERS:

A. Gravity Sewers and Manholes (Select one of the following):

1. Air Test: Vitrified Clay Pipe ASTM C828. PVC Pipe, Uni-Bell Uni-B-6. Clean and isolate the section of sewer line to be tested. Plug or cap the ends of all branches, laterals, tees, wyes, and stubs to be included in the test to prevent air leakage. The line shall be pressurized to 28 kPa (4 psi) and allowed to stabilize. After pressure stabilization, the pressure shall be dropped to 24 kPa (3.5 psi) greater than the average back-pressure of any groundwater above the sewer. The minimum test time shall be as specified in Uni-Bell Uni-B-6.
2. Exfiltration Test:
 - a. Subject pipe to hydrostatic pressure produced by head of water at depth of 900 mm (3 feet) above invert of sewer at upper manhole under test. In areas where ground water exists, head of water shall be 900 mm (3 feet) above existing water table. Maintain head of water for one hour for full absorption by pipe body before testing. During one hour test period, measured maximum allowable rate of exfiltration for any section of sewer shall be 11 L (3.0 gallons) per hour per 30 m (100 feet).
 - b. If measurements indicate exfiltration is greater than maximum allowable leakage, take additional measurements until leaks are located. Repair and retest.
3. Infiltration Test: If ground water level is greater than 900 mm (3 feet) above invert of the upper manhole, infiltration tests are acceptable. Allowable leakage for this test will be the same as for the exfiltration test.

B. Pressure (Force) Mains: Test at 690 kPa (100 psi) for two hours. Leakage shall be per the following:

$$L=J*D*\sqrt{P}/4500$$

Where:

L = Maximum Allowable Leakage in Gallons per Hour

J = Number of Joints in Test Area

D = Diameter of Pipe in Inches

P = Average Test Pressure (Psi)

C. Testing of Concrete Wet Well: No leakage with the wet well completely filled with water for a duration of 4 hours.

D. Testing of Grinder Pit: No leakage with the pit completely filled with water for a duration of 4 hours. Grinder shall be removed during testing.

3.17 FLOW:

It shall be the sole responsibility of the Contractor to maintain continued sanitary sewer flow and service for all users upstream. The contractor shall provide, install, and maintain all pumping, conveyance system, dams, weirs, etc. required to maintain the continuous flow of sewage. All temporary measures required to meet this requirement shall be subject to the review of the COR.

3.18 WORK PLANS:

The Contractor shall develop a work plan and submit a detailed report to the COR for approval of the following work items for the project.

- A. Trenchless installation of the new sanitary sewer pipe between MH34 and MH35.
- B. By-pass piping and pumping during forcemain work on the bridge.

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