

Special Specification 7185

Sanitary Sewer



1. DESCRIPTION

- 1.1. **Scope of Work.** Provide and install complete sanitary sewer construction and adjustments in conformity with the details shown on the plans, as described herein, in compliance with the Department's Utility Accommodation Policy (UAP)(Title 43, T.A.C., Sections 21.31-21.55) or as directed.

Reference specifications of the American Society for Testing and Materials (ASTM), American Water Works Association (AWWA) and American National Standards Institute (ANSI) will mean the latest standard in effect on the date of the proposal.

1.2. Definitions

- 1.2.1. **Sanitary Sewer Main.** Sanitary Sewer Main is defined as that portion of the sanitary sewer system which collects the wastewater from the service laterals, including stub outs from the nearest manhole, to the point of final destination.

- 1.2.2. **Sanitary Sewer Force Main.** Sanitary Sewer Force Main is defined as that portion of the sanitary sewer system which moves wastewater under pressure using a lift station to the point of final destination.

- 1.2.3. **Service Lateral.** Service Lateral is defined as that portion of the sanitary sewer system beginning at a customer property line or other establishment property line which is the point of origin of the wastewater being carried by the system to the sanitary sewer main, including the connection into the sanitary sewer main system.

- 1.2.4. **Point Repair.** Point Repair is defined as the repair of a small length of pipe section of an existing sewer line which has deteriorated due to settlement or corrosion, or is falling, missing, crushed or broken, or has offset joints. Point repairs are to be completed before rehabilitation by trenchless methods between two adjacent manholes is initiated.

- 1.2.5. **Rehabilitation.** Rehabilitation is defined as the rehabilitation of existing sanitary sewer mains by an approved trenchless method including Cured-In-Place-Pipe (CIPP) method or by slip-lining with Centrifugally Cast Fiberglass Pipe (ASTM D-3262) or by slip-lining with hollow Core I-Beam construction Closed Profile PVC Pipe (ASTM D-F794).

- 1.2.6. **Cured-In-Place-Pipe.** This method consists of inverting a resin-impregnated flexible sewn felt tube into the original conduit by use of hydrostatic head. The resin is cured by circulating hot water within the tube. The Cured-In-Place-Pipe (CIPP) will be continuous and tight fitting. The work must be completed with TxDOT schedule. Contractors may, when appropriate, elect to use any material that is considered to be equal (i.e. A product that has structural physical properties that are equal or greater than those of the specified products), however, submittal to the design Engineer is required no later than 10 days prior to bid opening.

- 1.2.7. **Television Inspection.** Television Inspection is defined as televising and videotaping of sewer lines utilizing a color closed circuit television inspection unit to determine the condition of the lines.

Television Inspection is part of the acceptance requirements for new sewer lines. All new sewer mains will not carry flow until the Engineer and Inspector approve and accept the mains for service.

- 1.2.8. **Cleaning Manholes and Mains.** Cleaning Manholes and Mains is defined as cleaning of existing sanitary sewer manholes and mains to facilitate the TV inspection and rehabilitation of the sanitary sewer mains.

The designated sanitary sewer manhole sections and the manholes themselves should be cleaned using mechanical, hydraulically propelled or high velocity sewer cleaning equipment. Debris generated by the cleaning process should be removed from the manhole, transported and disposed of.

- 1.2.9. By-Pass Pumping. By-Pass Pumping is defined as the installation of pumping equipment and temporary piping for the purpose of redirecting sewage flow to prevent interference with the rehabilitation of the sanitary sewer manholes and mains as well as providing reliable sewer service to the buildings being served.
- 1.2.10. Pipe Bursting or Crushing Replacement Process. The pipe bursting or crushing process is defined as the reconstruction of existing sanitary sewers by the simultaneous insertion (breaking and expanding the old pipe) of liner pipe within the bore of the existing pipe. The pipe bursting or crushing process involves the rehabilitation of deteriorated gravity sewer pipe by installing new pipe material within the enlarged bore created by the use of using s static, hydraulic, or pneumatic hammer "moling" device, suitably sized to break the existing pipe or by using a modified boring "knife" with a flared plug that crushes the existing sewer pipe. Forward progress of the "mole" or the "knife" may be aided by hydraulic equipment or other apparatus. Replacement pipe is either pulled or pushed into the bore. Sewer services are reconnected to the new pipe through small excavations from the surface. Sewage flows from the upstream line and from the services are pumped as required to prevent overflows and provide continual service. All excavations required for reconnecting and pumping service flows, entry pits, exit pits, obstruction removal, point repairs, among others, are to be kept to a minimum and all damage to surface and underground features, facilities, utilities and improvements are to be repaired.
- 1.2.11. Slip-lining. Sliplining is accomplished by pulling or pushing liner pipe into existing sewers by use of mechanical or hydraulic equipment. Once in place, liner pipe is allowed time to normalize and is then cut to fit between the manholes. Manhole inverts and benches are re-worked and re-shaped. Existing sewers remain in operation during sliplining process, with sewage flow diverted around operations in progress.
- 1.2.12. Grouting of Sewer Mains. This item will govern the grouting of existing sewer mains with diameter of larger than 4-in. for the purposes of abandonment underneath roadways, paved areas, and at other designated locations. The location of this Work is as shown on the Contract Document plans and/or as encountered in the field during construction. The Contractor must, unless otherwise specified, furnish all labor, materials, equipment, tools and all other appurtenances necessary to abandon sewer lines segments in place by filling them with flowable cementitious low strength grout including plugs, bulkheads, excavation and backfill at locations as required to completely fill the line to be abandoned in place to protect against future collapse of the line.

2. MATERIALS

All materials furnished for this project will be new. A manufacturer's certificate of compliance will be acceptable for quality control.

- 2.1. **Sanitary Sewer Pipe.** Materials for sanitary sewer pipe may be either rigid or flexible unless a specific type pipe is called for on the plans. All pipe not listed will be subject to pre-approval by the Engineer.
- 2.1.1. **Rigid Pipe.** Ductile iron pipe will, for the purpose of this specification, be known as rigid pipe.
- 2.1.2. **Flexible Pipe.** Pipe consisting of materials other than those listed above.

Any flexible pipe having a deflection of the inside diameter greater than 5% after 30 days of installation as determined by a mandrel test, will not be accepted.

Unless directed otherwise by the Engineer, a "GO, NO-GO" Deflection Testing Mandrel built in accordance with the detail drawing, as shown in the plans, and 30 TAC § 217, will be furnished at the Contractor's expense and will be used in testing pipe deflection for acceptance. Refer to "Air and Deflection testing," section of this specification for more information about mandrel deflection testing.

The working room for flexible pipe will be a minimum of 6 in.

Pipe stiffness is to be in accordance with ASTM 3034 SDR 26 [115 psi] or ASTM 2241 SDR 26 [160 psi].

At waterline crossings and where water and sewer mains are parallel and separation distance cannot be achieved as per 30 TAC§ 217.53, use extra stiff pipe SDR 26 PVC (ASTM D2241-09) with a pressure rating of at least 150 psi. This will include all lateral piping as well.

All sanitary sewer piping must pass the low pressure test, as described in 30 TAC § 217.57.

- 2.1.3. **Concrete Pipe.** Concrete pipe must not be used.
- 2.1.4. **Asbestos-Cement (AC) Pipe.** AC pipe must not be used. For any work requiring the removal of AC pipe, the Contractor will comply with the requirements of Item 6 of the Department Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges. Excavate to the top of the AC water line to allow a separate contractor hired by the State to remove the AC water line. The excavation for the AC water line removal is subsidiary to the work that created the need for the removal (excavation for structures, roadway, a new line, tie-ins, etc.). The third party contractor will remove whole sections of AC pipe.
- 2.1.5. **Fiberglass Reinforced Pipe, For Large Diameter Gravity Sanitary Sewer.** This item will govern the designing, fabricating, furnishing, installing, and joining of large diameter (18-in. or greater) fiberglass sewer piping for gravity-flow conveyance of wastewater. The pipe size, centerline alignment, and grades are presented in the project Drawings. All materials and construction will be in accordance with the Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewerage systems 30 TAC 217.1, 30 TAC 217.2, 30 TAC 217.3, and 30 TAC 217.13, or any revision thereto as applicable.

The work to be performed in this section includes design calculations, detailing, and fabrication of FRP for the conveyance of raw sanitary sewage. Pipe design calculations will be required for open-trench and tunneling installation methods. All pipes must be manufactured specifically for this project and no pipe should be furnished from stock unless approved by the Owner.

- 2.1.5.1. **Performance / Design Criteria.** Design in accordance with ASTM D3262 including the appendix and subsequent specifications. Depths must comply with requirement of ASTM D3681. Design pipe for service loads that include external groundwater and earth loads, jacking/pushing loads, allowable jacking/pushing capacity must not exceed 40 percent of the ultimate compressive strength or the maximum allowable compressive strength recommended by the manufacturer, whichever is less, and traffic loads.

Design is to be conducted under the supervision of a Professional Engineer licensed in the State of Texas, who must seal and sign the design. Standard lay length of 20 ft, except for special fittings or closure pieces necessary to comply with the Plans.

Design of pipe is to include the determination of design pressures up to 25 psi, stresses, external loads, pressure class (PN), and pipe stiffness class (SN).

Stiffness (SN) class that satisfies design requirement on the Plans, or not less than 115 psi when used in direct bury operations.

All lines must be able to withstand a high-velocity cleaning with a water jet capable of producing a minimum volume of 50 gpm with a pressure of 1500 psi at the nozzle. Install a gauge to indicate working pressure on the discharge of high-pressure water pumps. The jet angle of the outlet must be no greater than 30° relative to the pipe axis. A video of pipe before and after line cleaning must be submitted of all installed lines. No delamination should occur.

In no case should pipe be installed deeper than its design allows.

Pipe markings must meet the minimum requirements of ASTM 3236. Minimum pipe markings will be as follows:

- Manufacturer
- Manufacturer Number (identifies factory, location, date manufactured, shift and sequence)
- Nominal diameter
- Beam load
- Laying length
- ASTM designation

- 2.1.5.2. **Gaskets.** Supply from approved gasket manufacturer in accordance with ASTM F477 and suitable for service intended. Affix gaskets to pipe by means of suitable adhesive or install in a manner so as to prevent gasket from rolling out of pre-cut groove in pipe or sleeve coupling.

Provide the following gaskets in potentially contaminated areas.

- Petroleum (diesel, gasoline) – Viton
- Other contaminants – Manufacturer recommendation

- 2.1.5.3. **Fittings.** All bends exceeding a two-degree horizontal or vertical deflection will consist of a manufacturer fabricated fitting meeting the same requirements as the pipe material. Provide tolerance of laying length of fittings to +/-2-in. Use only manufactured fittings. Flanges, elbows, reducers, tees, wyes, laterals and other fittings will be capable of withstanding all operating conditions when installed. They may be contact molded or manufactured from mitered sections of pipe joined by glass-fiber reinforced overlays. For pipe diameters 18-in. or larger, lateral openings 6-in. or greater in size must be made using insert a-tee conforming to ASTM D3034 service connections, approved by Engineer.

- 2.1.5.4. **Couplings.** Unless otherwise specified, the pipe must be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness. Elastomeric sealing gaskets should be recommended by the manufacturer for application with sanitary sewage. Chemical grout, epoxy grout, or internal repair boots will not be accepted as long-term watertight seals. The joints must meet the performance requirements of ASTM D4161.

- 2.1.5.5. **Structure Conditions.** Provide an FRP water stop flange (wall pipe) or raised rib for water-tight connection to a concrete cast-in-place structure/manhole.

- 2.1.5.6. **Dimensional Tolerances.**

- Inside diameter Pipe must not vary more than 1/8-in. from the nominal inside diameter.
- Roundness The difference between the major and minor outside diameters must not exceed 0.1 percent of the nominal outside or ¼-in., whichever is less.
- Wall thickness Provide minimum single point thickness no less than 98 percent of stated design thickness.
- End Squareness Provide pipe ends square to pipe axis with maximum tolerance of 1/8-in.
- Fittings - Provide tolerance of angle of elbow and angle between main and leg of wye or tee to ± 2 degrees. Provide tolerance of laying length of fitting to ± 2 -in.

- 2.1.5.7. **Acceptable Manufacturer.** Vendors must have approval through SAWS Standards Committee prior to product use.

- 2.1.6. **PSM Polyvinyl Chloride Pipe.** Polyvinyl Chloride (PVC) pipe will be made from class 12454-B materials as prescribed in ASTM D-1784. For pipes 4-in. to 15-in. in diameter PSM pipe, fittings and joints must conform to ASTM D-3034 with elastomeric gasket joints meeting ASTM D-3212, or ASTM D-2241 and ASTM D-3139 where applicable, with the exception that solvent cement joints must not be used. All pipe that is 18-in. to 36-in. in diameter must meet requirements of ASTM F-679.

2.1.7. **PVC Pressure Pipe/Force Mains.** Pipe must be made from Class 12454-A or 12454-B, as defined in ASTM D1784-11. All pipe, fittings, and joints must meet or exceed the requirements of ASTM D2241-09, with the exception that solvent cement joints must not be used. The pressure rating, size, and pressure class will be as shown in the contract documents. Pipe must have an integral bell and gasket seal with the locked-in type gasket reinforced with a steel band or other rigid material conforming to ASTM F477-10. The joint must comply with the requirements of ASTM D3139-98(2011). All required joint restraint must be approved by the Engineer prior to the work being accepted. Pressure pipe/Force mains are required to have modified grade 5 material used as bedding. Pipes also must be hydrostatically tested at a minimum of 100 psi after their construction to ensure proper construction.

2.1.8. **High Density Polyethylene Pipe.** High Density Polyethylene Pipe (HDPE) and fittings must be made of high density extra high molecular weight (EHMW) polyethylene with a standard thermoplastic material designation code of PE3408 and having a cell classification of 345464E per ASTM D3350. The molecular weight category will be extra high (250,000 to 1,500,000) as per the Gel Permeation Chromatography determination procedure with a typical value of 300,000 to 330,000. The pipe must be manufactured in accordance with ASTM F714 and/or ASTM D3035.

All HDPE piping must have identifiable green striping (dual) every 120°. The pipe will be color grey and must meet the Utility Location and Coordination Council, "Uniform Color Code," for sewer lines per APWA/ULCC Standards Committee.

The pipe and fittings must have product traceability. The manufacturer will include a print line on the pipe. This will notate the manufacturer's name, date of manufacture, the lot and supplier of raw material, plant location, and production shift. The ASTM standard must also appear as ASTM F714 with the material designation as PE3408.

The polyethylene pipe manufacturer must provide certification that the stress regression testing has been performed on the specific product. The said certification will include a stress life curve per ASTM D2837. The stress regression testing must have been performed in accordance with ASTM D2837, and the manufacturer must provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi as determined by ASTM D2837.

The material will be listed by the Plastics Pipe Institute (PPI), a division of The Society of the Plastics Industry in PPI TR-4. The pipe material must have a Hydrostatic Design Basis of 1,600 psi at 73 degrees and 800 psi at 140 degrees. The PPI listing must be in the name of the pipe manufacturer and testing and validation of samples of the pipe manufacturer's production pipe must be based upon ASTM D2837 and PPI TR-3.

The manufacturer's certification must state that the pipe was manufactured from one specific resin in compliance with these specifications. The certificate must state the specific resin used and its source.

HDPE pipe manufactured from materials meeting the specifications of this section must have an Environmental Stress Crack Resistance of no failures in 10,000 hrs. (ESCR: FO>10,000) when tested in accordance with ASTM F1248.

Pipe and fittings must be manufactured from material meeting the requirements of this section. Pipe supplied under this specification must have a nominal IPS (Iron Pipe Size) outside diameter unless otherwise specified. The Dimension Ration (DR) and pressure rating of the pipe at 73 degrees will be as indicated on the drawings.

Both pipe and fittings must carry the same pressure rating. All fittings must be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness of the fitting must match the outside diameter and minimum wall thickness specifications of ASTM F714 for the same size pipe. Fittings must be manufactured by the manufacturer of the pipe. Ells, tees, wyes must be manufactured by mitered fabrication.

Clamps and Gaskets: Clamps must be stainless steel, including bolts and lugs as manufactured by JCM Industries Type 108 or equal. Furnish full circle, universal clamp couplings with a minimum 3/16 inch thick neoprene, grid-type gasket. Select clamps to fit outside diameter of pipe. Use minimum clamp length of 30 in for replacement pipes O.D. of 10.75-in. (10-in. nominal) or greater and 18-in. for replacement pipe O.D. less than 10.75-in.

Terminal sections pipe that are joined within the insertion pit will be connected with a full circle pipe repair clamp. The butt gap between pipe ends will not exceed ½ inch.

Force Mains: Where applicable, solid wall pipe for sanitary sewer force mains must have a minimum working pressure rating of 150 psi, and an inside diameter equal to or greater than the nominal pipe size indicated on the drawings.

For force mains or pressure rated fittings, all fittings must be de-rated according to the manufacturer's written specifications, and clearly labeled on the fittings as such. For direct bury or insertion lining; fittings will be fully pressure rated. All fittings will have a quality control label as approved by the manufacturer.

High density polyethylene pipe (HDPE) is related to pipe bursting or pipe crushing for sanitary sewer or related pipe line rehabilitation.

Yard Piping: DR 9 only, no more than two splices, and must use long inserts for connections.

Heat fusion joining systems: Pipe and fittings must be thermal butt fusion, saddle fusion, or socket fusion according to manufacturer recommended procedures.

2.1.9. **Mechanical or Compression Joints.** Mechanical or compression joints, concrete jointing collars, or non-reinforced rubber adaptors must not be used unless as approved by the Engineer.

2.1.10. **Ductile Iron Pipe and Fittings.** Ductile iron pipe must be centrifugally cast of 60-42-10 iron and must conform to the requirements of the latest revision of ANSI A21.51/American Water Works Association (AWWA) C151-09. Ductile iron pipe may be "thickness designed" in accordance with requirements of the latest revision of ANSI A21.50/AWWA C150-08. Thickness design should be based on standard laying conditions 4 or 5 in accordance with conditions at the site. Fittings for ductile iron pipe must have not less than the thickness, class, or pressure rating specified for ductile iron pipe. Fittings must be furnished with all necessary glands, gaskets, bolts, etc. as may be required to complete the joints.

Rubber gasket joints for mechanical joints or push on type joints must conform to the requirements of ANSI A21/AWWA C111-12.

All ductile iron pipe and fittings used for sewer applications must have the interior lined with a non-corrosive lining material consisting of polyurethane, ceramic epoxy, or calcium aluminate. The lining material should be applied per the manufacturer's written instructions and at thicknesses recommended by the pipe manufacturer for sewer applications. The type and brand of interior lining should be clearly marked on the outside of the pipe and fittings. Only one type and brand of lining should be used for pipe on a project.

Where ductile iron pipe is to be installed in a casing, the pipe should be thoroughly cleaned down to the coal-tar enamel pipe coating by approved methods. Where damaged, a prime coat, compatible to the polyvinyl tape to be used, should then be applied to the pipe. Following the application of the prime coat, the pipe must be wrapped with Scotchrap, Trantex V-10 polyvinyl tape, or other approved equal product. The tape must not be applied until the prime coat is completely dry. The tape must be spirally and tightly wrapped on each section of the pipe with a 50% lap. The wrap must be made to the bell on the bell end and to a point 6 in from the spigot end. The joint must be protected with tape 6-in. in width on pipe 12-in. or less in size and with tape 8-in. in width on pipe greater than 12-in. in size.

Ductile iron pipe to be installed in a trench must be protected in the following manner. Each pipe joint must be covered with a 4 mil thick polyethylene sleeve that is 2-ft. longer than the pipe joint. The sleeve must cover the full length of the pipe joint, lap over 1 foot on each end of the adjoining pipe joints, and be secured

with a minimum of two circumferential turns of pressure sensitive polyvinyl tape. Excess material should be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe, and held in place by means of pieces of pressure sensitive tape at approximately 5-ft. intervals. After assembling the joint, the polywrap tube from the previously installed pipe must be pulled over the joint and secured by the Contractor. The polywrap tube from the new joint must be pulled over the first tube and secured by the Contractor to provide a double seal.

Cast iron and ductile iron fittings and valves must be completely wrapped in 8 mil thick polyethylene film with a minimum of a 1-ft. overlap on each end and appropriately taped. Laps must cover joints with adjoining pipe joints or fittings when installed. Also, the fire Hydrant barrel, from the surface to the valve, must be wrapped as specified herein.

Any damaged areas in the polyethylene film must be repaired by covering the area with a sheet of polyethylene film large enough to lap over the damaged area 1-ft. minimum in any direction and appropriately taped. Extreme care should be taken at service tap locations to ensure that the tape extends beyond the corporation and onto the service line pipe by a minimum of 1-ft.

Prior to placing pipe in the trench, a cushion of approved materials must be placed in the trench as required herein. Backfill material must be carefully placed on the pipe so as to avoid any damage to the polyethylene sleeve.

The Contractor should use care to protect and preserve the polyethylene wrap around ductile iron water mains when installing service corporations. The required method is to wrap pipe tape around the pipe over the polywrap in the area to be tapped. The tap is to be made through the tape and polywrap. It is not necessary to remove and replace poly wrap. All exposed pipe, the corporation, and the first 3-ft. of the service must be wrapped and taped to achieve a complete seal. In addition, a sand envelope must extend over and around the connection to a depth of eight inches above the main.

2.1.10.1.

Polyethylene Wrapping Material. Polyethylene wrapping material will be used to encapsulate all ductile and cast-iron fittings. Polyethylene wrapping for ductile and cast-iron fittings will consist of a 4 mil tubular section of cross-laminated high-density polyethylene, which has a high dielectric and tensile strength, for use in insulating cast-iron and ductile-iron pipe from the electrolytic action encountered in highly active soils. All iron pipe, fittings, and accessories must be wrapped with edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the pipe and the surrounding backfill. Repair all punctures with duct tape to restore the continuous protection before backfilling.

Polyethylene wrapping is to consist of opaque cross-laminated high-density polyethylene sheet continuously thermally bonded to form a tubular section. The tubes may be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 1 for size and length chart, in accordance with AWWA C-105 (Table 1) for minimum requirements. When supplied in specific pipe lengths, the tubes are to contain a minimum of 4-ft. over the actual pipe length to allow for overlap.

The polyvinyl sheet of film for the tubular wrapping is to be of virgin resins meeting raw and physical properties of ASTM D-1248 and AWWA C-105, latest edition. The material is to be 4 mil cross-laminated high-density polyethylene of uniform film thickness and be free of imperfections such as pin holes, etc., after being thermally seamed into tubular form. The finished product will have a nominal thickness of 4 mils, with tolerances of minus ten percent.

The material is to have no volatile constituents, the loss of which may affect ductility. The material is also to have the following properties:

- Mechanical: The polyethylene film is to have a tensile strength per latest ASTM D-882 test, of 6300 psi min. The film is to have an elongation of not less than 100% of the test strip per latest ASTM D-882 test. The film is to have an impact resistance 800 gram min per (ASTM D-1709 Method B). The film is to have a propagation tear resistance of 250 gf minimum in machine and transverse direction (ASTM D1922).
- Dielectric: The film is to have a dielectric strength of 800 volts per mil thickness per ASTM D-149.

Inspection and Certification by Manufacturer:

- *Quality control and inspection.* The manufacturer must establish the necessary quality control and inspection practice to ensure compliance with this standard.
- *Manufacturer's statement.* The manufacturer must provide a sworn statement on each lot purchased that the inspection and all applicable material requirements of Section 2.1.2.1. have been met and that all results comply with the requirements of this standard.
- *Freedom from defects.* All polyethylene film must be clean, sound, and without defects that could impair service.

The polyethylene film supplied should be clearly marked, at a minimum of every 2-ft. along its length, containing the following information.

- Manufacturer's name or trademark
- Year of manufacture
- ANSI/AWWA C-105/A21.5
- Minimum film thickness and material type.
- Applicable range of nominal pipe diameter size(s).
- Warning-Corrosion Protection-Repair any Damage.

The San Antonio Water System may at no cost to the Contractor, subject random testing by an independent laboratory for compliance with this Specification. Any visible defect of failure to meet the quality standards herein will be grounds for rejecting the entire order.

TABLE 1 - 4 MIL POLYETHYLENE WRAPPING MATERIALS	
SIZE & LENGTH (All sizes lay flat size)	
Pipe Size	Product Size Width x Length
4", 6" & 8"	20" x 200/500
8", 10" & 12"	27" x 200/500
16" & 18"	37" x 200/500
20"	41" x 200/500
24"	54" x 200/500
30"	67" x 140/500
36"	81" x 120/500
48"	95" x 100/500
54"	108" x 100/500

- 2.1.11. **Concrete Steel Cylinder Pipe.** Concrete Steel Cylinder Pipe must not be used.
- 2.1.12. **Pipe Testing.** All sanitary sewer pipe and fittings produced within the jurisdiction of the SAWS must be tested by SAWS-approved laboratory method at the source of supply. All shipments of pipe not so tested must be accompanied by a certificate of compliance to these specifications prepared by an independent testing laboratory and signed by a Texas licensed professional Engineer.
- 2.1.13. **Steel Casing Pipe.** Steel casing pipe must conform to ASTM A134 with a minimum thickness of 3/8 in; actual thickness should be as indicated on the plans.
- 2.1.14. **Stainless Steel Casing Spacer/Insulators.** This section covers casing spacers for use in wastewater collection. Casing spacers are used to facilitate installing a sewer pipe inside a casing pipe or tunnel. Casing spacers should consist of two or more segments of circular steel that bolt together forming a shell around the

carrier pipe(s). Casing spacers should protect the carrier pipe and any protective coating or wrapping from damage during the installation, and properly support and electrically isolate the carrier pipe(s) within the casing or tunnel. On occasion multiple carrier pipes may be installed in one casing or tunnel.

- 2.1.14.1. **General Requirements.** Please see the SAWS website for a list of approved stainless steel casing spacer manufacturers - http://www.saws.org/business_center/specs/product_submittal/, providing such casing spacers conform to the provisions contained herein.

Casing spacers should be 8-in. long for carrier pipes up to 16-in. diameter and 12-in. long for larger carrier pipe sizes. Manufacturer's approval in writing will be required for installations exceeding 300-ft. in length, carrier pipes in excess of 48-in. diameter or multiple carrier pipes in one casing or tunnel.

Casing spacers must have a minimum 14-gauge type 304 stainless steel band and 10-gauge steel riser when required. The band, risers and connecting studs must be welded and cleaned at the factory before the application of a fluidized bed fusion bonded PVC coating.

The fluidized bed fusion bonded PVC coating must be between 10-16 mils thickness. The PVC coating must provide good resistance to acids and alkalize and excellent resistance under ASTM B117 salt spray tests. The coating must have a minimum 1380volts/mil per ASTM D149-61 short time 0.010" test and a Durometer-shore A@ (10 sec) of 80 per ASTM D1706-61T. Epoxy coatings are not an acceptable alternative.

The spacers must have a flexible PVC liner of 0.09-in. thickness with Durometer "A" 85-90 hardness and a minimum 58,000- volt dielectric strength (60,000-volt minimum Surge Test.) Moisture absorption must not exceed 1%.

The runners must be of high pressure molded glass reinforced polyester with a minimum compressive strength of 18,000 psi per ASTM D695, flexural strength of 25, 300 psi per ASTM D790, tensile strength of 17,600 psi per ASTM D638 and Rockwell hardness (M) of 90 per ASTM D785. The riser should be designed and fabricated to place the runner (skid) in full contact with the inside surface of the casing pipe. This evenly distributes the load force to all support members. The ends of all runners must be shaped to resist hanging or sticking inside casing during installation of the carrier pipe. Polyethylene runners are not acceptable.

Runners should be a minimum of 1-in. in width and a minimum of 7-in. long for carrier pipes up to 16-in., and a minimum of 2-in. in width and 11-in. long for larger carrier pipes. Bolts on runners are not acceptable. The runners should be attached to the band or riser by 3/8 the wearing surface on the runner. The recess should be filled with a corrosion inhibiting filler. There must be 4 runners per casing spacer for carrier pipes up to 12-in. diameter, 6 runners for 14-in. through 36-in. and 8 or more runners for carrier pipes over 36-in. diameter. Number of bottom runners should be multiples of 2. Number of top runners should be multiples of 2.

Stainless steel casing spacers must be furnished with stainless steel studs, nuts and washers.

Casing spacers must have ample riser height to limit vertical movement of the carrier pipe in the casing. A minimum of 1-in. to 2-in. clearance should be provided between the top runner and the ID of the casing or tunnel.

Continuous operating temperatures for the PVC Coated Casing Spacers should not exceed 150°F. Stainless steel casing should be used in applications where continuous operating temperatures exceed 150° F.

Unless noted otherwise, casing spacers will be required on all carrier pipes installed in casing or tunnel applications.

- 2.1.14.2. **Quality Assurance.** All casing spacers are to be manufactured in accordance to NACE International Recommend Practice RP 0286 (Isolation Spacers). Each casing spacer must be manufactured in the USA at a facility that has a Registered ISO 9002 Quality Management System or be in the process of achieving this certification by March 2005. Non-compliance to this registered commercial quality system requirement by March 2005 will result in removal of the manufacturer's product from approved manufacturers.

If on receipt of casing spacers they are found to be non-compliant, the manufacturer must replace the defective casing spacer with a casing spacer that meets the San Antonio Water System's specifications, at no charge to San Antonio Water System.

If San Antonio Water System audits, product inspection and performance data review in accordance to these specifications determine excessive casing spacer Noncompliance, the manufacturer will be subject to removal by the Products Standard Committee. Copy of the current ISO 9002 registration (or written documentation of being "in the process of achieving ISO registration," prior to March 2005) must be provided with material submittal.

2.1.15. **Water Main Crossings.** Gravity or force main sewers constructed in the vicinity of water mains will comply with the requirements of the "Criteria for Domestic Wastewater Systems," 30 TAC 217.53, as adopted by The Texas Commission on Environmental Quality, latest revision.

2.2. **Manholes.** This item should govern the construction of standard sanitary sewer manholes complete in place and the materials therein, including manhole rings and covers. All material and construction work must be in accordance with current Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems (30 TCEQ § 217). All constructed manholes must be watertight and equipped with pre-tested and approved low leakage frames and lids. Sewer manhole ring and cover castings must meet the current requirements of AASHTO Designation M306-10.

2.2.1. For new concrete manholes, all concrete manhole components (cast-in-place or precast manhole base, precast risers, precast cone sections, cast-in-place or precast flat tops, and concrete "throat rings" as applicable) for new manholes must conform to the applicable requirements of ASTM Designation C478, except as modified in this Specification.

All concrete grout used for patching or other similar fill-in work will be of non-shrink type made with the Komponent® admixture specified above, or approved alternate, in accordance with the manufacturer's recommended formulation with Portland cement, fine aggregate, water, and water reducer to produce a compressive strengths of approximately 4,800 psi within 7 days and 7,250 psi within 28 days at a 70 °F baseline temperature.

Unless otherwise shown in the contract documents or approved by the Engineer, standard sanitary sewer manholes should be constructed with influent and effluent piping less than or equal to 24-in. in diameter with precast reinforced concrete manhole sections. A standard sanitary sewer manhole must be a single entrance cylindrical structure, having a minimum internal diameter of 4-ft. between the cone and base sections. The base of the structure must include the load bearing portion beneath and exterior of the structure, invert channels and the fill or bench portions adjacent to the lower sewer pipes within the structure. The maximum vertical height of the diameter adjustment section or cone will be 36-in. Adjustment or throat rings may be used for final elevation adjustment of the manhole ring and cover. Concrete encasement of the manhole's ring will be as shown in the plans. Specifically, they must attach the ring and cover to the diameter adjustment section or cone. Manholes which differ from the above description will be identified as "Manhole Structures" or "Doghouse Manholes".

An internal drop manhole will be required when sewer lines enter a manhole more than 24-in. above the manhole invert, while an external drop manhole will be provided for a sewer entering a manhole more than 30-in. above the invert. Both conditions will require prior approval by the Engineer.

2.2.2. **Manhole Structures.** Cast in place concrete structures or pre-cast concrete structures, as detailed on the plans, will be installed where any pipe intercepted is larger than 24-in. in diameter. All material and construction work must be in accordance with the Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewerage Systems (30 TAC § 217), or any revisions thereto as applicable. All structures must be watertight and coated with a SAWS-approved sewer coating.

2.2.3. **Doghouse Manholes.** Material for manholes will conform to the requirements of this specification and as shown on the plans. All material and construction work must be in accordance with current Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems (30

TCEQ § 217). All constructed manholes must be watertight and equipped with pre-tested and approved low leakage frames and lids. Sewer manhole ring and cover castings must meet the current requirements of AASHTO Designation M306-10.

The intent of the doghouse manhole is to construct the base of the manhole, cast in place, on existing sewer mains, in order to keep the main active during construction and reduce the time needed for bypass pumping. A section with a "doghouse" is to be installed on the base, unless otherwise shown on the construction documents, and remaining sections of manhole to be installed. All requirements of standard manholes are applicable to doghouse manholes. Testing requirements within the EARZ are the same as those for standard manholes, as described in the specifications and the construction documents.

2.2.4. **Precast Reinforced Concrete Manhole Sections.** Precast reinforced concrete manhole sections must conform to the requirements of ASTM Designation C478-12a.

2.2.5. **Manhole Ring and Cover.** The manhole ring and cover must be of ductile iron or gray cast iron construction. The cover must be solid with no vent or pick holes; hinged with underlying special hinge area leakage protection; the cover secured with 4 stainless steel bolts; and must have a recessed "pick bar" for cover opening. Cam lock type covers will not be allowed. Approved SAWS manufactures, have previously completed required inflow leakage shop testing and have met a maximum allowable leakage rate criterion of 1 gallon per minute at 12-in. of water submergence above the manhole cover. Rings and covers must be furnished from the SAWS approved manufacturers list with the specified features. Please see SAWS website for a list of approved manufacturers and required features - http://www.saws.org/business_center/specs/product_submittal/.

All covers must have the words "SAN ANTONIO WATER SYSTEM Sanitary Sewer" cast thereon. Ring and cover must have the specified foundry's name, part number, country of origin preceded by "Made in" (example: MADE IN USA) in compliance with the country of origin law of 1984, and production date (example: mm/dd/yy) for tracking purposes. Each casting must be marked with DI (ductile iron) and ASTM A536 or A536-80-55-06 or CI (cast iron) and ASTM A-48, Class 35B to verify the materials used. Castings without proper markings will be rejected.

Four (4) bolts of 1/2-in. diameter x 13 thread pitch will be used to secure the cover. Bolts must be of stainless steel, grade 304 or better. The top of the cover must have a recessed area around each bolt assembly to accommodate the washer diameter and thickness and bolt head height so that the bolting assembly does not exceed the top of the manhole cover. Where cover bolts directly thread into the underlying cast iron frame, the bolt threads must be thoroughly coated with Nikal Jet Lube product, as manufactured by CSW Industrials Company or approved alternate before insertion to avoid subsequent "seize up" from dissimilar metals. If such bolts are removed for any purpose, the threads must be recoated. Stainless steel bolts that are threaded into stainless steel nuts within recessed slots in the underlying frame optionally do not require an anti-seize coating of the bolt threads.

2.2.6. **Throat Rings.** Throat rings must be made of either HDPE or reinforced concrete and have a maximum thickness of 2-in. The internal diameter must match that of the ring and cover's opening. Concrete must conform to the provisions of Concrete (Class "A"), TxDOT Item No. 421 Hydraulic Cement Concrete. If concrete throat rings are to be utilized, they must be used in conjunction with a UV stabilized polyethylene liner for the purpose of providing an infiltration/inflow (I/I) barrier. The I/I barrier must be as manufactured by Strike Tool Products of Cannon Falls, MN and must meet the following ASTM standards: ASTM D790 for flexural properties; ASTM D1505 for density; ASTM D1238 for Melt Flow Index; ASTM D638 for tensile strength at yield (50mm/mm); ASTM D790 for flexural modulus; ASTM D648 for heat deflection temperature at IGEPAL; and ASTM D693 for EsCR, 100% IGEPAL/10% IGEPAL. A minimum of two and a maximum of six "throat rings" may be used at each adjusted manhole. "Throat rings" are limited to a minimum of two and a maximum of four rings for new manhole construction.

2.2.7. **Bitumastic Joint Sealant.** To be applied between cones, risers, adjustment rings, flat tops, and between the ductile or gray cast iron ring (frame) and the uppermost adjustment ring or flat top: RAM-NEK, as manufactured by Henry, Inc.; Kent Seal, as manufactured by Hamilton Kent, Inc.; Encapseal, as manufactured by Miller Pipeline Corporation; or approved alternate.

2.2.8. **Interior Coating.** All manholes must be watertight and coated with a SAWS approved sewer coating. Prior to coating, all manholes must be vacuum tested, and approved. For new and rehabilitated manholes, apply a combination of both products with the cementitious coating first, followed by the epoxy coating. Please see SAWS website for a list of approved manufacturers and required features - http://www.saws.org/business_center/specs/product_submittal/.

2.3. **Glass-Fiber Reinforced Polyester (FRP) Manholes.** This item must govern the construction of FRP sanitary sewer manholes, complete in place and the materials therein, including manhole ring and covers. All material and construction work must be in accordance with current Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems (30 TCEQ § 217), or any revisions thereto as applicable. All constructed FRP manholes must be watertight. Sewer manhole ring and cover castings, throat rings, and miscellaneous specifications and details must meet the current requirements of AASHTO Designation M306- 10 and "Manholes" section of this specification.

All manholes must be watertight. Glass-Fiber Reinforced Polyester Manholes must be a one-piece monolithic designed unit constructed of glass-fiber reinforced, supplier-certified, unsaturated isophthalic polyester resin containing chemically enhanced silica to improve corrosion resistance, strength and overall performance. FRP manholes must be manufactured in strict accordance with ASTM D3753- 12.

For a UV inhibitor, the resin on the exterior surface of the manhole must have gray pigment added for a minimum thickness of 0.125-in.

Manholes must be a circular cylinder, reduced at the top to a circular manway not smaller than 30-in (inside diameter). Manholes must also be produced in whole foot increments of length +/- 2-in. Nominal inside diameter must be 48-in. Tolerance on the inside diameter must be +/- 1%. The minimum wall thickness for all FRP manholes (all depths) must be 0.50-in. Unless otherwise shown in the contract documents or approved by the Engineer, standard sanitary sewer FRP manholes must be constructed on influent or effluent pipes less than 24-in. in diameter. The maximum vertical height of the diameter adjustment section or cone must be 36-in.

The manway reducer must provide a bearing surface on which a standard ring and cover may be supported and adjusted to grade. The reducer must be joined to the barrel section at the factory with resin and glass fiber reinforcement, thus providing the required monolithic design to prevent infiltration and/or exfiltration through the manhole.

Manholes must be manufactured in one class of load rating. This class must be AASHTO H-20 wheel load.

Several methods exist that may be used to connect primary and secondary lines to manholes, and these must be performed per the Engineer's request. The most common of these methods include: installation of SDR PVC sewer pipe stub-outs to the manhole, Kor-N-Seal boots, or Insert-a-Tee fittings in the manhole wall. Installation of SDR PVC sewer pipe must be performed by sanding, priming, and using resin fiber-reinforced hand lay-up. The resin and fiberglass must be the same type and grade as used in the fabrication of the fiberglass manhole. Kor-N-Seal boots may be installed by the manhole manufacturer using fiberglass reinforced pipe stub-out for Kor-N-Seal boot sealing surface. Insert-a-Tee fittings may be installed only with the approval of the Engineer, and must be installed per the manufacturers' instructions.

Manholes are required to have a resin fiber-reinforced bottom. Deeper manholes (> 6 ft) may require a minimum of two 1½-in. deep x 3½-in. wide stiffening ribs, completely enclosed with resin fiber-reinforcement. All fiberglass manholes with a fiberglass bottom will have a minimum 3-in. anti-flotation ring. Manhole bottoms must be a minimum ½-in. thick.

All manholes must be marked in letters no less than 1-in. in height with the manufacturer's name or trademark, manufacturer's factory location, manufacturer's serial number, manhole length, ASTM designation, and installation assist marks (vertical lines 90 degrees apart at base of manhole).

Manhole ring and covers must be as described in these specifications for new manholes.

Mortar must be composed of 1 part Portland Cement, 2 parts sand and sufficient potable water to produce a working mixture.

All membrane curing compound must conform to the provisions of TxDOT DMS-4650, "Hydraulic Cement Concrete Curing Materials and Evaporation Retardants."

- 2.4. **Existing Manhole Adjustments.** This item will govern the adjustment of all existing manholes, to include the replacing of existing manhole covers and rings regardless of type shown in the contract documents and in conformity with the provisions of these specifications or as directed by the Engineer. All material and construction work must be in accordance with current Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems (30 TCEQ § 217), or any revision thereto as applicable. All manholes must be watertight and coated with a SAWS-approved sewer coating. The context of this specification is limited to replacing the existing manhole ring and covers and adjusting the final elevation of the manhole by the maximum or minimum number of throat rings. All manholes requiring adjustments beyond the maximum or minimum number of throat rings (described herein), will be subject to reconstruction under the "Existing Manhole Reconstruction" section.

2.4.1. **Manhole Rings and Covers (if replaced).** As described in this Specification.

2.4.2. **Concrete Throat Rings (if needed).** As described in this Specification, including infiltration/inflow barrier.

2.4.3. **Bitumastic Joint Sealant.** As described in this Specification.

- 2.5. **Reconstruction of Existing Manholes.** This item will consist of the reconstruction of all existing manholes, all types and sizes, to include the replacement of manhole ring and covers, the cones, manhole section(s) required regardless of type shown in the contract documents and in conformity with the provisions of these specifications. All material and construction work must be in accordance with current Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems (30 TCEQ § 217). All reconstructed manholes must be watertight and coated with a SAWS-approved sewer coating. Existing Monolithic Manholes are not to be reconstructed, but fully replaced with a new manhole in accordance with this Specification.

Materials used in manhole reconstruction (concrete, precast reinforced concrete manhole sections, grout, manhole ring and cover, throat rings, bitumastic joint sealant, and interior coating) must be per the requirements for new manholes described in this Section.

- 2.6. **Existing Manhole Adjustments.** This item will govern the adjustment of all existing manholes, to include the replacing of existing manhole covers and rings regardless of type shown in the contract documents and in conformity with the provisions of these specifications or as directed by the Engineer. All material and construction work must be in accordance with current Texas Commission on Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems (30 TCEQ § 217), or any revision thereto as applicable. All manholes must be watertight and coated with a SAWS-approved sewer coating. The context of this specification is limited to adjusting the final elevation of the manhole by the maximum or minimum number of throat rings. Manhole rings and covers must be in conformance with these specifications. Sewer manhole ring and cover castings must meet the current requirements of the American Association of State Highway and Transportation Officials (AASHTO) Designation M306-10. All manholes requiring adjustments beyond the maximum or minimum number of throat rings (described herein), will be subject to the requirements of "Existing Manhole Reconstruction."

Manhole ring and covers will be replaced with new ring and covers under this item. Concrete throat rings with liners, joint sealant, and other materials described under manholes in this specification will be used as necessary to adjust the manholes.

- 2.7. **Reconstruction of Existing Manholes.** This item will consist of the reconstruction of all existing manholes, all types and sizes, to include the replacement of manhole ring and covers, the cones, manhole section(s) required regardless of type shown in the contract documents and in conformity with the provisions of these specifications. All material and construction work must be in accordance with current Texas Commission on

Environmental Quality (TCEQ) rules to include: Design Criteria for Sewage Systems (30 TCEQ § 217). All reconstructed manholes must be watertight and coated with a SAWS-approved sewer coating. Sewer manhole ring and cover castings must meet the current requirements of AASHTO Designation M306-10. Existing Monolithic Manholes are not to be reconstructed, but fully replaced.

Manhole ring and covers, cover gaskets, concrete throat rings with liners, joint sealant, interior coating, and other materials described under manholes in this specification will be used as necessary in the reconstruction of existing manholes item.

- 2.8. **Sanitary Sewer System Cleaning.** The Contractor must furnish all labor, equipment, and materials necessary for cleaning the sanitary sewer system, including the removal of all debris/solids, sand, grease, grit, rock, etc. from the sewer mains, manholes, or structures to facilitate television inspection.
- 2.8.1. **Preparation.** The Contractor must only use the type of cleaning identified in Section 4 of this Specification for Cleaning Manholes and Mains to perform the necessary removal of all material which will not create hazards to health, property, affect downstream treatment plant processes, or damage to the sanitary sewer system.
- 2.9. **Concrete.** All concrete is to meet the requirements of TxDOT Item 421, "Hydraulic Cement Concrete". Unless otherwise shown on the plans or required by this specification, all concrete will be Class A.
- 2.10. **Mortar.** Mortar must be composed of 1 part Portland Cement, 2 parts sand and sufficient water to produce a workable mixture. When used to plaster manholes, it may be composed of 1 part cement to 3 parts sand. Lime up to 10% may be used. It will have a consistency such that it can be easily handled and spread.
- 2.11. **Reinforcing Steel.** Reinforcing steel and the placing thereof is to conform to the requirements of TxDOT Item 440, "Reinforcing Steel", except where welded wire is called for on the plans, the material will be welded wire flat sheets meeting A.S.T.M. A-185. Welded wire rolls will not be used.
- 2.12. **Cement Stabilized Backfill.** Cement stabilized backfill is to be in accordance with TxDOT Item 400, "Excavation and Backfill for Structures."
- 2.13. **Flowable Backfill.** When indicated on the plans, the trench is to be backfilled to the dimensions shown with flowable backfill. The flowable backfill with fly ash will be Mix Design Type B in accordance with TxDOT Item 401, "Flowable Backfill", or an acceptable mix as approved.
- 2.14. **Grout.** When shown on the plans for various applications, the grout is to be a cement/sand/water mixture as approved. It will have a consistency such that it will flow into and completely fill all voids.
- 2.15. **Sewer Main Television Inspection.** The Contractor must furnish all labor, materials, equipment, and incidentals to provide the televising and a NASSCO-(PACP) standard video, recorded in MPEG-1 format and written to DVD video of sewer lines and manholes utilizing a color, closed-circuit television inspection unit to determine their condition. The video should include an inclinometer, visible on the video being viewed, noting the slope of the main being televised.

After completion of the work specified in the contract documents, and prior to placement of the final course of asphalt or other final surface, the newly constructed or rehabilitated sanitary sewer main must be televised immediately upon cleaning. Televising must be observed by the Inspector or Engineer and Contractor, as the camera is run through the system. Any abnormalities such as, but not limited to, misaligned joints, cracked/defected pipe, rolled gaskets, must be repaired by the Contractor solely at his expense. Sections requiring repair must be re-televised to verify condition of repair. No additional compensation will be provided for all needed repairs, re-cleaning, or re-televising efforts.

The Contractor must provide a DVD and log of the televised system for review and approval by the Inspector. If the Contractor provides a DVD of such poor quality that it cannot be properly evaluated, the Contractor must re-televising as necessary and provide a DVD of good quality at no additional cost to SAWS. If the

Contractor cannot provide a DVD of such good quality that can be reviewed by SAWS, SAWS may elect to televise the line at the Contractor's expense.

The television unit must also have the capability of displaying in color, on DVD, pipe inspection observations such as pipe defects, sags, points of root intrusion, offset joints, service connection locations, and any other relevant physical attributes. Each DVD must be permanently labeled with the following:

- Project Name
- Date of Television Inspection
- Station to Station Location and Size of Sanitary Sewer
- Street/Easement Location
- Name of Contractor
- Date DVD Submitted
- DVD Number
- SAWS Inspector Name

The Contractor must provide a line diagram area sketch and written log for each completed segment of DVD sewer main describing the section being televised, flow and camera direction, position of service connections, description and location of failures, pipe condition, weather conditions, and other significant observations.

The television inspection equipment must have an accurate footage counter which displays on the monitor the exact distance of the camera from the center of the starting manhole. A camera with rotating and panning lens capabilities is required. The camera height should be centered in the conduit being televised. The speed of the camera through the conduit must not exceed 40 ft per minute. The produced video must also have an inclinometer that displays the slope of the sewer main being televised.

The Contractor will be required to have all materials, equipment, and labor force necessary to complete all videotaping on the job site prior to isolating the sewer manhole segment and beginning videotaping operations.

Television inspection will be done one section between two manholes at a time. Also, the flow in the section being televised must be bypassed if the line is in service and the flow exceeds 25% of the internal pipe diameter. When the depth of flow at the upstream manhole of the manhole section being worked is above the maximum allowable for television inspection, the flow can be reduced to allowable levels by performing bypass pumping, as approved by the Inspector.

The Contractor will not be allowed to float the camera. There may be occasions during the televised inspection of a manhole section when the camera will be unable to pass an obstruction. At that time, and prior to proceeding, the Contractor must contact the Inspector. If the length of sewer line cannot be televised because of obstructions, the Contractor must clean the system as is necessary. If, in the opinion of the Inspector, the obstruction is attributed to a collapsed main or pipe deflection, televising will be suspended, payment will be made based on the actual televised length, and the remaining televising of the sewer line will be continued upon successful correction of the blockage by the Contractor at his expense. No additional payment will be made for additional setups required due to obstructions encountered during televising.

No lateral connections should be made to the sanitary sewer main at the "12 o'clock" position. All lateral connections should clearly indicate which side of the sanitary sewer main it was installed from.

The Contractor is solely responsible for any damage of sewer mains as a direct result of televising operations. Any repair will also be the responsibility of the Contractor.

The method(s) used for securing passage of the camera are at the discretion of the Contractor, and as approved by the Inspector.

No sanitary sewer main televising effort will commence until all pertinent permits or required approvals have been obtained by SAWS.

No separate and/or additional payment will be made for any excavation, man entry, or any other method which may be required to retrieve video equipment that may have been hung up, destroyed, and/or lost during the operation.

- 2.16. **Air Release Assemblies for Wastewater.** Valves furnished under this specification must conform to ANSI/NSF Standard 60 for direct additives and ANSI/NSF Standard 61 for indirect additives. Cast Iron Valve Body and cover must be in accordance with ASTM A48-35 or ASTM A126 class B. Non-Metallic Valve Body must be fabricated from fiberglass reinforced nylon. Inlet sizes through 2 in must be screwed (NPT). Pipe sizes 3" and above must have flanged inlets (125# ASNSI B 16.1). A protective hood or cowl must be installed on the outlet of flange-bodied valves.

Metallic Internal seat trim float arm and pivot pin must be stainless steel type 303, 304 or 316. Metallic Floats must be stainless steel ASTM A 240. Other stainless steel metal internal parts must be stainless steel ASTM A240 or ASTM A276.

Non-metallic floats will be foamed polyethylene with stainless steel type 316 fasteners.

Valves requiring Internal seats or orifice buttons must be Buna-N rubber compounded for water service. For valves requiring cover gaskets, the cover gasket must be composition type, equal to Armstrong CS-231, Garlock 3000, or Lexide NK-511. If an O-Ring is used to seal the cover, it must be on NSF 61 certified rubber. Cover bolts must be alloy steel. Rolling seals must be furnished for non-metallic valves 2" and below.

Valve Body will have a test pressure rating of 300 psi and working pressure rating of 150 psi.

The air release valve should be designed to vent accumulated air automatically. The outlet orifice must be properly sized to facilitate valve operation at pressures up to 150 psi. The air release valve must be simple-lever, compound-lever, ball and orifice or rolling seal depending upon volume requirements and the design of the valve.

The air and vacuum valve should be designed with the inlet and outlet of equal cross-sectional area where applicable. The valve must be capable or automatically allowing large quantities of air to be exhausted during the filling cycle an also capable of automatically allowing air to re-enter the system to prevent a negative pressure at water column separation or during the draining cycle. The float must be guided to minimize premature closure by air and to provide proper alignment for normal closure by floating on the water surface.

Combination air and vacuum relief valves should provide for both automatic air release under system pressure and to allow air movement during filling or draining operations, or water column separation. The combination valve may be housed in a single casting. The housing must be designed to incorporate conventional or kinetic flow principles to properly vent the air without premature closure. Flanged sized (4 inch and larger) may be furnished in a dual housing. When dual casings are used a bronze manual isolation valve must be installed if indicated by the manufacturer. This will allow the air release valve to be serviced when the system is under pressure. Field service of the valve may also be performed by closing the isolation valve between the air valve and the pipe connection.

The San Antonio Water System may, at no cost to the manufacturer, subject random valves to testing by an independent laboratory for compliance with these standards. Any visible defect or failures to meet the quality standards herein will be grounds for rejecting the entire order.

The manufacturers must provide certification that products furnished under this specification are manufactured in an ISO 9001 certified facility or documentation from an accredited facility that ISO 9001 certification is in process.

- 2.17. **Point Repairs & Obstruction Removals.** Repair of sanitary sewer lines by replacing short lengths of failed pipe with new pipe. Repair of service laterals located within the utility easement or street right-of-way, when

replacing short lengths of failed pipe with new pipe. Obstruction removal by remote device or excavation. Use pipe material for repairs in accordance with "Sanitary Sewer Pipe" of this Specification. If point repair is located at a service connection, use a full-bodied fitting for the service connection. No field fabrication of fittings allowed. For joining to existing pipe, use flexible adapters secured with ½ inch stainless steel bands, as manufactured by Fernco, or approved equal. All flexible adapters must be concrete encased to prevent movement or breakage of the steel bands.

2.18. **Rehabilitation of Sanitary Sewer by Cured-In-Place Pipe (CIPP) (Hot Water or Steam Cured).**

This specification includes requirements to rehabilitate existing sanitary sewers by the installation of a resin-impregnated flexible tube, which is formed to the original conduit. The lining is inserted via an existing manhole or other access and, depending on the system selected, is installed using one of the following insertion methods:

- Water inversion – where the lining is inverted under the pressure of water, and cured by circulating hot water.
- Winched insertion – where the lining is winched into place and inflated against the sewer wall by either a removable bladder inverted into the lining under the pressure of water or a pre-positioned bladder, which is simply inflated. Curing is accomplished using circulated hot water.
- Air inversion – where the lining is inverted under the pressure of air and cured by introducing steam.

2.18.1. **Tube.**

The tube must consist of one or more layers of absorbent needled felt fabric or an equivalent non-woven or woven material, or a combination thereof which meets the requirements of ASTM F1216 or ASTM F1743, Section 5. The tube must be constructed to withstand installation pressures and curing temperatures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

The impregnated tube must have a uniform and homogenous thickness that when compressed at installation pressures will meet or exceed the design thickness.

The tube must be sized that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion.

The outside layer of the tube (before wet out) must be coated with an impermeable, flexible membrane that will contain the resin and facilitate monitoring of resin saturation during the resin impregnation (wet out) procedure.

The tube must be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material should be included in the tube that may cause delamination in the cured CIPP. No dry or unsaturated layers should be evident.

The wall color of the interior pipe surface of CIPP after installation should be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.

Seams in the tube must be stronger than the un-seamed felt and meet the requirements of ASTM D5813.

The outside of the tube must be marked for distance at regular intervals along its entire length, not to exceed 5-ft. Such markings must include the manufacturer's name or identifying symbol. The tubes must be manufactured in the USA.

2.18.2. **Resin.**

The resin system must be a corrosion resistant polyester, vinyl ester, or epoxy and catalyst system. When properly cured, the tube composite meets the requirements of ASTM F1216, ASTM F1743 and ASTM F2019, the physical properties herein, and those that are to be utilized in the design of the CIPP for this

project. The resin must produce CIPP that will comply with the structural and chemical resistance requirements of this specification.

2.18.3. Structural Requirements

The CIPP must be designed as per ASTM F1216, Appendix X1. The CIPP design should assume no bonding to the original pipe wall.

The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed by his Company. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (Tube and Resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Values in excess of 50% will not be applied unless substantiated by qualified third party test data. The materials utilized for the contracted project must be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in design.

The layers of the cured CIPP must be uniformly bonded. It must not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If separation of the layers occurs during testing of field samples, new samples will be cut from the work. Any reoccurrence may cause rejection of the work.

The CIPP must be classified as conforming to the following minimum structural properties for a cured composite:

- Modulus of Elasticity (per ASTM D790 - short term) – 250,000 psi
- Flexural Strength (per ASTM D790) – 4,500 psi
- Compressive Strength (per ASTM D695) – 6,500 psi
- Tensile Strength (per ASTM D638) – 3,500 psi

The required structural wall thickness must be based as a minimum on the physical properties listed above, the design equations in ASTM F1216, Appendix X1 (as referenced by ASTM F2019), and the following design parameters:

- Pipe condition: Fully deteriorated.
- Minimum design safety factor: 2.0.
- Percentage ovality of original pipe: 2.0%.
- Soil density: 120 lbs/cf.
- Traffic Loads: HS-20-44 per AASHTO highway loading.
- Soil Modulus: 500 psi.
- Groundwater depth must be ground surface at a minimum or the elevation of the 100 year floodplain water surface, whichever is greater", in order to account for all reasonable anticipated future loadings.
- Long Term Flexural Modulus Retention: 50%
- Soil depth: maximum distance in feet measured between the crown of the pipe and the highest point of soil cover over the length of continuous CIPP section.
- The liner must be designed for a minimum fifty-year service life under continuous loading conditions.

Contractor must submit design calculations in accordance with ASTM F1216 that substantiate the CIPP wall thickness for each continuous length of CIPP installed. The required CIPP wall thickness must be uniform from CIPP start point to CIPP finish point with no deviation in thickness.

Acceptable manufacturers must have approval through SAWS Standards Committee prior to product use and must meet all requirements set forth in this Specification.

- 2.19. **By-Pass Pumping – Small Diameter Sanitary Sewers.** The work covered by this item consists of bypass pumping operations for existing sanitary sewers less than 24-in. in diameter in order to temporarily reroute sanitary sewer flows to prevent a sanitary sewage overflow (SSO) and to provide adequate and reliable sanitary sewer flow at all times during construction, while the tasked scope of work is executed. The work also covered in this item is for the use of inflatable and mechanical pipe plugs. The use of inflatable / mechanical plugs in the water and sewer industry is the standard method to temporarily plug a pipe where permanent flow control devices are not available or are not operating as designed. An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others, do not use it.

This item includes all requirements for implementing a temporary pumping system for the purpose of diverting sanitary sewage flow around any construction-related activity to an approved reintroduction point within the sanitary sewer system. The Contractor must minimize the health, safety, and regulatory risks by taking all reasonable measures to avoid an SSO. Therefore, SAWS requires the Contractor to manage the flow of wastewater in a planned and proactive manner. Contractor will be fully responsible for all damages and costs related to the installation, modification of existing manholes/structures, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Bypass pumping systems must be stationary systems consisting of portable pumps, piping, and appurtenances unless a "pump and haul" bypass system is accepted by SAWS. Pump and haul bypass systems can use a relay system of vacuum trucks using a pump and haul approach to bypass sewage flows. Where pump and haul bypass systems are allowed the Contractor may elect to submit using a pump and haul bypass system for these locations or to use a stationary bypass system. All bypass systems must comply with all the requirements of this section unless specifically noted otherwise.

The Contractor will be responsible for the design of the bypass pumping plan and system. Contractor's bypass pumping system design must be developed based upon the requirements of the Contract Documents.

The bypass system must meet the requirements of all codes and regulatory agencies having jurisdiction

Pump and haul bypass systems will not be allowed within the Edwards Aquifer Recharge Zone (EARZ) or for larger sanitary sewers with significant sewage bypass flows. Contractor must provide for temporary measures to convey sewage flows and avoid sewage spills should a storm event occur that generates sanitary sewer flows in excess of Contractor's bypass pumping system.

- 2.19.1. **Submittals.** All submittals must be in accordance with Owner's requirements and must be acknowledged by Owner prior to delivery.

For all projects requiring bypass pumping, the Contractor must prepare and submit a Bypass Pumping Plan (BPP). The BPP must be submitted a minimum of two weeks prior to commencing any portion of the proposed scope of work and must be acknowledged by SAWS prior to beginning Work. The BPP must be signed and sealed by a professional Engineer licensed in the State of Texas (Contractor's Engineer).

Contractor must submit manufacturer's product data, instructions, recommendations, shop drawings, and necessary certifications in order for the proposed BPP to be reviewed and acknowledged.

The following must be submitted as part of the BPP:

- A cover letter containing the following information. The project name and job number. The name and address of the Contractor. Contact information of the Contractor's project manager, superintendent, foreman/supervisor, safety professional, etc. A description and location of the planned bypass pumping work to be performed; include data for stationary and pump and haul bypass systems as applicable.
- Emergency ("24/7") contact information for the bypass pumping Sub-Contractor, if applicable. Make sure to include the name, cell phone number, and title of the person(s) onsite responsible for the bypass pumping operation.

- The name, phone number, title, signature, and PE seal of the Contractor's Engineer preparing the BPP.
- Copies of permits or other documents showing the Contractor has obtained all clearances necessary for installation and operation of the BPP.
- If Contractor elects to use a combination of stationary bypass pumping and pump and haul for his bypass system, Contractor's BPP must identify the quantity of flows that will be pumped and pumped and hauled for each type of bypass system along with the points where flows will be removed and reintroduced into the sanitary sewer system.
- Certificate of Compliance that the BPP complies with all SAWS and regulatory requirements and that all components have been designed by a professional Engineer licensed in the State of Texas. The Contractor's Engineer will review all components of the submitted BPP for adequacy to the Contractor's selected design flow conditions and insure that all bypass pumping system components are of adequate size, strength, meet the reliability criteria specified herein.
- A description of the maximum amount of sanitary sewer flows to be bypassed by the Contractor's bypass pumping system and how the flow conditions will be monitored during system operations (including all flow measurement devices, calculations, equipment, or other sources of how data was obtained). If the bypass plan is not based on the maximum wet weather flow in the sanitary sewer, this description must include an explanation for how the Contractor plans to monitor the weather for potential flows exceeding his bypass system capacity and how he will avoid having to bypass during wet weather events exceeding his bypass system capacity.
- Descriptions of all proposed bypass pumping components to be used. If applicable, describe all different bypass pumping phases. Include bypass pump(s) size(s) and capacity, as well as the size(s) and capacity of the suction/discharge piping. The description should also include manhole(s)/structure(s) depth(s) and size(s) that will be used during the bypass pumping operation, sanitary sewer plugging method and type of plugs to be used, flowmeter installation locations, etc. Contractor must provide SAWS with adequate prior notification to allow SAWS to witness installation and removal of all plugs.
- The date and time the bypass pumping is expected to begin and be completed. Indicate if bypass pumping will take place outside normal work hours which are between 8 am to 5 pm Mondays through Fridays (except for SAWS observed holidays). Contractor must reimburse SAWS for the overtime costs required by his bypass pumping testing outside of SAWS normal work hours.
- The pump curves, showing operating range. This must include the proposed system curve, addressing the pump operation in relation to the suction/discharge piping's alignment with respect to restriction and/or elevations.
- Suction and discharge piping material(s) and capacity to be used for the bypass pumping operation, including the material(s) for any bend(s) and/or valve(s) that will be used.
- A sketch showing the location of the pump(s) and the route of the suction, and discharge piping. If Contractor elects to use locations outside of the easements obtained by SAWS, Contractor will be solely responsible for obtaining the required easements and written documentation required for use of these locations. The sketch should be dimensioned and all-inclusive showing all SAWS manhole numbers that will be used for suction and discharge operations. If any other structure will be used for suction and/or discharge operations, then the nearest manhole(s) should be labeled. The sketch should include the name of any streets and/or major intersection in the area. All features possibly affected by the alignment of the BPP's components (driveways, vehicular traffic, residential or commercial dwellings (due to noise) should likewise be addressed. For pump and haul systems the sketch should show the location of all system components along with the staging areas, haul routes, and an explanation of the expected cycle time of all aspects of the operation.
- Clear photographs of the manhole(s) interior that will be used for the bypass pumping operation, including pole camera photographs of pipes where plugs will be installed. All photographs will be labeled with the manhole number, date, and intended use of the manhole by the Contractor's BPP.
- A Traffic Control Plan that pertains solely to the bypass pumping operations. This may differ than the project's traffic control plan for the overall scope of work. The Traffic Control Plan should include all

required permits including street cut permits. Contractor must maintain pedestrian and vehicular traffic and comply with ADA regulations for access to all residential and commercial property unless written approval is otherwise obtained from the property owner allowing for reduced access.

- An Emergency Plan detailing procedures to be followed in the event any portion of the bypass operation fails and causes either surcharging or an actual SSO. Contractor is herein advised that:
 - The existing sanitary sewer system may surcharge during certain storm events. The Contractor's BPP must recognize this potential and accommodate it with sufficient bypass capacity, restoration of flow through the sanitary sewer system, or other measures acceptable to SAWS during these flow events. These measures must be included in the submitted BPP.
 - The Contractor's BPP cannot cause any excess surcharging (beyond that normally occurring within the existing sanitary sewer system at that flow event) that results in damage or SSOs.
 - Any damage or SSOs during bypass pumping operations resulting from Contractor's bypass system will be deemed a failure of BPP, and the Contractor must re-propose an improvement to their BPP for review and acknowledgment. A sanitary sewer surcharge is herein defined as any flows entering the manhole or structure (above the crown of the pipe). Excessive sanitary sewer surcharges are higher than normally occurring levels of surcharge levels resulting from the Contractor's BPP that result in damage or SSOs. Contractor will be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.
 - Contractor to include minimum equipment on hand for implementing and emergency plan. (i.e. spare pump, emergency power source.)
- Where bypass piping is installed within the floodplain of waterways subject to flooding, the Contractor must submit an anchorage plan and calculations to ensure that piping is properly anchored. The pipe must be capable of remaining in place during a 100-year storm event. Anchorage plan and calculations must be designed and sealed by a professional Engineer licensed in the State of Texas (Contractor's Engineer). This must be the same PE that sealed the BPP Certificate of Compliance.
- For pump and haul system, submit copy of Hauler's Transporter Registration as issued by TCEQ under 30 TAC Chapter 312, Subchapter G.
- For pump and haul system, submit information on licensed disposal site to be used by the Contractor
- Submit the checklist found at the end of this document confirming that all items required by this section are included in the BPP submittal.

2.19.2.

Equipment & Materials. The Contractor must provide all necessary pumping equipment, piping and all other necessary appurtenances in order to maintain adequate and reliable sanitary sewer flow in the sanitary sewer system (including any temporary manholes) at all times during construction for stationary pumping and pump and haul bypass pumping systems. All materials, equipment, etc., must be in good condition, and should not have visible damage such as cracks, holes, foreign material, blisters, etc.

Plugs must be selected and installed according to the size of the line to be plugged. Plugs must be adequately secured and anchored to prevent plug movement or escape into the adjoining sanitary sewers should the plug fail. An additional plug (for each size of plug used) must be onsite and ready to be installed in the event a plug fails or becomes dislodged. Plug(s) will be visually examined by the Inspector and/or Engineer for defects that might lead to failure prior to being installed. Contractor must immediately locate and remove any plug that has shifted its position, slipped within the pipe, dislodged, moved, or otherwise provided an indication that its suitability for use in plugging may be suspect or compromised. Contractor must notify SAWS of any plug that has provided an indication that its suitability for use in plugging may be suspect or compromised and allow SAWS to observe plug removal and replacement. It is also imperative that the Contractor notify the Inspector at the completion of the work in order to verify that all plugs have been removed from the system.

- The Contractor must provide all necessary equipment, plugs, hoses, gauges and necessary appurtenances to install the plug, maintain the plug during use and remove the plug at completion.

- All plugs must be in good condition, and must not have visible damage such as cracks, holes, tears, cuts, punctures, abrasions, loose or damaged fittings, cracks in castings and excessive wear.
- All plugs 15-in. and larger must have an air release valve for rupture protection.
- If the plug is damaged, it must be immediately removed from the job-site.
- Contractor must be aware of the limitations associated with plugs.

Stationary bypass pumping systems must consist of:

- High-Density Polyethylene (HDPE) is the preferred pipe material for all bypass piping. HDPE must be used when bypass discharge pipe will be going through streams, storm water culverts, the Edward's Aquifer Recharge Zone, and/or environmentally sensitive areas. At other locations, not within the Edward's Aquifer Recharge Zone, flexible discharge hose that is in good condition and does not leak, may be allowed subject to it acceptably passing testing.
- HDPE pipe must be assembled and joined using couplings, flanges or fusion welding in order to avoid joint leakage.
- HDPE fusion welding must be performed by personnel certified as fusion technician(s) by the manufacturer of HDPE pipe and/or fusing equipment. SAWS will examine welds prior to use in BPP operation.
- BPP must indicate the proposed DR of the pipe to be used.
- Rigid suction hose that is in good condition and does not leak may be allowed for withdrawal of flows from the suction point into the bypass pumps. Pipe material other than HDPE must be submitted to SAWS for approval. Neither "Irrigation type" pipe nor glued PVC pipe will be permitted.
- Any hoses or pipes that leak must be removed and replaced with non-leaking hoses or pipes.
- Pumps must be fully automatic self-priming units that do not require the use of foot valves or vacuum pumps to prime the system. No electric pumps will be allowed; all pumps must be diesel powered. Contractor must provide suitable spill control and containment measures to avoid environmental contamination by pumps, fuels, or lubricants. All pumps must be open impeller solids handling type pumps, capable of passing a minimum of 3-in. diameter solids. Contractor must have one backup pump, equal in capacity to the largest pump in the system, connected into the bypass pumping system, and ready for operation in case any of the primary pumps fail. The backup pump must not be used in Contractor's calculations for determining the pumping capacity requirements for the stated flow conditions above. Sound-attenuated pump enclosures will be required on all projects where the bypass pumps are located within 50-ft. of any residence, business, park, or other presence of people. Contractor must provide sufficient sound attention measures to comply with City of San Antonio noise limitation requirements.

Pump and haul bypass pumping systems must use good-quality vacuum trucks, equipment, and materials from manufacturers commonly engaged in the manufacture, service, and repair of these types of sanitary sewer service trucks and equipment. All equipment must be designed and manufactured for sanitary sewer service, must function acceptably, be reliable, and free from leaks or other deleterious environmental impacts. All equipment proposed for use in pump and haul bypass pumping must have been maintained per the manufacturer's recommendations. Equipment service records must be made available at SAWS request. Any hoses or pipes that leak must be removed and replaced with non-leaking hoses or pipes.

2.20.

Bypass Pumping – Large Diameter Sanitary Sewers. The work covered by this item consists of bypass pumping operations for existing sanitary sewers 24-in. and larger in diameter in order to temporarily reroute sanitary sewer flows to prevent a sanitary sewage overflow (SSO) and to provide adequate and reliable sanitary sewer flow at all times during construction, while the tasked scope of work is executed. The work also covered in this item is for the use of inflatable and mechanical pipe plugs. The use of inflatable / mechanical plugs in the water and sewer industry is the standard method to temporarily plug a pipe where permanent flow control devices are not available or are not operating as designed. An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others, do not use it.

This item includes all requirements for implementing a temporary pumping system for the purpose of diverting sanitary sewage flow around any construction-related activity to an approved reintroduction point within the sanitary sewer system. The Contractor must minimize the health, safety, and regulatory risks by taking all reasonable measures to avoid an SSO. Therefore, SAWS requires the Contractor to manage the flow of wastewater in a planned and proactive manner. Contractor will be fully responsible for all damages and costs related to the installation, modification of existing manholes/structures, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Bypass pumping systems must be stationary systems consisting of portable pumps, piping, and appurtenances unless a flow diversion bypass system is allowed on the Bypass Pumping Plan (BPP) sheet. Flow diversion bypass systems can use temporary gravity sewers (installed and removed by Contractor) to divert flows into an existing manhole identified in the BPP sheet. Where flow diversion bypass systems are allowed the Contractor may elect to submit using a flow diversion bypass system for these locations or to use a stationary bypass system. All bypass systems must comply with all the requirements of this section unless specifically noted otherwise.

The Contractor will be responsible for the design of Contractor's bypass pumping plan and system. Contractor's bypass pumping system design must be developed based upon the data and requirements of the Contract Documents. The bypass system must meet the requirements of all codes and regulatory agencies having jurisdiction. SAWS will furnish data on the BPP sheet which will include average daily flows and maximum peak flows.

Contractor may rely upon the data provided in the Contract Documents for designing Contractor's bypass pumping system. Contractor must provide for temporary measures to convey sewage flows and avoid sewage spills should a storm event occur that generates sanitary sewer flows in excess of Contractor's bypass pumping system. Contractor to include an emergency response plan in submittals. Plan should include measures for handling excess flows due to storm events. Plan needs to include additional emergency equipment and/or diversion plans and what measures will be taken to handle excess flows.

2.20.1. **Submittals.** All submittals must be in accordance with Owner's requirements and must be acknowledged by Owner prior to delivery.

For all projects requiring bypass pumping, the Contractor must prepare and submit a BPP. The BPP must be submitted a minimum of two weeks prior to commencing any portion of the proposed scope of work and must be acknowledged accepted by SAWS prior to beginning Work. The BPP must be signed and sealed by a professional Engineer licensed in the State of Texas (Contractor's Engineer).

Contractor must submit manufacturer's product data, instructions, recommendations, shop drawings, and necessary certifications in order for the proposed Bypass Pumping Plan (BPP) to be reviewed and acknowledged.

The following must be submitted as part of the BPP:

- A cover letter containing the following information. The project name and job number. The name and address of the Contractor. Contact information of the Contractor's project manager, superintendent, foreman/supervisor, safety professional, etc. A description and location of the planned bypass pumping work to be performed; include data for stationary and flow diversion bypass systems as applicable.
- Emergency ("24/7") contact information for the bypass pumping sub-Contractor, if applicable. Make sure to include the name, cell phone number, and title of the person(s) onsite responsible for the bypass pumping operation.
- The name, phone number, title, signature, and PE seal of the Contractor's Engineer preparing the BPP.
- Copies of permits or other documents showing the Contractor has obtained all clearances necessary for installation and operation of the BPP.
- If flow diversion to existing sewers is proposed by Contractor all diversion flows must be contained within pipes, use of excavated trenches are not allowable for diverting sanitary sewer flows.

- If Contractor elects to use a combination of stationary bypass pumping and flow diversion for his bypass system, Contractor's BPP must identify the quantity of flows that will be pumped and flows diverted for each type of bypass system along with the points where flows will be removed and reintroduced into the sanitary sewer system.
- Certificate of Compliance that the BPP complies with all SAWS and regulatory requirements and that all components have been designed by a professional Engineer licensed in the State of Texas. The Contractor's Engineer must review all components of the submitted BPP for adequacy to the Contractor's selected design flow conditions and insure that all bypass pumping system components are of adequate size, strength, meet the reliability criteria specified herein.
- A description of the maximum amount of sanitary sewer flows to be bypassed by the Contractor's bypass pumping system and how the flow conditions will be monitored during system operations (including all flow measurement devices, calculations, equipment, or other sources of how data was obtained). If the bypass plan is not based on the maximum wet weather flow in the sanitary sewer, this description must include an explanation for how the Contractor plans to monitor the weather for potential flows exceeding his bypass system capacity and how he will avoid having to bypass during wet weather events exceeding his bypass system capacity.
- Descriptions of all proposed bypass pumping components to be used. If applicable, describe all different bypass pumping phases. Include bypass pump(s) size(s) and capacity, as well as the size(s) and capacity of the suction/discharge piping. The description must also include manhole(s)/structure(s) depth(s) and size(s) that will be used during the bypass pumping operation, sanitary sewer plugging method and type of plugs to be used, flowmeter installation locations, etc. Where plugs greater than 24-in. are required, submit a Plug Use Plan (PUP) according to the requirements of Special Provision to this section. Contractor must provide SAWS with adequate prior notification to allow SAWS to witness installation and removal of all plugs.
- Description of procedure for locating and recovering any lost plug using the required radio transmitter and receiver system.
- Description of minimum equipment on hand should an emergency plan be implemented, i.e. spare pump, emergency generator.
- The date and time the bypass pumping is expected to begin and be completed. Indicate if bypass pumping will take place outside normal work hours which are between 8 am to 5 pm Mondays through Fridays (except for SAWS observed holidays).
- The pump curves, showing operating range. This must include the proposed system curve, addressing the pump operation in relation to the suction/discharge piping's alignment with respect to restriction and/or elevations.
- Suction, discharge, and diversion piping material(s) and capacity to be used for the bypass pumping operation, including the material(s) for any bend(s) and/or valve(s) that will be used.
- A sketch showing the location of the pump(s) and the route of the suction, discharge, and diversion piping. If Contractor elects to use locations outside of the easements obtained by SAWS or locations that are not indicated for use on the BPP plan sheet, Contractor will be solely responsible for obtaining the required easements and written documentation required for use of these locations, a copy must be provided to SAWS prior to Contractor's use. A sketch detailing proposed restoration of the suction and discharge points if the Contractor proposed to make openings in the existing pipes or structures.
- If different than shown in contract documents, the new sketch must be dimensioned and all-inclusive showing all SAWS manhole numbers that will be used for suction and discharge operations. If any other structure will be used for suction and/or discharge operations, then the nearest manhole(s) must be labeled. The sketch must include the name of any streets and/or major intersection in the area. All features possibly affected by the alignment of the BPP's components (driveways, vehicular traffic, residential or commercial dwellings (due to noise) must likewise be addressed.

- Clear photographs of the manhole(s) interior that will be used for the bypass pumping operation, including pole camera photographs of pipes where plugs will be installed. All photographs will be labeled with the manhole number, date, and intended use of the manhole by the Contractor's BPP.
- A Traffic Control Plan that pertains solely to the bypass pumping operations. This may differ than the project's traffic control plan for the overall scope of work. The Traffic Control Plan must include all required permits including street cut permits. Contractor must maintain pedestrian and vehicular traffic and comply with ADA regulations for access to all residential and commercial property unless written approval is otherwise obtained from the property owner allowing for reduced access.
- An Emergency Plan detailing procedures to be followed in the event any portion of the bypass operation fails and causes either surcharging or an actual SSO. Contractor is herein advised that:
 - The existing sanitary sewer system may surcharge during certain storm events. The Contractor's BPP must recognize this potential and accommodate it with sufficient bypass capacity, restoration of flow through the sanitary sewer system, or other measures acceptable to SAWS during these flow events. These measures must be included in the submitted BPP.
 - The Contractor's BPP cannot cause any excess surcharging (beyond that normally occurring within the existing sanitary sewer system at that flow event) that results in damage or SSOs.
 - Any damage or SSOs during bypass pumping operations resulting from Contractor's bypass system will be deemed a failure of BPP, and the Contractor must re-propose an improvement to their BPP for review and acknowledgment. A sanitary sewer surcharge is herein defined as any flows entering the manhole or structure (above the crown of the pipe). Excessive sanitary sewer surcharges are higher than normally occurring levels of surcharge levels resulting from the Contractor's BPP that result in damage or SSOs. Contractor will be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.
- Where bypass piping is installed within the floodplain of waterways subject to flooding, the Contractor must submit an anchorage plan and calculations to ensure that piping is properly anchored. The pipe must be capable of remaining in place during a 100-year storm event. Anchorage plan and calculations must be designed and sealed by a professional Engineer licensed in the State of Texas (Contractor's Engineer). This must be the same PE that sealed the BPP Certificate of Compliance.
- Submit the checklist found at the end of this document confirming that all items required by this section are included in the BPP submittal.

For all projects requiring the use of pipe plugs on pipes the Contractor must furnish a submittal containing manufacturer's product data, instructions, recommendations and a project Plug Use Plan (PUP). The PUP must be submitted a minimum of two weeks prior to commencing any portion of the proposed scope of work.

The following must be submitted with the PUP:

- A cover letter containing the following information. The project name and job number. The name and address of the Contractor. Contact information of the Contractor's project manager, superintendent, foreman/supervisor, safety professional, etc. Emergency (24/7) contact information for the staff responsible for operating and maintaining the plug. Include the name, phone number, email address and the person(s) onsite who is responsible for the project. The name and contact information for the PUP preparer.
- Plug plan that must show where on the project site the Contractor intends to use pipe plugs, including the following information. Manhole numbers; the upstream and downstream pipe diameters and pipe materials; pipe slopes; pipe depth; pipe flow direction; known peak or surcharge flow data; types of plugs to be used; types of restraint used; type of radio transmitting device.
- Provide calculations of the maximum anticipated head pressure on the plug and the resultant tensile force required to restrain the plug prior to plug inflation and during plug removal. Provide calculations of

the required inflation pressure of the plug. Calculations must be sealed and signed by a professional Engineer licensed in the state of Texas in civil or mechanical Engineering.

- Detail the plug selection for each installation including given conditions, pipe size and anticipated pressure requirements. Include in this plan whether sleeves will be used.
- Provide an inspection form detailing manufacturer's recommendations for plug inspection of plug condition before and after use; form to be signed by Contractor staff responsible for plug installation prior to and after plug installation.
- Provide a monitoring plan for observing the plug inflation pressure gauge and hoses. Monitoring must be for 24-hr. per day during the plug use duration. Provide a written response plan for when the plug loses pressure. Provide a plug retrieval plan.
- Provide means and methods for anchoring, support and bracing appropriate for anticipated operating pressure conditions. Size restraint (cable or chain) based on calculated loads using a safety factor of 4. Provide multiple tie-off locations for chain or wire cable restraint. Rope of any kind is not an acceptable material for plug restraint.
- Provide manufacturer's literature on proper plug use and safety precautions, including available on-line training.

2.20.2.

Equipment and Materials. The Contractor must provide all necessary pumping equipment, piping and all other necessary appurtenances in order to maintain adequate and reliable sanitary sewer flow in the sanitary sewer system (including any temporary manholes) at all times during construction for stationary pumping and flow diversion bypass pumping systems. All materials, equipment, etc., must be in good condition, and should not have visible damage such as cracks, holes, foreign material, blisters, etc.

Plugs must be selected and installed according to the size of the line to be plugged. Plugs must be adequately secured and anchored to prevent plug movement or escape into the adjoining sanitary sewers should the plug fail. All plugs must be equipped with a radio transmitter that will be used to locate any plug that has escaped in the adjacent system. The radio transmitter must be designed for environment that it will be installed. The Contractor must also provide and keep on site the matching radio receiver that will be used to locate any plug that is lost in the adjacent system.

An additional plug (for each size of plug used) must be onsite and ready to be installed in the event a plug fails or becomes dislodged. Plug(s) will be reviewed by the Inspector and/or Engineer for defects that might lead to failure prior to being installed. Contractor must immediately locate and remove any plug that has shifted its position, slipped within the pipe, dislodged, moved, or otherwise provided an indication that its suitability for use in plugging may be suspect or compromised. Contractor must notify SAWS of any plug that has provided an indication that its suitability for use in plugging may be suspect or compromised and allow SAWS to observe plug removal and replacement. It is also imperative that the Contractor notify the Inspector at the completion of the work in order to verify that all plugs have been removed from the system.

- The Contractor must provide all necessary equipment, plugs, hoses, gauges and necessary appurtenances to install the plug, maintain the plug during use and remove the plug at completion.
- All plugs must be in good condition, and must not have visible damage such as cracks, holes, tears, cuts, punctures, abrasions, loose or damaged fittings, cracks in castings and excessive wear.
- All plugs 15-in. and larger must have an air release valve for rupture protection.
- All plugs 24-in. in diameter and larger must be equipped with a radio transmitter locating device that is activated by the plug losing air pressure. The locating transmitter device must be effective to a depth of 65 ft, and have a battery life of 1,000 hr. when operated in pulse mode after activation.
- All plugs 24-in. in diameter and larger must have a protective sleeve.
- If the plug is damaged, do not use the plug and remove it from the job site.
- Contractor must be aware of the limitations associated with plugs.

Stationary bypass pumping systems must consist of:

- High-Density Polyethylene (HDPE) is the required pipe material for all bypass piping. HDPE must be used when bypass discharge pipe will be going through streams, storm water culverts, the Edward's Aquifer Recharge Zone, environmentally sensitive areas, and all other locations.
- HDPE pipe must be assembled and joined using couplings, flanges or fusion welding in order to avoid joint leakage. SAWS must be notified in sufficient time to allow them to inspect the pipe joints during assembly. SAWS must be notified a minimum of 48 hr. in advance of all fusing/joining operations
- HDPE fusion welding must be performed by personnel certified as fusion technician(s) by the manufacturer of HDPE pipe and/or fusing equipment. SAWS will examine welds prior to use in BPP operation.
- BPP must indicate the proposed DR of the pipe to be used.
- Any hoses or pipes that leak must be removed and replaced with non-leaking hoses or pipes.
- Neither "Irrigation type" pipe nor glued PVC pipe will be permitted.
- Disinfect and drain the entire BPP system in accordance with approved submittal.
- Pumps must be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps to prime the system. No electric pumps will be allowed; all pumps must be diesel powered. Contractor must provide suitable spill control and containment measures to avoid environmental contamination by pumps, fuels, or lubricants. All pumps must be open impeller solids handling type pumps, capable of passing a minimum of 3-in. diameter solids. Contractor must have one backup pump, equal in capacity to the largest pump in the system, connected into the bypass pumping system, and ready for operation in case any of the primary pumps fail. The backup pump must not be used in Contractor's calculations for determining the pumping capacity requirements for the stated flow conditions above. Sound-attenuated pump enclosures will be required on all projects where the bypass pumps are located within 50-ft. of any residence, business, park, or other presence of people. Contractor must provide sufficient sound attenuation measures to comply with City of San Antonio noise limitation requirements.

2.21. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process.** The pipe bursting process involves the replacement of deteriorated gravity sewer pipe by installing a new sanitary sewer pipe within the burst/enlarged excavation of the existing sewer created using a static, hydraulic, or pneumatic hammer bursting head device, suitably sized to break the existing sewer main. Forward progress of the bursting head is aided by hydraulic equipment or other apparatus. The new replacement pipe is attached to the back of the bursting head and is pulled into the excavation during the bursting process. The Contractor must provide equipment, planning, and job execution necessary to accomplish the work in an efficient manner and consistent with the objectives of these specifications, including preventing damage to existing infrastructure, maintaining pedestrian and vehicular access, and providing continual sewer service to customers.

2.21.1. **High Density Polyethylene Pipe (HDPE).** High Density Polyethylene Pipe (HDPE) related to pipe bursting or pipe crushing for a sanitary sewer or related pipe line rehabilitation:

Solid wall HDPE pipe that is in conformance with ASTM F714 and ASTM requirements stated herein. HDPE pipe will further be required to have a minimum pipe stiffness of 46 psi for 12-in. to 48-in. diameter pipe and 115 psi for 8-in. to 10-in. diameters as required by SAWS and TCEQ.

2.21.2. **Pipe Manufacturer.** All pipe and fittings will be high density polyethylene pipe and made of virgin material. No re-work except that obtained from the manufacturer's own production of the same formulation will be used. The liner material will be manufactured from a High Density High Molecular weight polyethylene compound which conforms to ASTM D 1248 and meets the requirements for Type III, Class C, Grade P-34, Category 5, and has a Plastic Pipe Institute rating of PE 3408.

The pipe produced from this resin will have a minimum cell Classification of 345434C (Inner wall will be light in color) under ASTM D 3350. A higher number cell classification limit which gives a desirable higher primary property, per ASTM D 3350 may also be accepted by the Engineer at no extra cost to SAWS. The value for

the Hydrostatic Design basis will not be less than 1600 psi (11.03 MPA) per ASTM D 2837. Pipe will have ultraviolet protection.

- 2.21.3. **Pipe Color and Quality.** For television inspection purposes, the polyethylene pipe will have light-colored interior achieved with a homogenous, light-colored material throughout or with a fully bonded light-colored interior liner meeting specifications indicated above. All pipe will be free of visible cracks, holes, foreign material, foreign inclusions, blisters, or other deleterious or injurious faults or defects. Pipe and fittings must be as uniform as commercially practical in color, opacity, density, and other physical properties.

For interior lined pipe, the liner will be a minimum of 10 mils thick and co-extruded. The bond between the layers will be strong and uniform. It will not be possible to separate the two layers with a probe or point of a knife blade so that the layers separate cleanly at any point, nor will separation of the bond occur, between layers, during testing performed under the requirements of this specification.

- 2.21.4. **Pipe Diameter.** Polyethylene Plastic Pipe will meet the applicable requirements of ASTM F 714 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter, ASTM D 1248, and ASTM D 3550. Internal diameter of the pipe indicated on the plans will be the minimum allowable pipe size.

- 2.21.5. **Pipe Dimension Ratios.** The minimum wall thickness of the polyethylene pipe will meet the following requirements in Table 3 as based on the deepest portion of a particular pipe pull, typically between manholes:

Depth of Cover (Feet)	Minimum SDR of Pipe
0-16.0	19
>16.1	17

Wall thickness must be as indicated on the plans and will be in accordance with manufacturer.

- 2.21.6. **Force Mains.** Where applicable, solid wall pipe for sanitary sewer force mains must have a minimum working pressure rating of 150 psi, and an inside diameter equal to or greater than the nominal pipe size indicated on the Drawings.
- 2.21.7. **Augering Pipe.** HDPE pipe is not approved in applications requiring augering of sewer pipe.
- 2.21.8. **Pipe Marking.** Each standard and non-standard length of pipe or fitting must be clearly marked with pipe size, pipe class, production code, material designation and other relevant identifying information.
- 2.21.9. **Pipe Inspections.** The Engineer reserves the right to inspect pipes or witness pipe manufacturing. Such inspection will in no way relieve the manufacturer of the responsibilities to provide products that comply with the applicable standards and these Specifications. Should the Engineer wish to witness the manufacture of specific pipes, the manufacturer must provide the Engineer with adequate notice of when and where the production of those specific pipes will take place. Approval of the products or tests is not implied by the Engineer's decision not to inspect the manufacturing, testing, or finished pipes.
- 2.21.10. **Acceptable Manufacturer.** Vendors must have approval through SAWS Standards Committee prior to product use and must meet all requirements set forth in this Specification.
- 2.22. **Sliplining.** Slip-lining sanitary sewer pipe is accomplished by pulling or pushing liner pipe into existing sewers by use of mechanical or hydraulic equipment. Once in place, liner pipe is allowed time to normalize and is then cut to fit between manholes. Annular spaces between liners and existing sewers are sealed at

each manhole. Manhole inverts and benches are reworked and reshaped. Existing sewers remain in operation during slip-lining process, with sewage flow diverted around operations in progress.

- 2.22.1. **Manufacturers.** Liner pipe systems must be fiberglass reinforced plastic (FRP) or T-Lock Liner concrete pipe, as approved by the SAWS.

Acceptable manufacturer for FRP liner pipe must conform to the current Standard Material Specifications accepted by SAWS. Please see the SAWS website for a list of approved FRP pipe manufacturers - http://www.saws.org/business_center/specs/product_submittal/.

Acceptable manufacturer for Amer-Plate T-Lock pipe: Ameron Protective Linings.

- 2.22.2. **FRP Liner Pipe and Fittings.** Pipe, joint and fitting; ASTM D 3262 Type 1, Liner 2, Grade 3.

FRP Liner Pipe: Reinforced plastic mortar pipe manufactured by centrifugal casting process resulting in dense, nonporous, corrosion-resistant, consistent, composite structure. Minimum Stiffness: 72 psi, measured in accordance to ASTM D2412. Use with a stiffness of 72 psi where specified or shown on the drawings.

Resin Systems: Thermosetting polyester epoxy resin, with or without filler, meeting ASTM D3262.

Reinforcing Glass Fibers: Commercial Grade E-type glass filaments, with binder and sizing compatible with impregnating resins.

Filler: Sand with at least 98 percent silica content, and maximum moisture content of 0.2 percent.

Joints: Low-profile FRP jacking bell-and-spigot joints or flush bell and spigot joints, with elastomeric sealing gaskets for watertight joints meeting ASTM D4161.

Dimensions and Tolerances:

- Pipe outside diameters and tolerances: Comply with ASTM D3262, Cast Iron Pipe Equivalent Outside Diameters, and table below.
- When possible, supply pipe in nominal lengths of 20-ft. Where radius curves in existing pipe or limitations in entry pit dimensions restrict pipe length, shorter lengths may be used. Engineer must first approve of all proposed pipe joints that are shorter than 20-ft.
- FRP pipe minimum outside diameters and minimum wall thickness as shown in Table 4:

TABLE 4 – FRP DIAMETER AND THICKNESS			
Minimum Existing Sewer Nominal Diameter	Minimum Wall Liner O.D.	Minimum Wall Thickness 46 p.s.i. Stiffness	Thickness 72 p.s.i. Stiffness
(in.)	(in.)	(in.)	(in.)
21	19.50	0.42	0.48
24	21.60	0.46	0.53
30	25.80	0.54	0.63
36	32.00	0.66	0.77
42	38.30	0.78	0.91
48	44.50	0.90	1.05
54	50.80	1.02	1.19
60	57.10	1.14	1.33
66	62.90	1.26	1.47
72	69.20	1.38	1.61
78	75.40	1.50	1.75

- Fabricate pipe ends square to pipe axis plus or minus 0.25-in., or plus or minus 0.5% of nominal diameter, whichever is greater.
- Flanges, elbows, reducers, tees, wyes, and other fittings: Capable of withstanding operating conditions.
- Fabrication: Contact-molded or manufactured from mitered sections of pipe joined by glass-fiber-reinforced overlays.

2.22.3. **Liner Pipe Seals at Manholes.** Sealer for annular spaced between liner pipes and host sewers at manholes: Oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation, or approved equal.

Non-Shrink Grout: Strong Seal's QSR patching material or approved equal.

2.22.4. **Clamps and Gaskets.** Clamps: Stainless steel, including bolts and lugs, as manufactured by JCM Industries, Type 108, or equal. Furnish full circle, universal clamp couplings with at least 3/16-in. thick neoprene grid-type gaskets. Select clamps to fit outside diameter of liner pipe as follows in Table 5

TABLE 5 – CLAMP LENGTH	
Liner Pipe O.D. (in.)	Minimum Clamp Length (in.)
7.125	15
8.625	18
10.750 or greater	30

2.22.5. **Bedding Material.** Make point repair and remove obstructions, such as roots, rocks and other debris, prior to installing liner pipe. Comply with excavation, trenching, and backfill requirements of this specification.

- 2.23. **Sliplining Grout.** Slip-lining grout is installed in the annular space between the slip-lining pipe and the host sewer. Completely fill the annular space without deflecting the pipe. Test grout equipment and procedures in accordance with approved submittals. Perform testing on the first pipeline segment to be grouted. Testing must be performed under observation by the Inspector. If the grout does not totally fill the annular space, adjust the procedure or the mix, and rerun the test on the first pipeline segment.
- 2.23.1. **Manufacturers/Application.** The applicator of the grout mix must be certified by the grout mix manufacturer and approved by the SAWS Engineer. The certified applicator must be regularly engaged in the placement of grout, including completion of pipeline grouting installations having at least 1000 cubic yards in the past 3 years.
- 2.23.2. **Materials.**
- 2.23.2.1. **Cement.** Comply with ASTM C150. Pozzolans and other cementitious materials are permitted.
- 2.23.2.2. **Fly Ash.** Comply with ASTM C618; either Type C or Type F must be used.
- 2.23.2.3. **Sand.** If provided, conform to ASTM C144, except as modified in Table 6 below:

U.S. Standard Sieve Size	Percent Passing By Weight
No. 16	100
No. 30	60 – 85
No. 50	10 – 35
No. 100	5 – 25
No. 200	- 10

- 2.23.2.4. **Water.** Use potable water free from deleterious amounts of alkali, acid, and organic materials which would adversely affect the setting time or strength of the slip-lining grout.
- 2.23.2.5. **Admixtures.** Admixtures should be selected by the slip-lining grout manufacturer to meet performance requirements, improve pumpability, control set time and reduce segregation.
- 2.23.2.5.1. **Compressive Strength.** The grout must have a minimum penetration resistance of 100 psi in 24 hr when tested in accordance with ASTM C 403 and a minimum compressive strength of 300 psi in 28 days when tested in accordance of ASTM C495 or C109.
- 2.23.2.5.2. **Performance Requirements.** The Contractor must submit the proposed grout mixes, methods, plans and criteria of the grouting operations. The grouting system must have sufficient gauges, monitoring devices, and test to determine the effectiveness of the grouting operation and to ensure compliance with the liner pipe specifications and design parameters.
- 2.23.2.5.3. **Mix Designs.** One or more mixes must be developed to completely fill the annular space based, but not restricted to, the following requirements:
- Size of annular void
 - Void (size) of the surround soil
 - Absence or presence of groundwater
 - Sufficient strength and durability to prevent movement of the line pipe.
 - Provide adequate retardation, and
 - Provide less than 1 percent shrinkage by volume.

2.23.2.5.4. **Density/Viscosity.** The Contractor must design a grout mix with a density to prevent floating of the liner pipe. The apparent viscosity must not exceed 20 seconds in accordance with ASTM C939 unless otherwise approved by the SAWS Engineer.

2.24. **Bedding and Backfill.** Backfilling for sanitary sewers is divided into three (3) separate zones: (a) bedding: the material in trench bottom in direct contact with the bottom of the pipe; (b) initial backfill: the backfill zone extending from the surface of the bedding to a point 1 foot above the top of the pipe; and (c) secondary backfill: the backfill zone extending from the initial backfill surface to the top of the trench. Materials and placement for each of the zones must be as described herein.

2.24.1. **Bedding.**

Stable Material: Existing stable material present during excavation including:

Trench bottom free of water, muck, debris;

Rock in boulder, ledge or coarse gravel (particle size not larger than 1- 3/4 inch) formations;

Coarse sand and gravels with maximum particle size of 1- 3/4 inch, various graded sands and gravels containing small percentages of fines, generally granular and non-cohesive either wet or dry; and

Fine sands and clayey gravels; fine sand, sand-clay mixtures, clay and gravel-clay mixtures.

Unstable Material: Existing unstable materials are: Silt, muck, trash or debris in the trench bottom bearing level; rock, in ledge or boulder, or coarse gravel (minimum particle size larger than 1- 3/4 inch) formations.

Bedding Material: The existing material at the bearing level must be removed and replaced to a minimum depth of 6 in. or 1/8 of the outside diameter of the pipe, whichever is greater, with bedding material. The bedding material must extend up the sides of the pipe sufficient to embed the lower quadrant of the pipe. The bedding material must be composed of well-graded, crushed stone or gravel conforming to the requirements of Table 7 unless modified by the Engineer in writing.

TABLE 7 – GRAVEL GRADATION	
Sewer Gravel	Percent
Passing 1-1/2-in. sieve	100
Passing 1-in. sieve	95 – 100
Passing 1/2-in. sieve	25 – 60
Passing No. 4 sieve	0 – 10
Passing No. 8 sieve	0 – 5

Over Excavation: Where the trench bottom has been over excavated beyond the limits as defined in Item No. 848, "Sanitary Sewers," due to removal of unstable material, the pipe must be concrete-encased. Encasement must extend from the trench wall to trench wall and be a minimum of 6-in. above the top of pipe. No separate pay item.

Reduced Excavation: Where the trench bottom is not excavated in accordance with the specification due to rock or other hard under lying materials, then the pipe must be concrete encased. No separate pay item.

Consolidating Backfill Material: The Initial Bedding material must be consolidated to assure it is incorporated from the bottom of the trench up to the pipe centerline. A hand-held vibrator, commonly used for concrete work, can be used for this purpose. The vibrator must be inserted every 3-ft. on each side of the pipe.

2.24.2. **Initial Backfill.** Initial backfill is defined as backfill having a thickness in its compacted state from the surface of the bedding to a point 1-ft. above the top of the pipe.

Initial backfill must consist of gravel which conforms to the requirements for bedding material.

- 2.24.3. **Secondary Backfill.** Secondary backfill is defined as backfill from 1-ft. above the top of the pipe to the top of the trench or bottom of pavement section. Secondary backfill must be constructed in accordance with details shown in the construction documents.

Secondary backfill must generally consist of materials removed from the trench and must be free of brush, debris and trash. Rock or stones having a dimension larger than 6-in. at the largest dimension must be sifted out and removed before the material is used in the secondary backfilling zone. Secondary backfill material must be primarily composed of compactible soil materials.

- 2.25. **Grouting of Sewer Mains.**

- 2.25.1. **Submittals.**

- Proposed Mix Design Report for grout
- Submit manufacturers data for proposed plugs and detail of bulkhead
- Technical information for equipment and operations procedures including projected injection rate, grout pressure, method of controlling grout pressure, bulkhead and vent design and number of stages of grout application.
- Submit project specific plan for abandonment at least 15 days prior to commencing grouting activities, describe proposed sequence, access points and other information pertinent for completion of Work.

- 2.25.2. **Materials.**

- Cement-based grout/flowable fill with self-leveling and non-shrink characteristics.
- Unconfined compressive strength: Minimum 100 psi at 56 days as determined based on average of three tests for same placement. Present at least three acceptable strength tests for proposed mix design in mix design report.

3. CONSTRUCTION

- 3.1. **Excavation.** Excavation as required to complete the work as outlined herein will be performed in accordance with TxDOT Item 400, "Excavation and Backfill for Structures".

- 3.1.1. **Trench Excavation Protection.** Excavation greater than 5-ft. in depth is to be protected as specified in TxDOT Item 402, "Trench Excavation Protection", or TxDOT Item 403, "Temporary Special Shoring".

- 3.1.2. Trench Excavation Protection must be applied to all protections and shoring for excavations where the width of a trench or excavation is not greater than 15-ft. (measure at the bottom of the excavation). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15-ft. or less (measure at the bottom of the excavation), the excavation is also considered to be a trench. All required shoring for Jacking, Boring and Receiving pits will be paid under item 3.1.1. "Trench Excavation Protection". In addition, "Trench Excavation Protection" will not be limited to these applications but may be used whenever deemed expedient and proper to ensuing work.

- 3.1.3. **Trenches.** Trench walls must be vertical. The practice of undercutting at the bottom or flaring at the top will not be permitted except where it is justified for safety or at the Engineer's and/or Inspector's direction. In special cases, where trench flaring is required, the trench walls must remain vertical to a depth of at least 1-ft. above the top of the pipe.

The trench bottom must be square or slightly curved to the shape of the trenching machine cutters. The trench must be accurately graded along its entire length to provide uniform bearing and support for each section of pipe installed upon the bedding material. Bell holes and depressions for joints must be dug after the trench bottom has been graded and bedding installed. The pipe must rest upon the new bedding material for its full length.

Where over-excavation occurs and when not as directed by the Engineer or Inspector, the under-cut trench must be restored to grade at no cost to SAWS by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.

3.2. **Width of Trench.**

Minimum Width of Trench. The minimum width of pipe trenches, measured at the crown of the pipe, must be not less than 12-in. greater than the exterior diameter of the pipe, exclusive of bells. The minimum base width of such trench must be not less than 12-in. greater than the exterior diameter of the pipe, exclusive of special structures or connections. Such minimum width must be exclusive of trench supports and not greater than the width at the top of the trench.

Maximum Width of Trench. The maximum allowable width of trench for pipelines measured at the top of the pipe must be the outside diameter of the pipe (exclusive of bells or collars) plus 24-in. A trench wider than the outside diameter plus 24-in. may be used without special bedding if the Contractor, at his sole expense, furnishes pipe of the required strength to carry additional trench load. Such modifications must be submitted to the Inspector and approved in writing. Whenever such maximum allowable width of trench is exceeded, except as provided for in the contract documents, or by written approval of the Engineer, the Contractor, at his sole expense, must encase the pipe in concrete from trench wall to trench wall, or with other approved pipe bedding material. Any excavation wider than this maximum width or subsequent surface or paving work, will be done at the Contractor's sole expense.

- 3.2.1. **Classification of Excavated Materials.** No classification of excavated materials will be made. Excavation and trench work is to include the removal and subsequent handling of all materials excavated in accordance with TxDOT Item 400, "Excavation and Backfill for Structures".
- 3.2.2. **Grade of Trench Bottom.** The trench is to be over-excavated to a depth of 6-in. below the grade line established for the bottom of the pipe, regardless of the type of pipe. The grade line of the pipe is to then be met by the addition of a layer of approved bedding material as directed.
- 3.2.3. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits specified in Section 3.2.2., "Grade of Trench Bottom", is to be corrected with approved material and compacted as directed. Should excessive over-excavation occur, except at bell holes, the grade is to be restored in accordance with the methods described in Section 3.2.4., "Unstable Conditions at Grade", at no cost to the Department.
- 3.2.4. **Unstable Conditions at Grade.** Where the bottom of the trench at grade is found to be unstable or to include ashes, cinders, any type of refuse, vegetable or other organic material, or large pieces of fragments or inorganic materials which in the judgment of the Engineer should be removed, the Contractor is to excavate and remove such unsuitable material to a depth no less than 6-in. below pipe. Before the pipe is laid the grade is to be restored by backfilling with an approved material in layers of 3-in. prior to compaction. The layers are to be slightly moistened and thoroughly compacted so as to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade is to be accurately graded to provide uniform bearing and support for each section of pipe at every point along its entire length except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper seating of pipe joints.
- 3.2.5. **Caution in Excavation.** The Contractor is to proceed with caution in the excavation and preparation of the trench so that the exact location of underground structures and utilities may be determined whether shown on the plans or not. Machine excavation is not permitted closer than 12-in. on either side of other existing underground utilities. The Contractor is to be responsible for the repair of such structures and utilities when

broken or damaged. He is also to be responsible for adjusting alignment and trench grades with reference to such structures in order to obtain specified clearance for the sewer main construction.

Whenever the Engineer determines that it is necessary to explore and excavate to determine the location of existing underground structures and utilities, the Contractor is to make explorations and excavations for such purposes at his expense. Backfill Material Derived from Excavation.

Any excess excavated material, not utilized after all fill requirements have been met, will become the responsibility of the Contractor. The Contractor must dispose of it by hauling and wasting outside the limits of the rights-of-way or easements of this project and of public thoroughfares and water courses, in conformity with pertinent City, County, State and Federal codes and ordinances and in a manner meeting the approval of the Engineer.

- 3.2.6. **Trench Surface Restoration.** The surface of the backfilled trench must be restored to match the previous existing conditions. This will include final grading, placement of topsoil and seeding, placement of sod (such as at homes or businesses that had maintained grass), or other unprepared and prepared surfaces.

Trenches in alleys actively being used by vehicles (such as trash pickup, vehicle parking, etc.) must be restored by grading and compacting to 98% or higher with a minimum of 4-in. of flex base materials for the entire width of the alley. Asphaltic materials must have a compaction density of 95%. Alleys not actively used by vehicles must be graded and compacted to 98% or higher from the top of the initial backfill to the bottom of the pavement section, then spread grass seed for entire width of the alley.

Trenches in paved streets must be covered with a temporary all weather surface to allow for vehicular traffic until the final asphalt/concrete paving is complete. This surface must be a minimum of 4-in. compacted and rolled asphaltic black base, either hot-mix or cold-mix applied. It is the Contractor's responsibility to maintain this surface until the final street restoration is complete. Temporary street striping may also be required. This surface must be removed prior to final asphaltting.

All street work must be done in accordance with the latest TXDOT construction specifications. Included in this requirement is replacement of any curbs or sidewalks damaged or removed during the construction.

No separate payment for the surface restoration is permitted. The cost for this work must be included in the appropriate bid item.

- 3.2.7. **Pavement.** The Contractor is to remove pavement and surfaces as a part of the trench excavation. The removal of pavement and surfaces and their restoration is to be based on the minimum trench widths as specified, plus 6-in. either side or as otherwise provided herein. The Contractor is to use such methods as sawing, drilling, or chipping to assure the breaking of the pavement along straight lines.

If the Contractor removes or damages pavement or surfaces beyond the limits specified above, such pavement and surfaces are to be restored at the expense of the Contractor.

Where water line construction necessitates cutting through existing streets outside the limits of new street construction, said streets are to be replaced in kind as directed. Where, in the opinion of the Engineer, it is necessary to maintain traffic across a trench, the Contractor is to install temporary metal bridges as necessary to facilitate the movement of traffic.

The street surface adjacent to the trench is to be kept free of surplus spoil. Construction materials are to be placed at locations that will minimize interference with the traveling public.

- 3.2.8. **Concrete Sidewalks, Driveways, Etc.** All concrete sidewalks, driveways, etc., are to be cut with a concrete saw. When transverse expansion or "dummy" joints are encountered, the concrete is to be removed to the nearest transverse joint on each side of the trench and restored. The depth of cut is to be such that upon removal of the concrete, the sides of the cut are to be straight and square.

Existing reinforcing wire fabric or bars are to be cut and removed to permit completion of trench excavation, pipe laying, and backfill operations. When the backfill operations have been completed, the existing reinforcement is to be replaced in its original position and satisfactorily spliced prior to the replacement of concrete over the new trench alignment.

Transverse "dummy" joints are to be made by a jointing tool or other means acceptable, and are to match in depth and thickness in the existing transverse joints.

Expansion joint material is to be provided where new construction abuts the existing curb or driveway if the Engineer deems it necessary.

Concrete is to be spaded, tamped, and thoroughly compacted until mortar entirely covers the surface and has a monolithic finish. The top surface is to be floated, troweled, and finished to match the existing concrete surface.

Immediately after finishing, the concrete surface is to be protected by a membrane compound curing agent, or by wetted cotton or burlap mats. Either method is to be subject to approval.

3.2.9. **Dewatering.** Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding areas.

The Contractor must not allow water to accumulate in excavations or at subgrade level. Remove water to prevent softening of foundation bottoms and soil changes detrimental to stability of subgrades and foundations. Provide and maintain dewatering system components necessary to convey water from excavations.

Convey water removed from excavation and rainwater to collecting or runoff areas away from buildings and other structures. Establish and maintain temporary drainage ditches and other diversion outside excavation limits. Do not use trench excavations as temporary drainage ditches.

Dewatering devices must be provided by the Contractor with filters to prevent the removal of fines from the soil. Should the pumping system draw fines from the soil, the Engineer will order immediate shutdown, and remedial measures will be responsibility of the Contractor.

Upon completion of the dewatering work, the Contractor must remove all equipment and leave the construction area in a neat, clean, condition that is acceptable to the Owner.

The Contractor must maintain ground water table at least 12-in. below the finished excavation subgrade.

Dewatering Performances. Performances of the dewatering system for lowering ground water should be measured by observation wells on piezometers installed in conjunction with the dewatering system, and these must be documented at least daily. The Contractor must maintain a log of these readings and submit them to the Owner.

No direct payment will be made for costs associated with dewatering. All costs in connection therewith should be included in the applicable contract price for the item to which the work pertains.

3.2.10. **Bedding and Backfill.**

3.2.10.1. **General.** Trenches must not be backfilled until the construction structures or appurtenances, as installed, conform to the requirements specified. Where specified, only the secondary backfilling may incorporate excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel, soft shale or other approved materials, free from large clods of earth or stones. Where pipe is specially coated or sleeve/tape wrapped for protection against corrosion, care should be taken not to damage the coating or sleeve/tape wrap.

Where a trench has been improperly backfilled, or where settlement occurs, the identified section must be excavated to a depth and length 50-ft. beyond the failed area, then refilled and compacted to the grade and compaction level required. The use of sand backfill will not be allowed. All compaction within the secondary backfill zone will be such that the apparent dry density of each layer must be not less than 98% from the top of the initial backfill to the bottom of pavement section. The pavement (asphalt) section must have 95% compaction density with a maximum dry density at + or - 2% optimum moisture content as determined by tests on samples as outlined in the latest provisions of TX-DoT Testing Method TEX 113-E or most applicable approved equal provisions, unless otherwise shown on the contract documents. At the time of compaction, the water content must be at optimum moisture content, + or - 2% points.

- 3.2.10.2. **Initial Backfill.** Prior to laying the pipe, the normal or select bedding material will be shaped to conform to the outside diameter of the pipe as shown on the plans. Bedding material must be consolidated to assure it is incorporated from the bottom of the trench up to the pipe centerline. A hand-held vibrator, commonly used for concrete work, can be used for this purpose. The vibrator must be inserted every 3-ft. on each side of the pipe.

For sewer lines up to 24-in. in diameter initial backfill material must be placed in two lifts above the bedding material the pipe is set on. The first lift must be spread uniformly and simultaneously on each side and under the bottom quadrant of the pipe to the midpoint or spring line of the pipe. Consolidate the Initial Backfill material as specified for bedding.

Placement of the first lift of initial backfill will be subject to inspection and approval prior to placement of second lift, which must extend from the spring line of the pipe to a minimum of 1-ft. above the top of the pipe. The second lift must be evenly spread in a similar manner as the first lift.

For diameters 24-in. and larger, initial backfill material must be evenly and simultaneously spread alongside, under the lower quadrant the pipe and over the pipe in 12-in. lifts to a point sufficient to a minimum of 1-ft. above the top of the pipe. Consolidate the Initial Backfill material as specified for bedding.

- 3.2.10.3. **Secondary Backfill.** The secondary backfill material must be placed in maximum 12-in. loose lifts or as directed by the Design Engineer and/or Inspector.

3.3. **Pipe Installation.**

- 3.3.1. **General.** All sanitary sewer mains must be constructed in accordance with the specifications herein outlined and in conformity with the required lines, grades, and details shown on the plans and as directed by the Engineer. Successful passage of the air and mandrel test (for flexible pipe, 30 days after installation), as described under TCEQ Criteria, will be required for the acceptance of the mains.

Water Main Crossings. Where gravity or force main sewers are constructed in the vicinity of water mains, the requirements of the TCEQ 30 TAC 217.53, must be met.

Pipe Installation. The Inspector will inspect all pipe before it is placed in the trench and will reject any sections found to be damaged or defective to a degree that would affect the structural integrity of the pipe. Rejected pipe must be immediately removed from the site of the work and replaced with new acceptable pipe. The Contractor must commence installation of the pipe at the downstream end of the sanitary sewer line and proceed nonstop in a forward upstream direction. No pipe should be laid within 10 ft. of any point where excavation is in progress. Pipe installation should proceed upgrade with the bell pointing in the upstream direction of flow. Pipe must be lowered into the trench without disturbing the prepared foundation or the trench sides. The drilling of lifting holes in the field will not be permitted. Pipe must be installed by means of a concentric pressure being applied to the pipe with a mechanical pipe puller. Pulling or pushing a joint of pipe in place by using a crane, bulldozer, or backhoe will not be permitted. Pipe must be "pulled home" in a straight line with all parts of the pipe on line and grade at all times. No side movement or up and down movement of the pipe will be permitted during or after the pulling operation. Should coupled joints of pipe be out of line or off grade, they must be removed one joint at a time in the presence of the Inspector and brought to the proper line and grade. The lifting or moving of several joints of coupled pipe at one time to close a partially open joint or to fine grade under laid joints of pipe will not be permitted. Also, Contractor

must ensure that all existing or proposed manholes or structures must remain visible and accessible at all times. No manhole or structure covers must be covered by pavement, equipment, or other obstructions other than a removable, temporary lid provided for safety. Inspector will cause all work to be suspended until this requirement is met without any valid claims of costs or schedule delays.

Laser Beams. The use of laser Beams for vertical control will be required provided the Contractor makes available to the Inspector, when requested, a level and rod of sufficient sensitivity to accurately determine differences in elevation between points 300-ft. apart with one instrument set-up. Contractor must provide a written summary to the Inspector of all elevations that all installed, repaired, or replaced sewer main enter and exit a manhole or structure.

No pipe should be installed in tunnels except as provided on the plans, or with the permission of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not provided on the plans, he must submit to the Engineer, prior to commencement of work, a detailed outline of procedures, methods, and use of materials depending on existing soil conditions.

No horizontal or vertical curves will be permitted in conformance with appropriate regulatory agency requirements.

Before leaving the work unattended, the upper ends of all pipelines must be securely closed with a tight fitting plug or closure. The interior of laid pipe must be kept free from dirt, silt, gravel, or foreign material at all times. All pipes in place must be approved before backfilling.

When replacing an existing system in place, Contractor must maintain screens to prevent the entrance of construction debris into the sewer system.

- 3.3.2. **Sanitary Sewer Laterals.** Sanitary sewer laterals, fittings and appurtenances must conform to these specifications and must be installed by the Contractor as specified herein, or as directed by the Construction Inspector or the Engineer and in accordance with the plans. Where the lateral is within the Edwards Aquifer Recharge Zone then it must be installed in accordance with details.

Designation of Lateral. A sewer pipe located between the sanitary sewer main and the customer's premise, is designated as a "sanitary sewer lateral."

Lateral Installation. All service line installations must be performed in accordance with this specification. For sanitary sewer mains that are 12-in. in diameter or smaller, all laterals must be connected using the appropriate size tee/wye placed in line with the main line. For mains larger than 12-in., insert-a-tee conforming to ASTM 3034-88 or approved or equal may be used. Where waterline crossings with sanitary sewer laterals are less than the regulated separation distances, all lateral piping must be SDR-26 PVC pipe (ASTM D2241-09) with a pressure rating of 150 psi.

Connection to the customer's end of the lateral must be performed using a flexible coupling, or pre-approved equal. All flexible couplings must be concrete-encased to prevent movement or breakage of the steel bands. All cleanouts at job sites must have installed an approved heavy duty sanitary sewer cap.

Cutting, excavation, and backfill will be as specified herein.

- 3.3.3. **Fiberglass Reinforced Pipe for Large Diameter Gravity Sanitary Sewer Installation.** All sanitary sewer mains must be constructed in accordance with the specification herein outlined and in conformity with the required lines, grades, and details shown in the contract documents and as directed by the Engineer.

- 3.3.3.1. **Quality Control.** All project pipes must be provided by a single manufacturer. Only the pipe and fittings that will be installed during a single work day will be allowed to be stored within the barricaded work area. Pipe manufacturing operations must be performed under the control of the manufacturer. All pipe furnished must be in conformance with this Specification and ASTM D3262.

3.3.3.2. **Delivery of Materials.** Provide adequate stalling during transport to prevent damage to the pipe, fittings and appurtenances in accordance with manufacturer's recommendations.

3.3.3.3. **Storage Requirements.** Gravity pipe must be stored and handled in accordance with the manufacturer's guidelines or Engineers recommendations.

All products must be stored above the ground upon platforms, pallets, skids, or other supports supplied by the Contractor and approved by SAWS. Products must be kept free from dirt and other foreign matter.

All products must be stored to permit ready access for identification and inspection by the Inspector.

If new pipe and fittings become damaged before or during installation, it must be repaired as recommended by the manufacturer or replaced as required by the Inspector or Engineer at the Contractor's expense, before proceeding further. Deliver, store, and handle other materials as required to prevent damage.

Pipe laid directly on the ground must be placed on an area free of loose stones or sharp objects in accordance with manufacturer's recommendations and approved by the SAWS.

3.3.3.4. **Pipe Handling.**

The Contractor must abide by the required handling techniques specified by the Manufacturer.

The Contractor must provide suitable quantities of all lifting equipment to handle the pipe. In no case will any equipment be used that is not rated to handle the intended loading or conditions of use to which it will be subjected, or which will damage or gouge the pipe.

Dragging or dropping the pipe will not be allowed.

Haul and distribute pipe and fittings at the project site.

Handle piping with care to avoid damage.

Inspect each joint of pipe and reject or repair any damaged pipe prior to lowering into the trench.

Use only nylon ropes, slings or other lifting devices that will not damage the surface of the pipe for handling pipe.

3.3.3.5. **Pipe Installation.**

Engineer and/or Inspector may request to inspect pipe prior to installation.

Install pipe, fittings, specials and appurtenances as specified herein, and in accordance with the pipe manufacturer's recommendations or Engineers requirements.

Must follow manufacture recommendation for initial and bedding.

Lay pipe to the lines and grades as indicated on the Plans. Clean ends of pipe and coupling components. Apply manufacturer approved joint lubricant to pipe ends and to the elastomeric seals of coupling. Use suitable equipment and end protection to push or pull the pipes together, applying a uniform seating force across the entire pipe and coupling circumference. Do not exceed forces recommended by the manufacturer for coupling pipe. Join pipes in straight alignment then deflect to required angle. Do not allow the deflection angle to exceed the deflection permitted by the manufacturer, and not more than 2-degrees unless approved by the Engineer. Excavate and backfill trenches in accordance with this specification.

Pipe Separation: Sewer pipe separation distances must be maintained in accordance with TCEQ rules 30 §217.53.

Laser Beams: The use of laser beams for vertical control will be required.

Contractor must also make available to the Inspector, when requested, a level and rod, of sufficient sensitivity, to accurately determine differences in elevation between points 300 ft. apart with one instrument set-up.

Contractor must provide a written summary to the Inspector of all elevations that all installed, repaired, or replaced sewer main enter and exit a manhole or structure.

No pipe should be installed in tunnels except as noted in the contract documents or by approval of the Engineer. If the Contractor finds it necessary to install pipe in tunnels not provided in the contract documents, he must submit to the Engineer a detailed outline of procedures, methods, and use of materials depending on existing soil conditions. This information requires review and approval prior to the commencement of work. Only SAWS Product Standards Committee approved pipe manufacturer will be allowed for tunneling.

No horizontal or vertical curves will be permitted in conformance with appropriate regulatory agency requirements.

Before leaving the work unattended, the upper ends of all pipelines must be securely closed with a tight-fitting plug or closure in accordance with manufacturers recommendations and approved by the SAWS.

The interior of laid pipe must be kept free from dirt, silt, gravel, or foreign material at all times.

All pipes in place must be approved by the Inspector before backfilling.

All fabricated bends must be encased with reinforced concrete, with #4 Bars at 12-in. on center each way completely around pipe, approximately centered in the encasement thickness, and extending longitudinally one pipe diameter each direction along trench measured from the pipe interior bend point. Concrete encasement must extend across the full width of the trench to both trench walls. Encasement requirement may be waived by the Engineer if manufacturer certifies that fabricated bends have been designed and constructed to withstand all static and dynamic loads imposed by the service conditions

When replacing an existing system in place, Contractor must maintain screens to prevent the entrance of construction debris into the sewer system. Ensure properly temporarily connected or maintain continuous by-pass.

At the close of each operating day, keep the pipe clean and free of debris, dirt, animals and trash – during and after the laying operation. Effectively seal the open end of the pipe using a gasketed night cap. When not temporarily connected. Cap must be in accordance with manufacturer's recommendations.

3.3.4.

HDPE Pipe. Pipe and fittings must be thermal butt fusion, saddle fusion, or socket fusion according to manufacturer recommended procedures. The butt-fused joint will be true alignment and will have uniform roll back beads resulting from the use of proper temperature and pressure. The joint surfaces will be smooth. The fused joint will be watertight and will have tensile strength equal to that of the pipe. All joints will be subject to acceptance by the Engineers and/or his representative prior to insertion. All defective joints will be cut out and replaced. Any section of the pipe with a gash, blister, abrasion, nick, scar, or other deleterious fault greater in depth than 10% of the wall thickness, will not be used and must be removed from the site. In addition, if in the opinion of the Engineers and/or his representative any section of pipe has other defects, including those hereinafter listed, that may indicate damaged, improperly manufactured, faulty, or substandard pipe, said pipe will be discarded and not used. Defects warranting pipe rejection include the following: concentrated ridges, discoloration, excessive spot roughness, and pitting; insufficient or variable wall thickness; pipe damage from bending, crushing, stretching or other stress; pipe damage that impacts the pipe strength, the intended use, the internal diameter of the pipe, internal roughness characteristics; or any other defect of manufacturing or handling.

The manufacturer must provide fusion training. The contractor (actual installers) and the onsite joint inspector must be trained by the manufacturer or manufacturer's authorized representative.

It will not be permitted to join unlike DR's to one another. Transition from unlike SDR's must be accomplished by mechanical couplings capable of identical pressure ratings or machined polyethylene nipples where a thicker wall polyethylene has been matched to the companion pipe wall.

Mechanical joining systems: Polyethylene pipe and fittings must be connected by means of a polyethylene flange adapter and backup ring. The polyethylene flange adapter will be of the same specifications as the Light View except will be made from black plate stock. This method is also approved to join to another piping system or valves. Mechanical compression couplings or full circle encasement clamps may be used depending on the test specification.

Mechanical couplings must be installed in accordance with the mechanical coupling manufacturer's recommended procedures.

The fusion equipment and operator must be required to demonstrate successful field experience. Regarding fusion over 36-in. capability, the fusion unit must be field tested for a period of five years and the fusion operator must have pipe size experience of the same pipe on the project for five years or longer.

- 3.3.5. **Protective Coating and Wrapping on Joints.** All bolts and nuts installed for underground service on cast-iron mechanical joint fittings and other ferrous metal appurtenances will be packed in an approved protective coating material after installation. After the joint has been made and bolts drawn to proper tension, the joint including glands, flanges, bolt heads, and nuts must be covered with an approved SAWS coating. Coating and wrapping of joints will be considered subsidiary to the installation and will not be paid for directly. Asphaltic material such as Talcote must not be used.

- 3.4. **Bypass Pumping – Small Diameter Sanitary Sewers.** For sanitary sewers less than 24-in. in diameter. During construction, it will be the Contractor's responsibility to maintain a safe and secure environment at all times. All provisions and/or requirements of the BPP must be followed throughout the course of any bypass flow operations. Contractor must notify the SAWS' Inspections Department 72 hr. prior to commencing the bypass pumping operations.

The Contractor must have full time (24-hour), onsite qualified pump personnel including supervision for monitoring the entire bypass installation while it is in operation. The entire length of bypass piping must be walked and inspected hourly to monitor for leaks. High-level alarm notification to cell phones must not eliminate this requirement. Where bypass pumping systems exceed 1,500-ft. in length or cannot be completely observed from the bypass pump location, at least one attendant must be assigned to the pump operation, and one additional attendant must be assigned to walk and monitor the pipeline.

Prior to installing any plugs, the Contractor and SAWS will inspect the existing pipe using a pole camera, for imperfections that might cause damage to the plug, cause the plug to not seal or function properly, or compromise the integrity of the pipe when the plug is inflated. The results of this inspection will directly impact the planned plugging location(s). Afford SAWS an opportunity to confirm that the location of plug(s) is acceptable.

Lines inserted into any manholes or structures must be constructed with elbows, or be otherwise angled, to direct discharge along the most efficient path for entry into the downstream line without causing unnecessary turbulence of flow. The termination point of the discharge piping must extend to the crown of the pipe housed within the manhole or structure receiving the bypassed flows.

Contractor must provide continuous supply on-site fuel storage sufficient for 24- hour operation of the bypass pumping installation.

Contractor must protect all components of the bypass operations from vandalism and vehicular damage by making the site secure.

Contractor must minimize sanitary sewer odors by using lids, shroud covers, or any method accepted by the Inspector or Engineer.

Contractor will be solely responsible for any and all damages to private and/or public property caused by, or during, the installation, operation, and/or removal of the bypass pumping system. Contractor will be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Once all work is completed and the bypass pumping operation is no longer required, the Contractor must disinfect and drain the entire BPP system in accordance with approved submittal.

SAWS will not be responsible for additional traffic control measures that might be required by CoSA, Bexar County, TxDOT, or any other public entity having jurisdiction of the project location.

Flow Tracking logs must be downloaded from the SAWS website (saws.org) in order to continuously track all flows being bypassed.

Plug installation:

- The Contractor will be solely responsible for the safe and effective use of plugs, including the proper combination of inflatable/mechanical plugs to block the sewer flow at both the upstream and downstream ends of a sewer bypass.
- Inflatable plugs should be used only after receiving training as recommended by the manufacturer.
- An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others corrective actions should be taken prior to the equipment use.
- Plugs must be selected and installed in accordance with the manufacturers recommendations.
- Plugs must also be selected and installed according to the size of the line to be plugged.
- Spare plugs – Provide spare plugs on-site ready to be installed in the event a plug fails or becomes dislodged.
- Plugs will be in good condition and reviewed by the Contractor for defects that might lead to failure prior to being installed. The Contractor must sign the Plug Inspection form.
- Plugs must be removed from the system upon completion of the work.
- Damages – The Contractor will be responsible for damages due to plugs being left in place or dislodged, including but not limited to: Damages to SAWS infrastructure or private property. Costs associated with sanitary sewer overflows including: regulatory fines; sewage and debris cleanup; debris disposal at an appropriate landfill; disinfection of all surfaces which have come in contact with the sewage. Costs associated with locating and retrieving lost or dislodged plugs.

3.5.

Bypass Pumping – Large Diameter Sanitary Sewer. For sanitary sewers 24-in. in diameter or greater. During construction, it will be the Contractor's responsibility to maintain a safe and secure environment at all times. All provisions and/or requirements of the BPP must be followed throughout the course of any bypass flow operations. When working inside manhole or force main, the Contractor should exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible or oxygen-deficient atmospheres, and confined spaces. Contractor must notify the SAWS' Inspections Department 72 hr. prior to commencing the bypass pumping operations. The Contractor must ensure that the temporary pumping system is properly maintained and a responsible operator must be on hand at all times when pumps are operating.

The Contractor must have full time (24-hour), onsite qualified pump personnel including supervision for monitoring the entire bypass installation while it is in operation. The entire length of bypass piping must be walked and inspected hourly to monitor for leaks. High-level alarm notification to cell phones must not eliminate this requirement. Where bypass pumping systems exceed 1,500-ft. in length or cannot be completely observed from the bypass pump location, at least one attendant must be assigned to the pump operation, and one additional attendant must be assigned to walk and monitor the pipeline.

Prior to installing any plugs, the Contractor and SAWS will inspect the existing pipe using a pole camera, for imperfections that might cause damage to the plug, cause the plug to not seal and function properly, or

compromise the integrity of the pipe when the plug is inflated. The results of this inspection will directly impact the planned plugging location(s). Afford SAWS an opportunity to confirm that the location of plug(s) is acceptable.

After installation of the plug, the Contractor must monitor on daily basis the radio transmitter battery and radio signal strengths. If either are found to be below the manufacturer's requirements the radio transmitter must be immediately replaced.

Lines inserted into any manholes or structures must be constructed with elbows, or be otherwise angled, to direct discharge along the most efficient path for entry into the downstream line without causing unnecessary turbulence of flow. The termination point of the discharge piping must extend to the crown of the pipe housed within the manhole or structure receiving the bypassed flows.

Contractor must provide continuous supply on-site fuel storage sufficient for 24- hour operation of the bypass pumping installation.

Contractor must protect all components of the bypass operations from vandalism and vehicular damage by making the site secure.

Contractor must minimize sanitary sewer odors by using lids, shroud covers, or any method accepted by the Inspector or Engineer.

Contractor will be solely responsible for any and all damages to private and/or public property caused by, or during, the installation, operation, and/or removal of the bypass pumping system. Contractor will be fully responsible for all damages and costs related to the installation, operation, and maintenance of Contractor's bypass pumping operations including damages, clean up, fines, penalties, and other related costs.

Once all work is completed and the bypass pumping operation is no longer required, the Contractor must drain the entire sanitary sewer system flows into an existing SAWS sanitary sewer manhole prior to disassembly and removal of the system from the construction site. The intent is to prevent spillage of sewage.

SAWS will not be responsible for additional traffic control measures that might be required by CoSA, Bexar County, TxDOT, or any other public entity having jurisdiction of the project location.

Flow tracking logs must be downloaded from the SAWS website (saws.org) in order to continuously track all flows being bypassed.

Plug Installation:

- The Contractor will be solely responsible for the safe and effective use of plugs, including the proper combination of inflatable/mechanical plugs to block the sewer flow at both the upstream and downstream ends of a sewer bypass.
- Inflatable plugs should be used only after receiving training as recommended by the manufacturer.
- An inherent danger exists with all inflatable products. If any conditions with this equipment exist that may jeopardize the safety of workers or others corrective actions should be taken prior to the equipment use.
- Plugs must be selected and installed in accordance with the manufacturers recommendations.
- Plugs must also be selected and installed according to the size of the line to be plugged.
- Spare plugs – Provide spare plugs on-site ready to be installed in the event a plug fails or becomes dislodged.
- Plugs will be in good condition and reviewed by the Contractor for defects that might lead to failure prior to being installed. The Contractor must sign the Plug Inspection form.
- Plugs must be removed from the system upon completion of the work.

- Damages – The Contractor will be responsible for damages due to plugs being left in place or dislodged, including but not limited to: Damages to SAWS infrastructure or private property. Costs associated with sanitary sewer overflows including: regulatory fines; sewage and debris cleanup; debris disposal at an appropriate landfill; disinfection of all surfaces which have come in contact with the sewage. Costs associated with locating and retrieving lost or dislodged plugs. If the plug is damaged, it must be immediately removed from the job-site.

3.6. **Manhole Construction.** Manholes must be constructed of materials and workmanship as prescribed by these specifications, at such places shown in the contract documents or as designated by the Engineer, and in conformity with the typical details and sketches shown.

Footings or bases of manholes must be a minimum of 6 in. in depth below the bottom of the pipe.

All invert channels of manholes are to be constructed and shaped accurately so as to be smooth, uniform and cause minimum resistance to flow. The bench is to be finished smooth with a slope of 1/2-in./ft. from the manhole walls to the edges of the invert. The top half of all sewer pipes within the invert channel or bench zone are to be removed flush to the inside manhole walls.

Joints on sewer pipes are not to be cast or constructed within the wall sections of manholes.

Concrete cradles are required for new pre-cast manholes. Concrete cradles are to be provided for all influent and effluent pipes on new monolithic manhole and sewer pipe systems. Concrete cradles are to extend beyond the outside walls of the manhole a minimum of 36-in.

Voids between exterior pipe walls and manhole walls at all pipe connections in manholes must be filled with a non-shrink grout, concrete or mortar, as approved by the Engineer or as shown in the contract documents and inspected prior to backfilling.

Where connections to existing manholes are required, the adjacent pipe bedding is to be prepared to proper grade, the existing manhole neatly cut and the new pipe inserted so that the end is projecting 2-in. from the inside wall. The invert is then to be reshaped to properly channel new flows. Debris of any kind is to be kept out of new or existing manholes or mains.

Joints between cones, risers, adjustment rings, flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top, as applicable, must be thoroughly sealed in accordance with manufacturer's recommendations with strongly adhesive bitumastic products as specified. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with non-shrink grout to a minimum thickness of 1/4-in.

After adjustment ring joints have been sealed as specified above and prior to the placement of final backfill and pavement, the Contractor must apply the specified heat shrink wrap around the outer perimeter of the adjustment "throat rings". All receiving surfaces must first be thoroughly cleaned to allow proper adhesion of the heat shrink wrap. Installation of the wrap must be in strict accordance with manufacturer's instructions and using the proper hot air equipment under suitable temperature and dry weather conditions. Provide sufficient vertical overlaps of the wrap around the base of the manhole ductile cast iron ring and the top of the manhole cone as applicable to the finished manhole geometry. Final backfill and pavement work must be conducted in a careful manner to avoid damaging the plastic wrap, as further specified below.

No more than 6 throat rings of 2-in. thickness, or no more than 4 throat rings of 3-in. thickness may be used on any new manhole. Manhole Ring Encasement. All manhole rings are to be encased with 4000 psi reinforced Class B concrete as shown on the plans or approved by the Engineer. Manhole ring encasements are to extend 6-in. below the top of the cone and have a minimum thickness when measured at the manhole ring of 1-ft. The surface of the encasement is to be 4-1/2-in. below the top of the manhole ring as shown on the plans or as approved.

Where manholes are constructed in existing streets and where directed by the Engineer or shown in the contract documents, the exterior exposed surfaces of the ring, mortar, throat rings and manhole surface must be coated with a ¼-in. minimum thickness of heat shrink wrap plastic prior to placement of concrete.

- 3.7. **Glass-Fiber Reinforced Polyester (FRP) Manholes.** Fiberglass manholes must be installed according to manufacturer's installation instructions. In addition to these instructions, local codes may apply and should be consulted as applicable in manhole installation. Correct manhole installation requires proper concrete foundation, good backfill and proper handling to prevent manhole damage and insure long term corrosion resistant service.

Prepare excavation at manhole location should be at least wide enough to accommodate the slab specified and to provide working room around manhole. Ensure the depth of manhole is sufficient to allow between two and four concrete rings for adjustment of ring and cover at top of final grade. Quarter marks have been provided on barrel to facilitate alignment.

To lift manhole, insert 4-in. x 4-in. timber crosswise inside the manhole to the underside of the collar with a rope or woven fabric slings attached to backhoe or other lifting device and lower the manhole. Level manhole and connect sewer lines to manhole. A concrete base encasement must be placed at least 12-in. from the manhole and must come over the top of the anti-flotation ring a minimum of 12-in.

Initial backfill material must be used for backfill around the manhole for a minimum distance of one foot from the outside surface and extending from the bottom of the excavation to the top of the reducer section. Secondary backfill material may be used for the remainder of the backfill, subject to pre-approval by the Engineer. An approved flowable fill material may also be used for backfilling operations.

Backfill material must be placed in layers of not more than 12-in. loose and mechanically tamped to 98% Standard Proctor Density. Flooding will not be permitted. Backfill must be placed in such a manner as to prevent any wedging action against the fiberglass manhole structure.

- 3.8. **Sanitary Sewer System Cleaning**

The sanitary sewer mains, manholes, and structures must be cleaned using mechanical, hydraulically-propelled, and/or high velocity sewer cleaning equipment. The cleaning process must remove all debris, grease, sand, silts, solids, rags, rock, etc. from each sewer segment, including the manhole(s) or structures. Selection of cleaning equipment and the method for cleaning must be based on the condition of the sanitary sewer lines at the time work commences and will be subject to SAWS' pre-approval. All cleaning equipment and devices must be operated by experienced personnel. Satisfactory precautions must be taken to protect the sanitary sewer lines, manholes, or structures from damage that might be inflicted by the improper use of the cleaning process or equipment. Any damages done to a sewer line manhole, or structure by the Contractor must be repaired by the Contractor at no additional cost and to the satisfaction of SAWS. Cleaning must also include the manhole or structure wall washing by a high pressure water jet.

Hydraulic Cleaning. Hydraulic-propelled devices which require a head of water to operate must utilize a collapsible dam. The dam must be easily collapsible to prevent damage to the sewer line, property, etc. When using hydraulically-propelled devices, precautions must be taken to ensure that the water pressure created does not cause damage or flood public or private property. The Contractor must not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or laterals. The flow of wastewater present in the sanitary sewer line must be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible.

High Velocity Cleaning. Cleaning equipment that uses a high velocity water jet for removing all debris must be capable of producing a minimum volume of 50 gpm, with a pressure of 1,500 psi, for the sanitary sewer main and 3,500 psi for the (manhole) structure at the pump. Any variations to this pumping rate must be pre-approved by the Inspector. To prevent damage to older sewer lines and property, a pressure less than 1,500 psi can be used. A working pressure gauge must be used on the discharge of all high pressure water pumps. The Contractor must use, in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18-in. and larger in diameter. The Contractor must operate the equipment so

that the pressurized nozzle continues to move at all times. The pressurized nozzle must be turned off or reduced anytime the hose is on hold or delayed in order to prevent damage to the line.

Mechanical Cleaning. Mechanical cleaning, in addition to normal cleaning when required, must be with approved equipment and accessories driven by power winching devices. The Contractor must submit the equipment manufacturer's operational manual and guidelines to the Inspector, which must be followed strictly unless modified by the Inspector. All equipment and devices must be operated by experienced operators so that they do not damage the pipe in the process of cleaning. Buckets, scrapers, scooters, porcupines, kites, heavy duty brushes, and other debris-removing equipment/accessories must be used as appropriate and necessary in the field, in conjunction with the approved power machines. The use of cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites, and other approved equipment, in conjunction with hand winching device, and/or gas, electric rod propelled devices, must be considered normal cleaning equipment.

In addition to the requirements specified herein, the Contractor must maintain a clean work area and surrounding premises within the work limits so as to comply with Federal, State, and local environmental and anti-pollution laws, ordinances, codes, and regulations when cleaning and disposing of waste materials, debris, and rubbish. The Contractor must also keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish. Suitable containers for storage of waste materials, debris, and rubbish must be provided until time of disposal. It is the sole responsibility of the Contractor to secure a licensed legal dump site for the disposal of this material. Under no circumstances must sewage or solids removed from the main or manhole be dumped on the ground, streets, ditches, catch basins, storm drains, or sanitary sewers. Cost for this item will be included in the price bid for sanitary sewer system cleaning.

In addition to the requirements specified herein, the Contractor must maintain a clean work area and surrounding premises within the work limits so as to comply with Federal, State, and local environmental and anti-pollution laws, ordinances, codes, and regulations when cleaning and disposing of waste materials, debris, and rubbish. The Contractor must also keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish. Suitable containers for storage of waste materials, debris, and rubbish must be provided until time of disposal. It is the sole responsibility of the Contractor to secure a licensed legal dump site for the disposal of this material. Under no circumstances will sewage or solids removed from the main or manhole be dumped on the ground, streets, ditches, catch basins, storm drains, or sanitary sewers. Cost for this item will be included in the price bid for sanitary sewer system cleaning.

The Contractor, when instructed, will be required to demonstrate the performance capabilities of the cleaning equipment proposed for use. If the results obtained by the proposed sanitary sewer cleaning equipment are not satisfactory, the Contractor must use different equipment or attachments, as required, to meet specification. More than one type of equipment or attachments may be required at a location. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam or suction must be constructed in the downstream manhole in such a manner that all solids and debris are trapped for removal.

Whenever hydraulically-propelled cleaning tools which depend upon water pressure to provide their cleaning force, or any tool which retard the flow of water in the sanitary sewer lines are used, precautions must be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole section involved. Any damage of property, as a result of flooding, will be the liability and responsibility of the Contractor. The flow of wastewater present in the sanitary sewer main must be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water must be conserved and not used unnecessarily. No fire hydrant must be obstructed or used when there is a fire in the area. The Contractor will be responsible for obtaining the water meter and all related charges for the set-up, including the water usage bills from respective water purveyor agency. All expenses will be considered incidental to the cleaning of the existing sanitary sewer system.

- 3.9. **Jacking, Boring, or Tunneling Pipe.** Jacking: Suitable pits or trenches must be excavated for the purpose of jacking operations for placing end joints of the pipe. When trenches are cut in the side of embankment, such work must be securely sheeted and braced. Jacking operations must in no way interfere with the operation of railroads, streets, highways or other facilities and must not weaken or damage such facilities. Barricades and lights must be furnished as directed by the Engineer to safeguard traffic and pedestrians.

The pipe to be jacked must be set on guides to support the section of pipe being jacked and to direct it in the proper line and grade. Embankment material must be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the opening thus provided.

The excavation for the underside of the pipe, for at least $\frac{1}{3}$ of the circumference of the pipe, must conform to the contour and grade of the pipe. A clearance of not more than 2-in. may be provided for the upper half of the pipe.

The distance that the excavation must extend beyond the end of the pipe will depend on the character of the material, but it must not exceed 2-ft. in any case.

Generally, the pipe should be jacked from the downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will be as shown in the contract documents or as determined by the Engineer. Any pipe that cannot be repaired to its original condition or is damaged in jacking operations must be removed and replaced at the Contractor's expense. Jacking pits must be backfilled immediately upon completion of jacking operations.

Excavation for "Boring" pits and installation of shoring will be as outlined under "Jacking." Boring operations may include a pilot hole which must be bored the entire length of crossing and must be used as a guide for the larger hole to be bored. Water or drilling fluid may be used to lubricate cuttings. Variation in line and grade will apply as specified under "Jacking."

Tunneling: Tunneling may be used when the size of the proposed pipe or the use of a monolithic sewer would make the use of tunneling more satisfactory than "Jacking" or "Boring." The excavation for pits and the installation of shoring will be as specified under "Jacking." The lining of the tunnel must be of the material shown on the plans.

Access holes for grouting annular space must be spaced a maximum of 10 ft.

Joints: Joints for pipe for "Jacking," "Boring," or "Tunneling," will be as specified in these specifications, or as shown on the project plans or shop drawings as per pipe manufacturer's recommendation.

Grouting of Bores or Tunnels: Annular Space between casing pipe and limits of excavation (borehole) must be pressure grouted, unless otherwise specified on the plans.

- 3.10. **Concrete Encasement, Cradles, Saddles and Collars.** Concrete Encasement. When concrete encasement is shown on the plans or when directed, the trench is to be excavated and fine graded to a depth conforming to the details and sections shown on the plans. The main must be supported by precast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement must then be placed to a depth and width conforming to the details and sections shown in the contract documents or per the referenced standard drawings.

Concrete Cradles. When concrete cradles are shown on the plans or when directed, the trench is to be prepared and the pipe supported in the same manner as described in Concrete Cradles, of this Section. The cradle must be constructed in accordance with details and sections shown on the plans. Strap/Tie Downs must be No. 4 rebar diameter minimum or better as determined by the Water System Inspector.

Concrete Saddles. When shown on the plans or when directed, pipe to receive concrete saddle is to be backfilled in accordance with this specification to the spring line and concrete placed for a depth and width conforming to details and sections shown on the plans.

Concrete Collars. When shown on the plans or when directed, concrete collars are to be constructed in accordance with details and sections shown on the plans.

- 3.11. **Existing Manhole Adjustments.** Existing manholes are to be adjusted or abandoned in accordance with TxDOT Item 479, "Adjusting Manholes and Inlets", and as specified herein.

Manholes must be lowered below street subgrade before placing base materials, and openings must be protected by temporary hatch covers. Manholes adjusted in non-paved areas must be set per proposed final grade.

Existing manhole rings and covers which are determined by the Inspector to be in an unacceptable condition, will be removed and replaced with new rings and covers. If the cone section is removed, the Contractor is to upgrade it to a 30-in. opening as required by 30 TAC § 217. All manhole openings upgraded to 30-in. will then be considered Reconstruction of Manholes and subjected to all provisions contained under the appropriate section in this specification. Contractor should take all necessary measures to prevent damage to existing or new rings, covers, or cones from equipment and materials used in, or taken through, the work area. If an existing or new manhole cover, ring, or cone is damaged by the Contractor, it must be replaced (as directed by the Inspector) by the Contractor at his own expense. If concrete throat rings are to be installed, they must be used in conjunction with a UV stabilized polyethylene liner and I/I barrier. I/I barrier must meet the following ASTM standards: ASTM D790/1505 Density of Polyethylene Materials, ASTM D1238-10 Melt Flow Index, ASTM 638-10 Tensile Strength @ Yield (50mm/mm), ASTM 790 Flexural Modulus, ASTM 648 Heat Deflection Temperature @ IGEPAL, ASTM 1693-12 EsCR, 100% IGEPAL/10% IGEPAL.

Manholes should be adjusted after the street's base material has been laid and before placing of the final surface course. Manholes that are going to be adjusted on an existing surface course (not planned for replacement) will be in accordance with the plans. All manholes should then be raised, or lowered a sufficient height so as to be level with the finished surface course. Adjustment in height will be made by the addition or removal of "throat rings" above the manhole cone, where feasible. A minimum of two and a maximum of six throat rings may be used at each adjusted manhole.

Joints between cones, risers, adjustment "throat rings", flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top must be thoroughly sealed in accordance with manufacturer's recommendations with strongly adhesive bitumastic products: RAM-NEK, as manufactured by Henry, Inc.; Kent Seal, as manufactured by Hamilton-Kent, Inc.; Encapseal, as manufactured by Miller Pipeline Corporation; or approved alternate. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with quick-set, non-shrink grout.

Material excavation from around the manholes must be replaced with flowable fill in accordance with these specifications, and select materials from the excavation (as shown in the contract documents). All excess materials must be disposed of by the Contractor at his own expense and in an approved location. The Contractor also has the option of backfilling with approved secondary materials, subject to the provisions in this specification.

Manholes existing on sewer lines replaced by new sewer piping and which are no longer needed for the revised sewer network are to be classified as "Abandon Manhole". Work required on an abandoned manhole is to consist of installing a permanent concrete plug on all pipes within the manhole, removing the top of the manhole to an elevation of 2-ft. below proposed subgrade or existing grade, whichever is the lower elevation, and backfilling the manhole with a grout material as specified. The ring and cover of the manholes are to be removed and delivered to Sanitary Sewer Owners facility designated by the Engineer. If directed, drainage holes are to be drilled in the bottom of manhole walls prior to backfilling.

- 3.12. **Reconstruction of Existing Manholes.** Manholes must be raised or lowered by replacing the existing cone and manhole section or sections as required for installation to the finished surface course. All openings must be protected by hatch covers or the necessary steel plates. The Contractor will be required to backfill all manholes with an approved flowable fill (in accordance with all requirements of the right-of-way owner having jurisdiction over the project scope) up to 1-ft. above the cone section. The Contractor also has the option of

backfilling with approved secondary materials, subject to the provisions of this specification. All excess materials (of any type) must be disposed of by the Contractor at his own expense, and in an approved location.

Reconstructed manholes must also be cleaned of any debris as required by the Inspector. If a new manhole cover, ring, or reconstructed manhole is damaged by the Contractor, it must be replaced (as directed by Inspector) by the Contractor at his own expense. All installed concrete throat rings must be used in conjunction with a UV stabilized polyethylene liner and I/I barrier as specified above. Coat all interior concrete surfaces with a SAWS approved coating system as specified above.

Voids between exterior pipe walls and manhole walls at all pipe connections in manholes must be filled with a non-shrink grout, as specified above, or as approved by the Engineer, or as shown in the contract documents and inspected prior to backfilling.

Joints between cones, risers, adjustment rings, flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top, as ductile cast iron ring and the uppermost adjustment ring or flat top, as applicable, must be thoroughly sealed in accordance with manufacturer's recommendations with strongly adhesive bitumastic products as specified above. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with non-shrink grout to a minimum thickness of ¼-in. 5.

- 3.12.1. **Manhole Ring Encasement.** All manhole rings must be encased with 4,000 psi reinforced concrete as shown in the contract documents or as approved by the Engineer.

Concrete manhole ring encasement must extend 6-in. below the top of the cone and have a minimum width when measured at the manhole ring of 1-ft. The surface of the encasement must be flush with the top of the manhole ring.

Where manholes are reconstructed in existing streets and where directed by the Engineer or shown in the contract documents, the exterior exposed surfaces of the ring, mortar, throat rings and manhole surface must be coated with a ⅛ inch minimum thickness of heat shrink wrap plastic prior to placement of concrete.

- 3.13. **Cut and Restore Pavement.** Where sewers must be installed in streets or other paved areas that are going to remain, the work is required to be in accordance with TxDOT Item 400, "Excavation and Backfill for Structures".

When allowed by the construction sequence shown on the plans or as directed, a "Temporary Concrete Cap" of the depth and class of concrete as shown on the plans or as directed may be used in lieu of a permanent repair.

- 3.14. **Concrete Sidewalks, Driveways, Curbs, Medians and Islands Replacement.** Existing concrete sidewalks, driveways, curbs, medians and islands required to be removed and replaced solely for sewer installation are to be a part of sewer work. Removal is to be in accordance with TxDOT Item 104, "Removing Concrete". Replacement is to be in accordance with the plans and with TxDOT Item 529, "Concrete Curb, Gutter and Combined Curb and Gutter", TxDOT Item 530, "Intersections, Driveways and Turnouts", TxDOT Item 531, "Sidewalks", and TxDOT Item 536, "Concrete Medians and Directional Islands".

Any work done due to damage to curbs, sidewalks, driveways, islands or medians outside the limits shown on the plans or approved in advance will not be measured for payment but is to be restored at the Contractor's expense.

- 3.15. **Removing and Replacing Chain-Link and/or Wire Fence.** Existing chain link or wire fences required to be removed solely for sewer installation is to be replaced as part of the sewer work to a condition comparable to that at removal. The existing fence materials may be reused if they are not damaged during removal. Any removal or damage to existing fences outside the limits shown in the plans or not approved in advance will not be measured for payment but is to be restored at the Contractor's expense.

3.16. **Abandon Sewer Lines.** Abandonment of existing sewer lines will be in accordance with the requirements under the "Grouting of Sewer Mains" section of this Special Specification.

3.17. **Sewer Main Television Inspection.**

3.17.1. **By-Pass Pumping.** The Contractor must perform bypass pumping operations in accordance with "By-Pass Pumping" sections of this Special Specification.

The Contractor must furnish all labor, supervision, tools, equipment, appliances, and materials to perform all operations in connection with bypass pumping of sewage flow for the purpose of preventing interference with the televising of the sanitary sewer manholes and mainlines as well as providing reliable sewer service to the occupants of the buildings being served.

3.17.2. **Post Repair TV Inspection.** Upon completion of any repairs required by the Inspector or Engineer, the Contractor will re-televising the sewer and submit these DVDs to the Inspector. These DVDs are to be permanently labeled as described in this specification, and are to be used as a portion of the acceptance criteria. This post repair-TV inspection is to be done to the satisfaction of the Engineer and is subject to the same acceptance criteria as the post construction-TV inspection DVDs. Post repair-TV inspection is to be provided at the Contractor's expense.

3.17.3. **Negotiability of Sewers.** The Engineer makes no guarantee that all of the sanitary sewer mains proposed to be TV inspected are clear for the passage of a camera.

No separate or additional payment will be made for any excavation, man entry or any other method, which may be required to retrieve video equipment that has been hung up, destroyed or lost during the televising operation.

3.18. **Reconstruct Manholes.** The reconstruction of existing manholes, all types and sizes, will include the replacement of manhole ring and covers, the replacing of existing cone, manhole section or sections required, regardless of the type shown on the plans, and as specified herein.

Manholes must be raised or lowered by replacing the existing cone and manhole section or sections as required for installation to the finished surface course. All openings must be protected by hatch covers or the necessary steel plates. The Contractor will be required to backfill all manholes with an approved flowable fill (in accordance with all requirements of the right-of-way owner having jurisdiction over the project scope) up to 1-ft. above the cone section. All excess materials (of any type) must be disposed of by the Contractor at his own expense, and in an approved location. All openings will be protected by hatch covers or steel plates, as needed.

Reconstructed manholes will be cleaned of any debris as accepted by the San Antonio Water System's Inspector. If a new manhole cover, ring, or reconstructed manhole is damaged by the Contractor, it will be replaced, as directed by the San Antonio Water System Inspector, by the Contractor, at his expense. All installed concrete throat rings must be used in conjunction with a UV stabilized polyethylene liner and I/I barrier. Coat all interior concrete surfaces with a SAWS approved coating system as specified.

Voids between exterior pipe walls and manhole walls at all pipe connections in manholes must be filled with a non-shrink grout, as specified above, or as approved by the Engineer, or as shown in the contract documents and inspected prior to backfilling.

Joints between cones, risers, adjustment rings, flat tops, and between the ductile cast iron ring and the uppermost adjustment ring or flat top, as ductile cast iron ring and the uppermost adjustment ring or flat top, as applicable, must be thoroughly sealed in accordance with manufacturer's recommendations with strongly adhesive bitumastic products as specified above. Where precast concrete risers are used, any gaps in the outer joint surfaces must be additionally coated with non-shrink grout to a minimum thickness of ¼ inch.

3.19. **Air Release Assembly.** Air release valves and appurtenant items will be installed at the locations shown on the plans unless otherwise directed.

- 3.20. **Anchorage and Blocking.** Suitable reaction blocking or anchorage will be provided at all locations specified on the plans. Anchor blocks will be constructed solidly behind the fitting and symmetrical with the axis of resultant thrust except where this is not possible as in the case of gravity anchorage for vertical bends. Special ties and anchor fittings may be utilized in conjunction with blocking when shown on the plans or as directed.

Concrete blocking for mains will be a minimum of 3,000 psi placed between solid ground and the fitting except as otherwise shown on the plans. The area of bearing in contact with solid ground will be that shown on the plans or as directed.

All thrust blocking placed in conjunction with mains and appurtenances constructed in Pressure Zones (formally known as Service Levels) 9 through 15 must be in accordance with the plans. In all cases, the design of thrust blocking must be of sufficient size to withstand a soil pressure of 3,000 psf, unless specified otherwise in the job plans or specifications. The maximum soil pressure value that will be allowed for the design of thrust blocking must be 5,000 psf. When soil pressure bearing values of 4,000 psf or 5,000 psf are recorded for design of thrust blocks, copies of soil tests made for determining the bearing value of the soil in question must be submitted to the Engineering for verification.

The blocking must be placed so that pipe and fitting joints will be accessible. Pipe polywrap must be placed between the pipe or fitting and the concrete.

The reaction block on the unused branch of a fitting must be poured separately from the block across the back of the fitting. If they are poured simultaneously, a rigid partition must be placed between the blocks.

Valves 12-in. or larger in size must be supported on a concrete pad extending vertically from 12-in. below the bottom of the valve to the lower quarter point of the hub and laterally from face to face of hubs and transversely from wall to wall of the trench.

- 3.21. **Rehabilitation of Sanitary Sewer by Cured-In-Place Pipe (Hot Water or Steam Cured).**

- 3.21.1. **Installer Qualification Requirements.** Installation of the CIPP products must be performed by a work force that is experienced and certified in installation of the products. The installer must be certified by the CIPP product manufacturer to have been trained and approved in the installation of their CIPP products and have a minimum of 3 years total experience with the product. The Contractor must submit such certification of hot water or steam cured CIPP Installer to Owner. Contractor must also submit to Owner at least five (5) recent references of the CIPP installer, indicating successful installation of proposed hot water or steam cured CIPP on projects of similar size and scope. Installer's project manager must have a minimum of 3 years of CIPP installation experience and must be onsite during the installation of the CIPP products.

- 3.21.2. **Installer Equipment Requirements.** Installer must only use hot water or steam curing equipment that has been certified and approved for use by the CIPP product manufacturer.

- 3.21.3. **Public Notification.** The Contractor must maintain service usage throughout the duration of the project. In the event that a service will be out of service, the maximum amount of time of no service will be 8 hr for any property served by the sewer. A public notification program must be implemented, and must at a minimum, require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer informing them of the work to be conducted, when the sewer will be offline, and any alternative method of service that may be provided.

Written notice to be delivered to each home or business two business days prior to the beginning of work being conducted on the section, and a local telephone number of the Contractor they can call to discuss the project or any problems which could arise.

Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

Inform SAWS Inspection Department 48 hr. prior to starting the work.

- 3.21.4. **Protection.** The Contractor must provide for the general safety of workers, pedestrians and traveling public throughout the project. Existing surface improvements and underground facilities and utilities must also be protected. Damage caused by the Contractor must be repaired at his own expense. Protection to be provided must include but not be limited to:
- Provide barricades, warning lights and signs for excavations created by point repairs and/or excavation pits. Conform to requirements of TxDOT, City of San Antonio, Bexar County, or any other governing entity, and of contract documents.
- Protection of Manholes/Structures: Install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes/structures, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances will the liners be stressed beyond their elastic limit.
- Do not allow sand, debris, or runoff to enter sewer system.
- Verify location of all underground utilities and facilities potentially impacted by rehabilitation or other related project activities and take necessary precautions to provide protection from damage. Damage caused by the Contractor will be his responsibility and repaired at no additional cost to SAWS.
- Protect the liner and components during all phases of work including, but not limited to hauling, installation, entry into the entry pit, and prevention of scarring or gouging of the liner, pipe or components.
- Contractor will be responsible for monitoring weather prior to planning a CIPP tube insertion to account for a sufficient duration of tube wet out and insertion and curing in order to ensure that wet weather that will prevent access to the project site is accounted for. Contractor's failure to account for oncoming weather will be Contractor's sole responsibility which may extend to removal of damaged or improperly cured CIPP resulting from interrupted CIPP construction process.
- Contractor must notify owner 72 hr. prior to liner wet out process for approval. Weather conditions and on-site conditions need to be considered.
- One (1) hour prior to liner being installed, Contractor must televise host pipe with Inspector present to ensure no pipe condition changes have occurred.
- 3.21.5. **Access Pit Location.** Location and number of insertion or launching pits will be chosen by the Contractor and approved by SAWS, and will typically be located at or near existing or proposed manholes or junction boxes, Points of Intersection (P.I.) in the line, at logical breaks in the construction phasing, or at locations to comply with access or maintenance requirements. The ends of the insertion excavation pit must be sloped 2:1 or flatter, or proper shoring devices must be used. Pits must be placed and located to minimize the total number of pulls and maximize the length of CIPP, within the constraints of maintaining service and access and other requirements. When excess ground water is encountered, it must be removed by the Contractor, and will be considered incidental to the project.
- 3.21.6. **Sewage Bypass.** A detailed bypass plan must be submitted by Contractor and approved prior to starting work. The bypass plan must be developed in accordance with the Bypass Pumping sections of this specification.
- 3.21.7. **Cleaning and Television Inspection.** Before installing the new pipe, the existing sewer must be cleaned and television inspected per the requirements of this specification. Notify SAWS Inspection Department of any conditions which may prevent proper installation of the liner. All CCTV work will confirm active laterals and location.
- 3.21.8. **Point Repairs and Obstruction Removal.** SAWS must be notified and must approve any point repair or obstruction removal before it is constructed. Point Repairs and Obstruction Removals must conform the requirements of this specification.

3.21.9. **Pipe Leakage Control.** Contractor must stop infiltration or leakage into the existing pipeline to prevent contamination of resin in liner.

3.21.10. **Operation.** CIPP installation must be in accordance with ASTM F1216, Section 7, or ASTM F1743, Section 6, and manufacturer's recommendations with the following modifications:

Resin Impregnation – The quantity of resin used for tube impregnation must be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall. A vacuum impregnation process must be used. To ensure thorough resin saturation throughout the length of the felt tube, the point of vacuum must be no further than 25-ft. from the point of initial resin introduction.

After vacuum in the tube is established, a vacuum point must be no further than 75-ft. from the leading edge of the resin. The leading edge of the resin slug must be as near to perpendicular as possible. A roller system must be used to uniformly distribute the resin throughout the tube. If the installer uses an alternate method of resin impregnation, the method must produce the same results. Any alternate resin impregnation method must be proven.

Tube Insertion – The wetout tube must be positioned in the pipeline using either inversion or a pull-in method. Under the inversion method, care must be taken during the inversion process so as not to over-stress the tube. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extended to the next designated manhole or termination point. The Contractor must install a gauge to monitor the pulling force of the pulled in tube. A written log must be kept noting the pulling force and any fluctuations in the pulling force. The force must not exceed the manufacturer's recommendations. Any occurrences exceeding the manufacturer's recommendations will be cause for rejection of work.

The manufacturer must provide the minimum pressure required to hold the tube tight against the existing conduit, and the maximum allowable pressure so the tube is not damaged. These pressure ranges must be maintained until the inversion has been completed. A temporary water meter must be installed on the fire hydrant, if used for inversion process. The cost to coordinate and install the meter for construction purposes will be at the Contractor's expense.

Temperature gauges must be placed between the impregnated tube and the existing pipe at the invert level of each end to monitor the temperatures during the cure cycle. A written log must be kept and submitted to the owner. Any invalid temperature readings not recommended from the manufacturer will be cause for rejection.

The curing must be accomplished by utilizing hot water or steam under hydrostatic pressure in accordance with the manufacturer's recommended cure schedule. After the tube is cured, the new pipe must be cooled to a temperature below 100° F (38° C) before relieving the internal pressure within the section. In addition, care must be taken during cool down so that a vacuum will not develop that may damage the newly installed pipe.

The finished pipe must be continuous over the entire length of an inversion run and be free of dry spots, lifts, and delaminations. If these conditions are present, the Contractor must remove and replace the CIPP in these areas at no cost.

Branch connections or service reconnections must be reopened without excavation, utilizing a remote controlled cutting device, monitored by a video TV camera. The Contractor must certify he has a minimum of 2 complete working cutters plus spare key components on the site before each inversion. Unless otherwise directed by the owner or his authorized representative, all laterals will be reinstated. Open cut excavation for service reconnections will only be allowed if it has been approved in writing from a SAWS Inspector. Service reconnections must be in accordance with this specification. Contractor must provide all coupons removed as part of the reinstatement of service process to confirm that a) the appropriate number of service connections has been made and b) no coupons were left in the pipe to create an obstruction.

3.21.11. **Clean Up.** Upon acceptance of the installation work and testing, the Contractor must restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

3.22. **Point Repairs.**

3.22.1. **General.** Locate and replace small lengths of one or more pipe sections where isolated line failure has occurred due to settlement, corrosion, crushing, or separation of joints.

The Inspector may identify potential locations for point repair, but the Contractor is responsible for verifying locations.

Determine the location of service line repairs by smoke testing the manhole section in which the failed pipe is located. The Saws Engineer will authorize the Contractor to make point repairs based on results of smoke testing.

Smoke testing must not be performed within 24 hr. of a rainfall event or if ponded or standing water is present on the ground or in the drainage channels in the area planned for smoke testing.

Smoke testing must be accomplished utilizing two minimum 1,750 CFM blowers designed specifically for smoke testing of sewers. Place blower on the upstream and downstream manhole of the line section to be tested. Place sandbags in the upstream and downstream manholes to isolate the section being tested and prevent the migration of smoke into sections not being tested. Utilize smoke bombs as necessary to ensure a continuous supply of smoke is provided for the entire duration of the test period.

Determine the location of point repairs by smoke testing or video inspection of the manhole section in which the failed pipe is located. The Inspector will authorize the Contractor to make additional point repairs. Replace all identified damaged pipe for point repairs unless otherwise directed by the Inspector.

The Inspector will authorize each point repair after failure points are located. Do not make point repairs without prior authorization of the Inspector. Perform point repairs only on those portions of service lines which are located in an easement or right-of-way; perform no repairs to service lines on private property.

3.22.2. **Typical Sequence of Point Repair.** Perform pre-installation video inspection, if required, to verify location of sewer main point repair locations. Perform service testing between manholes to verify location of service lateral point repair locations.

After the location of a point repair is determined, excavate the required length for the point repair.

Prior to replacing a damaged section(s) of pipe, determine condition of the existing line on both sides of the point repair by lamping the main at least 10-ft. in each direction. Determine whether additional lengths of main (beyond "minimum length" criteria) need replacement. Report need for additional replacement to Inspector and obtain authorization before proceeding.

Remove the damaged section(s) pipe and replace with new pipe, shaping the bottom of the trench and placing the required pipe bedding so that the grade of the replaced pipe matches the grade of the existing main. Establish proper grade for the section(s) of pipe being replaced using methods acceptable to the Inspector.

Connect the new pipe to existing main using flexible adapters. If joints cannot be made watertight using flexible adapters, place waterstop gaskets on each joint and encase in a reinforced concrete collar. Reconnect affected service connections or stacks using full-bodied fittings. No field fabrication of fittings is allowed.

After completion of point repair, and prior to backfill, perform a smoke test to demonstrate satisfactory integrity of the repair, in the presence of the Inspector. Test as specified in this specification. Repair and retest sections that fail until repaired sections pass the test.

Encase exposed pipe in cement stabilized sand. Backfill the excavation as specified in this specification.

Perform a post-installation video inspection as specified in these specifications. Point repairs that show offset joints, non-uniform grade, incorrect alignment, excessive deflection or similar conditions are considered defective work. Contractor must replace pipe and bedding, as required, to correct defective work.

- 3.22.3. **Abandonment of Point Repair.** Notify the Inspector if a pipe is exposed by excavation and is found to be in good condition, not requiring a point repair. That point repair must not be performed.

Notify the Inspector if the pre-installation video inspection reveals that no point repair is required. The point repair must not be performed.

Backfill the excavation, replace pavement or sidewalk, and repair and seed or sod unpaved areas. No separate pay item.

- 3.22.4. **Obstruction Removal.** Remote Device: Remove obstructions identified on video of a sanitary sewer line segment which could cause a non-uniform liner pipe installation or obstruction of the liner during installation. Obtain authorization from the Saws Construction Inspector for obstruction removal with a remote device before proceeding.

Use a power-driven cutting device (robotic cutter) to remove protruding taps. Cut protruding taps so that protrusions are no greater than $\frac{3}{4}$ -in. If a protruding tap cannot be removed by the cutting device, then a point repair may be performed. Obtain authorization from the Saws Construction Inspector before proceeding.

To remove other obstructions, use a remote device. Pull or drive the device from manhole to manhole up to a continuous length of 500-ft. using a solid steel mandrel, porcupine, root saw, bucket, robotic cutter or similar device to remove the obstruction. Select a device that is adequately sized to remove the obstruction.

Use excavation as the method of obstruction removal when installation of the liner in the sanitary sewer is in progress. If during the liner insertion operation, a collapsed sewer, offset joint, or other obstruction is encountered which prevents or blocks the passage or insertion of the liner, notify the Inspector for authorization to excavate.

Excavate at the point where there is an obstruction. Use a trench safety system as required.

Break out the existing sanitary sewer pipe (carrier pipe) as directed by the Saws Construction Inspector. Remove only that amount of material which is causing the obstruction. Remove the minimum amount of carrier pipe.

Under such conditions, replacement of the carrier pipe is not required. Do not disturb the existing sewer bedding during excavation. However, if embedment is disturbed during the obstruction removal procedure, place cement-stabilized sand or crushed stone beneath the liner. No Separate pay item.

When the liner is completely in place, encase it with crushed stone or cement- stabilized sand.

- 3.22.5. **By-Pass Pumping.** Install and operate bypass pumping equipment as required to maintain sewage flow and to prevent backup or overflow. Comply with "Bypass Pumping" sections of this specification.

3.23. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process.**

- 3.23.1. **Pit Location.** Location and number of insertion or launching pits will be chosen by the Contractor, and will typically be located near existing or proposed manholes, P.I.'s in the line, at logical breaks in the construction phasing, or at locations to comply with access or maintenance requirements.

Pits must be placed and located to minimize the total number of pulls and maximize the length of pipe replaced per pull, within the constraints of maintaining service and access and other requirements. Use excavations at point repair locations for insertion pits where possible.

- 3.23.2. **Operations.** The Contractor must provide equipment, planning, and job execution necessary to accomplish the work in an efficient manner and consistent with the objectives of this specification, including preventing damage to existing infrastructure, maintaining pedestrian and vehicle access, and providing continual sewer service to customers.

Pipe must be assembled and fused on the ground in sections equivalent to the length of the anticipated pull. During installation, all bending and loading the pipe will be in conformance with manufacturer's recommendations and must not damage the pipe.

Manholes must be prepared so as to provide pipe installation at the lines and grades indicated in the contract documents. The invert in the manholes must be removed as required to allow for pipe installation activities and to accommodate invert replacement. Manhole inverts must be restored upon completion with 3,000 psi grout so as to establish a minimum 4-in. thick bottom on the manhole after shaping per the contract documents.

- 3.23.3. **Equipment.** The Contractor must utilize pipe bursting/crushing equipment with adequate pulling/pushing force to complete pulls in timely manner. The Contractor must provide equipment on the pulling mechanism to verify the pulling/pushing force exerted on the pipe does not exceed the manufacturer's recommendation for allowable pulling force to prevent damage to the pipe. The pulling force may not exceed the following: 6 tons for 8.625-in. O.D.; 10 tons for 10.75-in. O.D.; 17 tons for 14-in. O.D.; 23 tons for 16-in. O.D.; 28 tons for 18-in. O.D. Allowable pulling force for all diameters must be determined by the Contractor depending on the pipe size, wall thickness, manufacturer, field conditions, pull distance, manhole integrity, bearing capacity of soils, adjacent infrastructure, related equipment and cable strength, and related considerations.

- 3.23.4. **Equipment Configuration.** Equipment must be configured with adequate knives or other appropriate devices to minimize interruptions in the installation process due to obstruction removal and other problems. Pipe must be secured to the pulling/pushing device in accordance with standard practice. The diameter of the pulling/pushing head must be equal or slightly greater than the pipe O.D.

- 3.23.5. **Minimize Noise Impact.** Equipment used to perform the work will be located away from buildings so as not to create noise impact. Provide silencers or other devices to reduce machine noise as required to meet requirements.

- 3.23.6. **Protection.** The Contractor must provide for the general safety of workers, pedestrians and traveling public throughout this project. Existing surface improvements and underground facilities and utilities must also be protected. Damage caused by the Contractor must be repaired at his own expense. Protection to be provided includes:

Provide barricades, warning lights and signs for excavations created by point repairs. Conform to requirements of TxDOT, City of San Antonio, and of contract documents.

Protection of Manholes. The Contractor will install all pulleys, rollers, bumpers, alignment control devices and other equipment required to protect existing manholes, and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances will the pipes be stressed beyond their elastic limit.

Do not allow sand, debris, or runoff to enter the sewer system.

Verify location of all underground utilities and facilities potentially impacted by rehabilitation related or other project activities and take necessary precautions to provide protection from damage. Damage caused by the Contractor will be at his cost and responsibility.

Protect the new pipe and components during all phases of work, including hauling, installation, entry into the entry pit and prevention of scarring or gouging of the pipe or components.

- 3.23.7. **Sealing Liner in Manhole.** Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes at least 12 hr. for polyethylene.

Cut liner so that it extends four in. into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.

Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and non-shrink grout. Place strips of oakum soaked in sealer (Scotchseal 5600 as manufactured by 3M Corporation, or approved equal) in a band to form an effective water-tight gasket in the annular space between liner and existing opening in manhole. Make width of the sealing band a minimum of eight in. or the thickness of the manhole wall, whichever is greater.

Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than six in. wide.

Reshape and smooth the manhole invert. Form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

- 3.24. **Slip-lining Sanitary Sewers.**

- 3.24.1. **Obstruction Removal and Point Repair.** Make point repairs and remove obstructions, such as roots, rocks and other debris, prior to installing liner pipe. Inspector is to first validate the need for either an obstruction removal or point repair. Refer to "Obstruction Removal" under "Point Repair" section of this specification.

- 3.24.2. **By-Pass Pumping.** Install and operate bypass pumping equipment as required to maintain sewage flow and to prevent backup or overflow. Comply with "Bypass Pumping" section of this specification.

- 3.24.3. **Insertion or Access Pits.** Locate pits so that the total number is minimized and footage of liner pipe installed in a single pull is maximized. Where possible, use excavations at point repair locations for insertion pits.

Before excavating, check with various utility providers (e.g., CPS Energy, AT&T, Time Warner, etc.), and determine locations of utilities in or near the work area. Costs of utility repairs, temporary service and other costs arising out of damage to, or interruption of, utilities, resulting from operations under this Contract, will be borne by Contractor at no additional cost to SAWS.

Perform excavation and backfill in accordance with this specification. Perform excavation requiring trench safety in accordance with OSHA standards and this specification. Install and operate necessary dewatering and surface water control measures.

- 3.24.4. **FRP Liner Pipe Installation.** FRP Liner pipe may be pushed or pulled into existing sewers. Insert pipes, spigot end first, with bell end trailing. Apply pushing force to pipe wall end inside bell in accordance with manufacturer's instruction. Do not apply jacking loads to end of bell. Maximum allowable joint angular deflection one degree.

- 3.24.5. **Clamp Installation.** Where excavations for liner pipe insertion are made between two manholes, cut ends of liner pipe smooth, square to pipe axis. Join liner pipes with appropriately sized stainless steel universal clamp couplings. Butt together gap between ends of liner pipe with space between ends not exceeding 2 in.
- Install bedding in accordance with this specification.
- 3.24.6. **FRP Collar/Closure.** Install FRP collar closure pieces in accordance with manufacturer's recommendations.
- 3.24.7. **Field Quality Control.** After liner installation, perform the following tests:
- Service lateral connection test: After all service laterals have been completed for a particular sewer section, verify integrity of re-connections at points where they join liners and existing service lines by performing smoke test.
- 3.24.8. **Sealing Liner in Manhole.** Allow liner pipe to normalize to ambient temperatures and recover from imposed stretch before cutting to fit between manholes, sealing at manholes and shaping manhole invert. Allow at least 12 hr. for normalization of polyethylene.
- Cut liner so it extends 4-in. into manhole. Make smooth, vertical cuts and slope areas over top of exposed liner using non-shrink grout.
- Seal annular spaces between liner and sanitary sewer main at each manhole with chemical seal and non-shrink grout. Place strips of oakum soaked in sealer in a band to form effective water-tight gasket in annular space between liner and existing pipes in manhole. Make width of the sealing band at least 12-in., or one-half pipe diameter, whichever is greater.
- Finish seal liner pipe to host pipe with non-shrink grout placed around annular space from inside manhole. Apply grout in a band at least 6-in. wide. Obtain the SAWS Engineer's approval of sealing methods, including seal chemicals and materials.
- Use cementitious grout to form smooth transitions with reshaped inverts and raised manhole benches to eliminate sharp edges of liner pipe, concrete benches, and channeled inverts. Build up and smooth manhole invert to match flow line of new liner.
- 3.24.9. **Grouting Annular Space.** Provide grouting plan and obtain approval of grouting plan from SAWS Engineer before proceeding with the Work.
- Grout annular space between the outside of liner and inside of existing pipe for sewer pipe 18-in. in diameter and larger.
- 3.24.10. **Post Installation Videotape Recording.** Provide the SAWS Engineer with DVD showing completed work including condition of restored connections. Comply with requirements of "Television Inspection" of this specification.
- 3.24.11. **Final Clean-up.** Upon completion of installation and testing, clean and restore project area affected by work of this Section. No separate pay item.
- 3.25. **Sanitary Sewer System Cleaning.** The Contractor will be required to have all materials, equipment, and labor necessary to complete the cleaning of the sanitary sewer system on the jobsite prior to isolating it for the cleaning process. The Contractor must only use the type of cleaning identified below to perform the necessary removal of all material which will not create hazards to health, property, affect downstream treatment plant processes, or damage to the sanitary sewer system.
- The sanitary sewer mains, manholes, and structures must be cleaned using mechanical, hydraulically-propelled, and/or high velocity sewer cleaning equipment. The cleaning process must remove all debris, grease, sand, silts, solids, rags, rock, etc. from each sewer segment, including the manhole(s) or structures.

Selection of cleaning equipment and the method for cleaning will be based on the condition of the sanitary sewer lines at the time work commences and will be subject to SAWS' pre-approval. All cleaning equipment and devices must be operated by experienced personnel. Satisfactory precautions must be taken to protect the sanitary sewer lines, manholes, or structures from damage that might be inflicted by the improper use of the cleaning process or equipment. Any damages done to a sewer line manhole, or structure by the Contractor must be repaired by the Contractor at no additional cost and to the satisfaction of SAWS. Cleaning must also include the manhole or structure wall washing by a high pressure water jet.

- 3.25.1. **Hydraulic Cleaning.** Hydraulic-propelled devices which require a head of water to operate must utilize a collapsible dam. The dam must be easily collapsible to prevent damage to the sewer line, property, etc. When using hydraulically-propelled devices, precautions should be taken to ensure that the water pressure created does not cause damage or flood public or private property. The Contractor must not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or laterals. The flow of wastewater present in the sanitary sewer line must be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible.
- 3.25.2. **High Velocity Cleaning.** Cleaning equipment that uses a high velocity water jet for removing all debris must be capable of producing a minimum volume of 50 gpm, with a pressure of 1,500 psi, for the sanitary sewer main and 3,500 psi for the (manhole) structure at the pump. Any variations to this pumping rate must be pre-approved by the Inspector. To prevent damage to older sewer lines and property, a pressure less than 1,500 psi can be used. A working pressure gauge must be used on the discharge of all high pressure water pumps. The Contractor must use, in addition to conventional nozzles, a nozzle which directs the cleaning force to the bottom of the pipe for sewers 18-in. and larger in diameter. The Contractor must operate the equipment so that the pressurized nozzle continues to move at all times. The pressurized nozzle must be turned off or reduced anytime the hose is on hold or delayed in order to prevent damage to the line.
- 3.25.3. **Mechanical Cleaning.** Mechanical cleaning, in addition to normal cleaning when required, must be with approved equipment and accessories driven by power winching devices. The Contractor must submit the equipment manufacturer's operational manual and guidelines to the Inspector, which must be followed strictly unless modified by the Inspector. All equipment and devices must be operated by experienced operators so that they do not damage the pipe in the process of cleaning. Buckets, scrapers, scooters, porcupines, kites, heavy duty brushes, and other debris-removing equipment/accessories must be used as appropriate and necessary in the field, in conjunction with the approved power machines. The use of cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites, and other approved equipment, in conjunction with hand winching device, and/or gas, electric rod propelled devices, must be considered normal cleaning equipment.
- 3.25.4. **General Requirements.** In addition to the requirements specified herein, the Contractor must maintain a clean work area and surrounding premises within the work limits so as to comply with Federal, State, and local environmental and anti-pollution laws, ordinances, codes, and regulations when cleaning and disposing of waste materials, debris, and rubbish. The Contractor must also keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish. Suitable containers for storage of waste materials, debris, and rubbish must be provided until time of disposal. It is the sole responsibility of the Contractor to secure a licensed legal dump site for the disposal of this material. Under no circumstances must sewage or solids removed from the main or manhole be dumped on the ground, streets, ditches, catch basins, storm drains, or sanitary sewers. Cost for this item will be included in the price bid for sanitary sewer system cleaning.

The Contractor may be required to demonstrate the performance capabilities of the cleaning equipment proposed for use on the project. If the results obtained by the proposed sanitary sewer system cleaning equipment are not satisfactory to the Inspector, the Contractor must use different equipment and/or attachments, as required, to meet the requirements of the contract documents. More than one type of equipment/attachments may be required at any given location within the project scope. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam, or suction must be constructed in the downstream manhole in such a manner that all the solids and debris are trapped for removal.

Whenever hydraulically-propelled cleaning tools which depend upon water pressure to provide their cleaning force, or any tool which retard the flow of water in the sanitary sewer mains are used, precautions must be taken to ensure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole section involved. Any damage of property, as a result of flooding, will be the sole liability and responsibility of the Contractor. The flow of wastewater present in the sanitary sewer system must be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water must be conserved and not used unnecessarily. No fire hydrant must be obstructed or used when there is a fire in the area. The Contractor will be responsible for obtaining the water meter and all related charges for the set-up, including the water usage bills from respective water purveyor agency. All expenses will be considered incidental to the cleaning of the existing sanitary sewer system.

- 3.26. **Grouting of Sewer Mains.** Abandoning and grouting of sewer lines must not occur until all existing sewer mains and services have been transferred to a relocated sewer line or another line as designated in the Contract Documents. The Contractor will be responsible for the satisfactory coordination of the pipe abandonments with other construction and activities in the area. Delays in work resulting from lack of coordination must not be cause for additional compensation. Any work involving or impacting asbestos concrete pipe must be in accordance with the specifications.

Remove or pump out any free standing wastewater in compliance with TCEQ and EARZ requirements prior to starting grout placement.

Place grout/flowable fill using concrete or grout pumps capable of continuous delivery at planned placement rate to fill volume between placement points not to exceed 500 linear feet at a time. Pump grout/flowable fill through bulkheads constructed for placement of PVC pipes or other methods to contain grout in line to be abandoned. These pipes will be used for injection points or vents during placement. Place grout/flowable fill under pressure into properly vented open system until grout emerges from vent pipes indicating pipe is completely filled. Pumping must be completed under sufficient pressure to overcome friction and to fill sewer main from downstream to upstream end. Remediate areas where grout/flowable fill did not fill voids in sewer main by pressure grouting from inside sewer main or from surface if necessary. Plug each end of the sewer main being abandoned. Ensure that concrete is placed around plug/bulkhead and around pipe including bedding area, such that it is not penetrable by groundwater and that bedding at this location is not a conduit for groundwater. The method of installation must meet the requirement of completely filling the existing sewer main and any voids adjacent to it.

Backfill to grade above pipe left in place. Place and compact backfill in compliance with the Special Specifications.

Remove, transport, and dispose of spoils. Spoils including pipe, unused grout/flowable fill and other unsuitable materials must be hauled to a facility permitted to accept the material. The abandonment method must provide for the release of air. When intermediate points are required to be constructed for the abandonment of the system, they must be a part of the abandonment project process. The method must provide for the isolation of sewer mains to be grouted from sewer mains that are abandoned in place without grouting as shown on the plans.

Sewer mains that are not under proposed pavement are generally not required to be grouted unless it is specified in the contract documents. Mains to be abandoned must be grouted only if required by the contract documents and payment as per these specifications is provided.

4. TESTING

- 4.1. **Manhole Testing.** The Contractor must perform the testing for all sanitary sewer manholes in accordance with the following.

- 4.1.1. **Leakage Testing.** All manholes must pass a leakage test. The Contractor must test each manhole (after assembly and backfilling) for leakage, separate and independent of all other sanitary sewer piping, by means

of either a hydrostatic test, vacuum test, or other methods approved by the Engineer. The Contractor is hereby instructed to conduct either of the two identified tests in the following manner:

4.1.1.1. **Hydrostatic Testing.** Hydrostatic testing must be conducted by utilizing approved plugs to seal all influent and effluent pipes in the manhole and filling the manhole to the top of the cone with water. Additional water may be added over a 24-hour period to compensate for absorption and evaporation losses. At the conclusion of the 24-hour saturation period, the manhole must be filled to the top and observed. Any measureable loss within a 30 minute period will be considered an unsuccessful test and thus require the Contractor to assess the needed repairs, perform such repairs (subject to the approval of the Engineer), and notify the Inspector when the retest will be performed. All effort, materials, or other costs will be solely at the Contractor's expense.

4.1.1.2. **Vacuum Testing.** General: Manholes must be tested after construction/installation and backfilling with all connections (existing and/or proposed) in place. Drop connections and gas sealing connections must be installed prior to testing.

Test Procedure: The lines entering the manhole must be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs must be installed in the lines beyond drop connections, gas sealing connections, etc. Prior to performing the test, the Contractor must plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering the manhole. No grout must be placed in horizontal joints prior to testing. Contractor must use a minimum 60-in./lb torque wrench to tighten the external clamps that secure the test cover to the top of the manhole. The test head must be inflated in accordance with the manufacturer's recommendations. A vacuum of 10-in. of mercury must be drawn, and the vacuum pump will be turned off. With the valve closed, the level vacuum must be read after the required test time. If the drop in the level is less than 1-in. of mercury (final vacuum greater than 9-in. of mercury), the manhole will have passed the vacuum test. The required test time is 2 minutes.

Acceptance: Manholes will be accepted with relation to vacuum test requirements, if they meet the criteria above. Any manhole which fails the initial test must be repaired with a non-shrink grout or other suitable material based on the material of which the manhole is constructed. The manhole must be retested as described above until a successful test is attained. After a successful test, the temporary plugs will be removed. To ensure that the plugs have been removed, Contractor must only do so in the presence of the Inspector.

Repairs to Existing Manholes: Any existing manhole which fails to pass the vacuum test must be closely examined by the Inspector and the Contractor to determine if the manhole can be repaired. Thereafter, the Contractor must either repair or remove and replace the manhole as directed. The manhole must then be retested and coated with a SAWS-approved sewer coating as stated above. The Owner may elect to simply remove and replace the existing manhole with a new one. Any manhole excavated for repairs or excavated for tie in, must be backfilled with flowable fill up to 1-ft. below the top of the cone.

Measurement and Payment: Vacuum testing of new structures will not be a pay item. The cost of this work will be included in the bid price for the new manhole. Each vacuum test of an existing manhole will be a separate pay item. Repairs to existing manholes will be a separate pay item when authorized.

4.1.2. **Holiday Testing.** Inspect each sanitary sewer manhole using high-voltage holiday detection equipment. All detected holidays must be marked and repaired by abrading the coating surface with grit disk paper, or other hand tooling method. After abrading and cleaning, additional protective coating material must be applied to the repair area. All touch-up repair procedures should follow the protective coating manufacturer's recommendations.

If a sanitary sewer manhole fails to pass one of the above tests, it must be repaired in accordance with the manufacturer's recommendations and re-tested. It will not be accepted until it passes all tests. All repairs and re-testing will be at no additional cost to SAWS.

4.2. **Sanitary Sewer Pipe Low Pressure Air Testing.** The Contractor must perform a low pressure air test, or an infiltration/exfiltration test, and a mandrel test before the installed work will be considered accepted. If a

gravity collection main is composed of flexible pipe, a deflection test will also be required. Flexible pipe is defined as pipe that will deflect at least 2% without structural distress. Contractor must insure that all testing is performed in the presence of the Inspector, with copies of all written test results made available to the Inspector.

Materials for Air Testing. The Contractor is to furnish all materials and equipment for air testing including the Air Compressor.

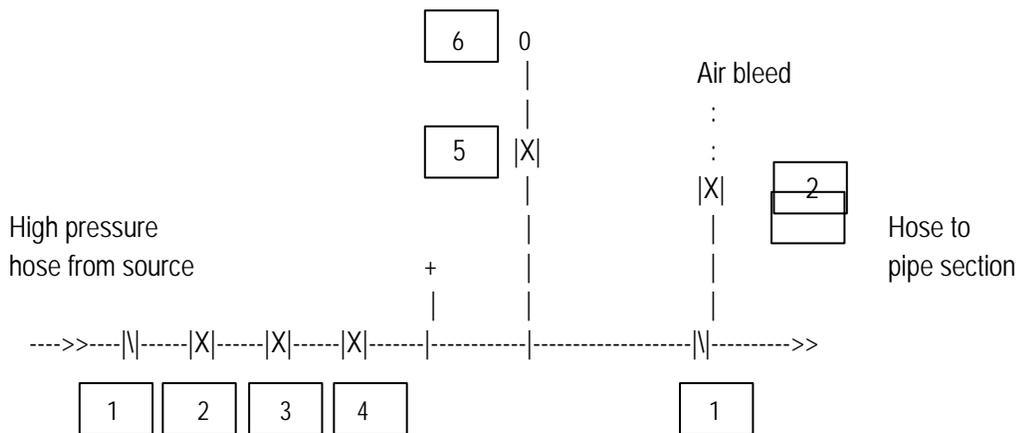
Compressor Air Supply. Any source which will provide at least 300-cu. ft. per minute at 100 pounds per square inch.

The equipment for air testing will consist of valves, plugs, and pressure gauges used to control the rate at which air flows to the test section and to monitor the air pressure inside the plugs and, for large diameter pipe, joint testers as manufactured by Cherne Industrial, Inc., of Edina, Minn., or an approved equal. Test equipment is to be assembled as follows and as shown in Figure 1 below:

- Hose connection,
- Shut off valve,
- Throttle valve,
- Pressure reduction valve,
- Gage cock, and
- Monitoring pressure gage.

Figure 1

Air Testing Equipment Assembly Order



Test Procedures.

The procedure for the low pressure air test must conform to the procedures described in ASTM C-828, ASTM C-924, ASTM F-1417 or other appropriate procedures, except for testing times. The test times will be as outlined in this section. For sections of pipe less than 36-in. average inside diameter, the following procedure will apply unless the pipe is to be joint tested. The pipe must be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure is stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge must be computed from the following equation:

$$T = (0.085 \times D \times K) / Q$$

T = Time for pressure to drop 1.0 pound per square inch gauge in seconds

K = $0.000419 \times D \times L$, but not less than 1.0

D = Average inside pipe diameter in inches.

L = Length of line of same pipe size being tested, in feet

Q = Rate of loss, 0.0015 cubic feet per minute per square foot internal surface must be used since a K value of less than 1.0 must not be used.

There are minimum testing times for each pipe diameter as shown in Table 8.

TABLE 8 – MINIMUM TESTING TIMES			
Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
Inches	Seconds/Feet	Feet	Seconds/Feet
6	340.	398	0.855
8	454	298	1.52
10	567	239	2.374
12	680	199	3.419
15	850	159	5.342
18	1,020	133	7.693
21	1,190	114	10.471
24	1,360	100	13.676
27	1,530	88	17.309
30	1,700	80	21.369
33	1,870	72	25.856

Note: Test time starts after the required 60 seconds of stabilization time.

The test may be stopped if no pressure loss has occurred during the first 25% of the calculated testing time. If any pressure loss or leakage has occurred during the first 25% of the testing period, then the test will continue for the entire test duration as outlined above or until failure.

Mains with a 27-in. average inside diameter and larger must be air tested at each joint. If the joint test is used, a visual inspection of the joint must be performed immediately after testing. The pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum time allowable for the pressure to drop from 3.5 psi gauge to 2.5 psi gauge must be 10 seconds.

Mains that are greater than 33-in. diameter must be tested for leakage at each joint, or as approved by the Engineer.

- 4.3. **Sanitary Sewer Pipe Infiltration/Exfiltration Test.** The Contractor must perform a low pressure air test, or an infiltration/exfiltration test, and a mandrel test before the installed work will be considered accepted. The total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gal/in. of diameter per mile of main per 24 hr., at a minimum test head of 2-ft. above the crown of the main at an upstream manhole. The Contractor must use an infiltration test in lieu of an exfiltration test when mains are installed below the ground water level. In such cases, the total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gal/in. diameter per mile of main 24 hr. at a minimum test head of 2-ft. above the crown of the main at an upstream manhole, or at least 2-ft. above the existing groundwater level, whichever is greater. For construction work occurring within a 25-year floodplain, the infiltration or exfiltration must not exceed 10 gallons per inch diameter per mile of main per 24 hr. at the same minimum test head as stated in the previous sentence. If the quantity of infiltration or exfiltration exceeds the maximum quantity specified, the Contractor must propose to the Engineer, and receive approval therefrom, all necessary remedial action, solely at the Contractor's own cost, in order to reduce the infiltration or exfiltration to an amount within the limits specified herein.
- 4.4. **Sanitary Sewer Pipe Deflection Testing.** The Contractor must perform a low pressure air test, or an infiltration/exfiltration test, and a mandrel test before the installed work will be considered accepted. As stated in the 30 TAC § 217, deflection test must be performed on all flexible pipe installed.
- For mains with inside diameters less than 27-in., a rigid mandrel must be used to measure deflection.

- For main with an inside diameter 27-in. and greater, a method approved by the Engineer must be used to test for vertical deflections.

The deflection test must be accurate to within + 0.2% deflection. The test must be conducted after the final backfill has been in place at least 30 days. No pipe must exceed a deflection of five percent. If a pipe should fail to pass the deflection test, the problem must be corrected and a second test must be conducted after the failed areas final backfill has been in place an additional 30 days. The tests must be performed without mechanical pulling devices. The Engineer should recognize that this is a maximum deflection criterion for all pipes and a deflection test less than 5% may be more appropriate for specific types and sizes of pipe. Upon completion of construction, the Engineer or other Texas Registered Professional Engineer appointed by the owner must certify to the Inspector, that the entire installation has passed the deflection test. This certification may be made in conjunction with the notice of completion required in 30 TAC § 217.14. (1) of this title (relating to General Provisions). This certification must be provided for the Owner to consider the requirements of the approval have been met.

Mandrel Sizing:

The rigid mandrel must have an outside diameter (O.D.) not less than 95% of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, must be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. All dimensions must be per appropriate standard. Statistical or other "tolerance packages" will not be considered in mandrel sizing.

Mandrel Design:

The rigid mandrel must be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel must have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel must have a length of at least 75% of the inside diameter of the pipe. A proving ring must be provided and used for each size mandrel in use.

Method Options:

Adjustable or flexible mandrels are prohibited. A television inspection is not a substitute for the deflection test.

- 4.5. **Testing for Reconstruction of Existing Manholes.** The Contractor must perform the testing for all sanitary sewer manholes in accordance with the following. All manholes must pass a leakage test. The Contractor must test each manhole (after reconstruction and backfilling) for leakage, separate and independent of all other sanitary sewer piping, by means of either a hydrostatic test, vacuum test, or other methods approved by the Engineer. The Contractor is hereby instructed to conduct either of the two identified tests in the following manner.
- 4.5.1. **Hydrostatic Testing.** Hydrostatic testing must be conducted by utilizing approved plugs to seal all influent and effluent pipes in the manhole and filling the manhole to the top of the cone with water. Additional water may be added over a 24-hour period to compensate for absorption and evaporation losses. At the conclusion of the 24-hour saturation period, the manhole must be filled to the top and observed. Any measureable loss within a 30 minute period will be considered an unsuccessful test and thus require the Contractor to assess the needed repairs, perform such repairs (subject to the approval of the Engineer), and notify the Inspector when the retest will be performed. All effort, materials, or other costs will be solely at the Contractor's expense.
- 4.5.2. **Vacuum Testing.** Manholes must be tested after construction/installation and backfilling with all connections (existing and/or proposed) in place. Drop- connections and gas sealing connections must be installed prior to testing.

Test Procedure: The lines entering the manhole must be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs must be installed in the lines beyond drop connections, gas sealing connections, etc. Prior to performing the test, the Contractor must plug all lift holes and exterior joints with a non-shrink grout and plug all pipes entering the manhole. No grout must be placed in horizontal joints prior to testing. Contractor must use a minimum 60 in.-lb. torque wrench to tighten the external clamps that secure the test cover to the top of the manhole. The test head must be inflated in accordance with the manufacturer's recommendations. A vacuum of 10-in. of mercury must be drawn, and the vacuum pump will be turned off. With the valve closed, the level vacuum must be read after the required test time. If the drop in the level is less than 1-in. of mercury (final vacuum greater than 9-in. of mercury), the manhole will have passed the vacuum test. The required test time is 2 minutes.

Acceptance: Manholes will be accepted with relation to hydrostatic/vacuum test requirements, if they meet the criteria above. Any manhole which fails the initial test must be repaired with non-shrink grout or other suitable material based on the material of which the manhole is constructed. The manhole must be retested as described above until a successful test is attained. After a successful test, the temporary plugs will be removed. To ensure that the plugs have been removed, Contractor must only do so in the presence of the Inspector.

Repairs to Existing Manholes: Any existing manhole which fails to pass the hydrostatic and/or vacuum test must be closely examined by the Inspector and the Contractor to determine if the manhole can be repaired. Thereafter, the Contractor must either repair or remove and replace the manhole as directed. The manhole must then be retested and coated with a SAWS approved sewer coating as stated above. The Owner may elect to simply remove and replace the existing manhole with a new one. Any manhole excavated for repairs or excavated for tie in, must be backfilled with flowable fill up to 1-ft. below the top of the cone. The Contractor also has the option of backfilling with approved secondary materials, subject to the provisions of this specification.

Measurement and Payment: Hydrostatic/Vacuum testing of new structures will not be a pay item. The cost of this work will be included in the bid price for the new manhole. Each hydrostatic/vacuum test of an existing manhole will be a separate pay item. Repairs to existing manholes will be a separate pay item when authorized.

- 4.5.3. **Holiday Testing.** Inspect each sanitary sewer manhole using high-voltage holiday detection equipment. All detected holidays must be marked and repaired by abrading the coating surface with grit disk paper, or other hand tooling method. After abrading and cleaning, additional protective coating material must be applied to the repair area. All touch-up repair procedures must follow the protective coating manufacturer's recommendations.
- 4.5.4. **Test Failure.** If a sanitary sewer manhole fails to pass one of the above tests, it must be repaired in accordance with the manufacturer's recommendations and retested. It will not be accepted until it passes all tests. All repairs and re-testing will be at no additional cost to SAWS.
- 4.6. **Bypass Pumping.** Testing and quality control will be required for all bypass pumping systems, stationary pumping and flow diversion systems, as indicated below. Contractor must obtain and keep copies of all required permits on site prior to beginning Testing and throughout performance of the Work.

Contractor must prove to the Owner that the equipment, materials and all operational aspects and/or appurtenances related to the BPP are in good condition prior to commencing the bypass pumping operation. Failure to do so will result in the Contractor not being permitted to continue with any construction work requiring bypass pumping operations. Contractor must notify the SAWS' Inspections Department 48 hr. prior to commencing any testing. Any flows excessively surcharging the sanitary sewer system during the test and/or during actual bypass periods will deem the BPP to be unacceptable and must be revised and resubmitted for approval. There will be no separate pay item if this condition occurs during the timeframe in which bypass pumping test and/or operations are underway during the project. No testing of the bypass pumping operation must be conducted between Thursday and Sunday, unless approved by SAWS. If bypass pumping will take place outside normal work hours which are between 8 am to 5 pm Mondays

through Fridays (except for SAWS observed holidays), Contractor must reimburse SAWS for the overtime costs required by his bypass pumping testing outside of SAWS normal work hours.

Discharge piping, joints and all accessories will be required to be hydrostatic tested. All piping, joints, and accessories must be able to withstand at least twice the maximum system pressure or a minimum of 50 psi, whichever is greater.

For any bypass operations proposed a 24-hour test run must be satisfactorily performed prior to commencing any construction work. The Inspector must provide acknowledgment first. Contractor must provide both a strobe light type high level alarm, as well as alarm notification to their cell phones, as well as other appointed personnel to be identified by SAWS, and insure adequate alarm notification is attained prior to actual startup of the test period.

During the testing period, the Contractor must install a Float Monitoring System in the upstream manhole and/or pipe to confirm that the bypass pumping flow data shown in their BPP remains applicable. The float monitoring system must remain in the manhole and/or pipe for the duration of the bypass operation. The data collected during the test and duration of the bypass operation must be provided to SAWS for evaluation and recording. It will be required of the Contractor to have personnel remain onsite at the flow monitoring system in order to continuously record (every 30 minutes) the flows during both the test and actual bypass pumping periods. Contractor must submit a copy of Testing Float Monitoring System Data log to SAWS upon successful completion of test. Data log must be in column format with each line entry indicating the time, elapsed time of test, level of flow indicated in manholes, total flow being pumped by the BPP system, and any comments pertaining to the test.

Contractor must perform a full scale demonstration test of his proposed pump and haul bypass system to prove that his system can be successfully used for bypass pumping at the proposed locations. Contractor's test must use all of the equipment and staff that will operate the bypass pumping system during performance of the Work. Traffic control systems required during the Work must be utilized during the test. Withdrawals and discharges of flow must be from or into the manhole locations identified in the Contractor's BPP except for pump and haul system. This requirement is intended to demonstrate that the Contractor's proposed BPP is capable of providing satisfactory bypass pumping prior to Contractor beginning the Work, including the size and number of trucks and cycles times. Pump and haul system flow must be disposed of in a TCEQ licensed facility and all manifests must be kept and submitted. Disposal pump and haul flow in a nearby manhole is not acceptable.

Any failure of equipment, or activities associated with the bypass pumping operations contributing to either an excessive surcharge or SSO, will be deemed a failed test. The test will then be stopped and any necessary cleanup or reporting efforts performed. The BPP will need to be revised, resubmitted and acknowledged prior to the test initiating again. Any effort by SAWS or other third parties to mitigate damages resulting from any surcharging or SSOs will be the direct and sole responsibility of the Contractor. This includes any related fines, penalties, or damages.

Plugs must be tested prior to use. The inflatable plug must be placed inside of a structurally sound pipe or conduit and inflated to its operating pressure and monitored for 24 hr. to observe it holds the required pressure. This testing must be performed in accordance with the manufacturer's recommendations. Inflating a plug when it is not constrained or overinflating the plug creates a risk of being injured by pieces of the plug exploding if it fails.

4.7. Sewer Force Main Flushing and Testing.

- 4.7.1. **Flushing.** Immediately upon completion of pipe laying, the Contractor will flush all mains which are scheduled to be tested. This flushing will be at the direction of the Engineer and will consist of completely filling sections of main between valves and then displacing such initial volumes of water by introducing clear water from existing facilities into and through the main to the point of discharge from the main being flushed. The flow-through will continue until the Engineer determines all dust, debris, or foreign matter that may have entered during pipe laying operations have been flushed out. The new line will then be left under system pressure for testing.

To avoid damage to pavement and inconvenience to the public, fire hoses will be used to direct flushing water from the main into suitable sewers.

- 4.7.2. **Operation of Valves.** No valve in the sanitary sewer force main system will be operated by the Contractor without prior permission. The Contractor will notify the Engineer when a valve is to be operated and will only operate the valve in the presence of the Engineer's representative.
- 4.7.3. **Hydrostatic Tests.** All new pressure mains will be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance. It is the intent of these Specifications that all joints be watertight and that all joints which are found to leak by observation during any test must be made watertight by the Contractor.

All joints which are found to leak either by observation or during any test will be made watertight by the Contractor. In case repairs are required, the hydrostatic field test will be repeated until the pipe installation conforms to the specified requirements and is acceptable. The expense for tests which meet specified requirements will be made in accordance with the unit price for the hydrostatic pressure test. No payment will be made for tests which fail to meet specified test leakage requirements.

After the new main has been laid and backfilled as specified, but prior to replacement of pavement, it will be filled with water for a minimum of 24 hr. and then subjected to a hydrostatic pressure test.

The specified test pressure will be supplied by means of a pump connected to the main in a satisfactory manner. The pump, pipe connection, and all necessary apparatus including gauges and meters will be furnished by the Contractor. Unless otherwise specified, the San Antonio Water System will furnish potable water for filling lines and making tests through existing mains. Before applying the specified test pressure, all air will be expelled from the main. To accomplish this, taps will be made, if necessary, at the points of highest elevation and afterwards tightly plugged. At intervals during the test, the entire route of the new main will be inspected to locate any leaks or breaks. If any are found, they will be stopped or repaired. The test will be repeated until satisfactory results are obtained.

The hydrostatic test will be made so that the maximum pressure at the lowest point does not exceed the specified test pressure. The duration of each pressure test will be a minimum of 4 hr. for new mains in excess of 1,000-ft. after the main has been brought up to test pressure. The test pressure will be measured by means of a tested and properly calibrated pressure gauge acceptable. All pressure tests will be continued until the Engineer is satisfied that the new main meets the requirements of these specifications. Should any test of pipe in place disclose leakage greater than listed in Table 9 - Hydrostatic Test Leakage Allowances Table, the Contractor will, at his expense, locate and repair the defective joints until the leakage is within the specified allowance. Leakage is defined as the quantity of water supplied into the newly laid main, or any valved section of it, necessary to maintain the specified leakage test pressure after the main has been filled with water and the air expelled. The Contractor will notify the Engineer prior to beginning the test, and the San Antonio Water System's Inspector will be present during the pressure test.

Table 9 - Hydrostatic Test Leakage Allowances (Max) @ 200 psi										
Nominal Diameter and Pipe Material	Allowable Leakage in Gallons Per Hour (gph) **									
	100 LF	200 LF	300 LF	400 LF	500 LF	600 LF	700 LF	800 LF	900 LF	1000 LF
6" DI*	0.13	0.25	0.38	0.51	0.64	0.76	0.89	1.02	1.14	1.27
8" DI*	0.17	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70
12" DI*	0.26	0.51	0.77	1.02	1.28	1.53	1.79	2.04	2.30	2.55
16" DI*	0.34	0.68	1.02	1.36	1.70	2.04	2.38	2.72	3.06	3.40
20" DI*	0.43	0.85	1.28	1.70	2.13	2.55	2.98	3.40	3.83	4.25
24" DI*	0.51	1.02	1.53	2.04	2.55	3.06	3.57	4.08	3.59	5.10
30" DI*	0.64	1.27	1.91	2.55	3.19	3.82	4.46	5.10	5.73	6.37
36" DI*	0.76	1.53	2.29	3.06	3.82	4.58	5.35	6.11	6.88	7.64
42" DI*	0.89	1.78	2.68	3.57	4.46	5.35	6.24	7.14	8.03	8.92
48" DI*	1.02	2.04	3.06	4.08	5.10	6.11	7.13	8.15	9.17	10.19

* PVC pipe must be tested to DI pressures. DI Pipe includes mechanical and push-on joints.

Note: Leakage allowances may be determined for footages not specifically listed by interpolation or by the combination of various tabular data.

- 4.7.4. **Contractor's Personnel and Equipment.** The Contractor will supply labor and equipment necessary to make all excavations required for flushing, equipment connections, and placing the mains in service.
- 4.7.5. **Safeguarding and Backfilling Open Holes.** The Contractor will be responsible for safeguarding any open holes excavated or left open for flushing and testing purposes. Following completion of testing, the Contractor will backfill such holes in accordance with appropriate provisions of these specifications.
- 4.8. **Rehabilitation of Sanitary Sewer by Cured-In-Place Pipe Testing.**
- 4.8.1. **Chemical Resistance.** Chemical Resistance - The CIPP must meet the chemical resistance requirements of ASTM F1216, Appendix X2 except as modified herein. Table X2.1 of ASTM F1216 must be modified as follows. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements. Proof of chemical resistance test must be provided to the Engineer at least 15 days prior to commencement of work.

<u>Chemical Solution</u>	<u>Concentration %</u>
Tap water	pH of 5 to 11
Acids	pH not less than 5.0
Gasoline	Total BETX limit of 100 mg/L
Oil & Grease	50 mg/L
Total Phosphorous	40 mg/L
Sodium Hydroxide and other	pH not higher than 11.0 Strong bases
Ferric Chloride	3 mg/L
Sodium Hypochlorite	3 mg/L

- 4.8.2. **Hydraulic Capacity.** The Contractor must submit design calculations verifying that the CIPP must have flow capacity equal to at least 100 percent of the existing pipe. Flow capacity calculation must be based on Manning's formula using n (Manning's roughness coefficient) of 0.013 for existing sewer. The "n" value for CIPP used must have been verified by an independent testing laboratory (third party testing) which the Contractor must provide.
- 4.8.3. **Samples.** For each CIPP liner section installed, the Contractor must obtain CIPP samples large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing. CIPP samples must be prepared and physical properties tested in accordance with ASTM F1216 or ASTM F1743, Section 8, using either method proposed. The properties must meet or exceed the values listed this specification. If test results do not meet the properties, Contractor must remove and replace CIPP at no additional cost.
- 4.8.4. **Television Inspection.** Visual inspection of the CIPP must be in accordance with ASTM F1743, Section 8.6 and these specifications.
- 4.9. **Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process Testing.** After the existing sewer is completely replaced, internally inspect with television camera and DVD as required. The finished tape will be continuous over the entire length of the sewer between two manholes and to be free from visual defects.

Defects which may affect the integrity or strength of the pipe in the opinion of the Engineer will be repaired or the pipe replaced at the Contractor's Expense.

The Contractor must smoke test to verify all sewer service connections.

The following items are excerpted from 30 TAC § 217 requirements for gravity sewer construction testing. Compliance with these requirements is required unless the Contractor obtains and provides written authorization from the TCEQ authorizing alternative testing and compliance procedures: Testing of Installed Pipe. An infiltration, exfiltration or low-pressure air test must be specified. Copies of all test results must be made available to the executive director (TCEQ) upon request. Test must conform to the following requirements:

Infiltration or Exfiltration Tests. The total exfiltration as determined by a hydrostatic head test, must not exceed 50 gal./in. diameter per mile of pipe per 24 hr. at a minimum test head of 2-ft. above the crown of the pipe at the upstream manhole. When pipes are installed below the groundwater level an infiltration test must be used in lieu of the exfiltration test. The total infiltration, as determined by a hydrostatic head test, must not exceed 50 gallons per inch diameter per mile of pipe per 24 hr. at a minimum test head of 2-ft. above the crown of the pipe at the upstream manhole, or at least 2-ft. above existing groundwater level, whichever is greater. For construction within the 25 year flood plain, the infiltration or exfiltration must not exceed 10 gal./in. diameter per mile of pipe per 24 hr. at the same minimum test head. If the quantity of infiltration or exfiltration exceeds the maximum quantity of infiltration or exfiltration exceeds the maximum quantity specified, remedial action must be undertaken in order to reduce the infiltration or exfiltration to an amount within the limits specified.

Low Pressure Air Test. Perform in accordance with requirements of this specification.

Deflection Testing. Perform in accordance with requirements of this specification.

Clean-up and Restoration. Any damage to existing utilities, structures, storm drain systems, curbs, sprinkler systems, mail boxes, driveway, etc., must be repaired as directed. All repairs and replacements will be made at the Contractor's expense. Upon acceptance of the installation work and testing, the Contractor must clean-up and restores the project area affected by operations. Daily clean-up of the project site to the satisfaction of the Engineer will also be required.

5. MEASUREMENT

Sewer Excavation and Non-stabilized Backfill

Sewer excavation and non-stabilized backfill will not be measured for payment and will be considered subsidiary to the sewer line installation.

Trench Excavation Protection

Trench Excavation Safety Protection will be measured by the linear foot along the centerline of any OSHA defined trench that may be entered by personnel and is not greater than 15-ft. wide, including manholes and other structures.

Sanitary Sewers

Longitudinal measurement of sanitary sewers will be made along the centerline of the sewer from center of manhole to center of manhole or end of main by the foot of the various sizes and types (when a specific type is required) of sewers shown on the plans, in accordance with this specification, complete and accepted.

One way cleanouts to be installed in all laterals at the customers property line and will be measured for payment by each installed.

Plugging existing sewer lines will be considered subsidiary to the pipe installation.

Casing installed in open trenches, where required by the plans, of the size and material required will be measured by the linear foot actually installed by the various sizes and materials in accordance with plans.

Sanitary Sewer Laterals

Sanitary sewer laterals will be measured by the linear feet installed at the various diameter sizes. The measured dimension will be taken from the centerline of the main to the connection at – or just inside – the customer's property line. Measurement will be continuous through any fittings in the main. Wyes, tees, and bends of any kind will not be paid for separately for laterals but will be measured for payment by the foot of lateral to be installed.

Force Mains

Longitudinal measurement of force mains will be made along the centerline of the sewer from fitting to fitting or end of main by the linear foot of the various sizes and types (when a specific type is required) of force mains shown on the plans, in accordance with this specification, complete and accepted. Hydrostatic pressure test will not be measured separately, but will be inclusive of the force main installation and will be considered subsidiary to the force main bid item.

Tie-In (Complete) will be measured as each of the various sizes and types completed.

Restraint anchor will not be measured separately and will be inclusive of the force main installation and will be subsidiary to the force main bid item.

Jacking, Boring or Tunneling

Jacking, Boring or Tunneling will be measured by the linear foot of bore or tunnel as measured from face to face of jacking pits.

Carrier pipe used in bores and tunnels or backed into place will be measured by the linear foot of pipe installed from end to end of pipe to the limits shown on the plans.

Casing or liners, where required for plans of the size and material required will be measured by the linear foot actually installed in accordance with plans.

Steel Casing Installed in Open Cut

"Pipe Sewer Main (Steel Casing) (Open Cut)" for sewer pipe of the various sizes shown on the plans, will be measured by the linear foot.

Vertical Stacks

Vertical Stacks will be measured by the vertical linear foot. Footage will be computed as follows: Dimension from the top of the lateral (where it appears in the trench wall), to the invert of the sewer main.

Sanitary Sewer Cleanouts

"Sanitary Sewer Cleanout" will be measured by each cleanout of the size and type (when a specific type is required) specified on the plans.

Sanitary Sewer Structures

Manhole structures will be measured by each manhole structure complete in place. Manhole structures will be installed where any pipe intercepted is larger than 24-in. in diameter. Rings and Watertight Covers,

concrete ring encasement and I&I Barriers, will not be measured for payment, but will be considered subsidiary to the manhole.

Pre-Cast Manholes

Manholes to 6-ft. deep and designated on plan will be measured by each type manhole complete in place including those exceeding 6-ft. in depth from the lowest invert elevation to the top of the ring. Rings and Watertight Covers, concrete ring encasement and I&I Barriers, will not be measured for payment, but will be considered subsidiary to the manhole.

Manholes deeper than 6-ft. will be measured by the number of vertical feet in excess of 6-ft.

FRP Manholes

FRP manholes to 6-ft. deep and designated on plan will be measured by each type manhole complete in place including those exceeding 6-ft. in depth from the lowest invert elevation to the top of the ring. Rings and Watertight Covers, concrete ring encasement and I&I Barriers, will not be measured for payment, but will be considered subsidiary to the FRP manhole.

Manholes deeper than 6-ft. will be measured by the number of vertical feet in excess of 6-ft.

Doghouse Manholes

Manholes up to 6-ft. deep and designated on plans will be measured by each type manhole complete in place including those exceeding 6-ft. in depth from the lowest invert elevation to the top of the ring. Rings and Watertight Covers, concrete ring encasement and I&I Barriers, will not be measured for payment, but will be considered subsidiary to the manhole.

Manholes deeper than 6-ft. will be measured by the number of vertical feet in excess of 6-ft.

Abandoned Manholes

Manholes abandoned, and excavation and backfill required will not be measured for payment, but will be considered subsidiary to other items.

Sanitary Sewer Bypass Pumping

Measurement for the work specified herein will be by lump sum for either "Small Diameter Sanitary Sewers" or "Large Diameter Sanitary Sewers" as defined herein. Any effort required for multiple set-ups and operations will be included in the lump sum price. Measurement of the work for pipe plugs will be incidental to the work and will not have a separate pay item. Any damages, repairs, etc., to private or public property will not be considered for any additional payment.

Select Backfill

Cement Stabilized Backfill will be measured by the cubic yard in accordance with the backfill diagram shown on the plans or as directed.

Flowable Fill

Flowable Backfill will be measured by the cubic yard based on the dimensions and depths shown on the plans or as directed.

Select Bedding Material

Where directed to be used for rigid pipe installations, Select Bedding Material will be measured by the cubic yard as dimensioned on the plans. Select Bedding Material is always required for Flexible Pipe installation; therefore, it will not be measured for payment.

Concrete Encasement, Cradles, Saddles and Collars

Concrete encasement, cradles, saddles and collars for pipe will be measured by the cubic yard as dimensioned on the plans or as directed, complete in place. Reinforcing if required will not be measured.

Concrete Curb, Sidewalks, Driveways, Islands and Medians

For concrete curbs, sidewalks, driveways, islands and medians required to be removed and replaced due to placement of sewer lines, removal of the existing concrete will be measured by the foot or by the square yard as dimensioned and detailed on the plans.

Cut and Restore Pavement

The work to be done in the cutting and restoring of pavement will be measured by the square yard in accordance with the dimensions and details shown on the plans.

Television Inspection

Measurement and payment will be made for the work to be done on the basis of the unit bid price per linear foot of pipe diameters 8-in. through 15-in., 18-in. through 27-in., and 30-in. and larger and will be considered full compensation for all labor, materials, equipment, tools, logging, cleaning, by pass pumping and incidentals necessary to complete the work.

Automatic Air Release Valve

Automatic Air Release Valve will be measured as each assembly of the size installed.

Ductile-Iron Fittings

Ductile-Iron and Grey-Iron Fittings will be measured by their weight as listed in Table 10 of this specification of the various sizes of fittings installed.

Table 10 - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)							
BENDS							
Size (Inches)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (Inches)	MJ Compact (C153)	MJ (C110)	FLG SB
1/4 Bend (90 Degrees)				1/8 Bend (45 degrees)			
4	25	55	44	4	21	51	36
6	43	86	67	6	35	75	57
8	61	125	115	8	50	110	105
12	119	258	236	12	96	216	196
16	264	454	478	16	200	345	315
20	447	716	878	20	337	555	485
24	602	1105	1085	24	441	777	730
30	979	1740	1755	30	775	1393	1355
36	1501	2507	2135	36	1140	2163	1755
42	2277	3410	3055	42	1652	2955	2600
48	3016	4595	4095	48	2157	4080	3580
BENDS							
Size (Inches)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (Inches)	MJ Compact (C153)	MJ (C110)	FLG SB
1/16 Bend (22-1/2 Degrees)				1/32 Bend (11-1/4 degrees)			
4	18	50	35	4	17	50	40
6	32	75	64	6	30	73	56
8	46	110	90	8	42	109	90
12	85	220	194	12	74	220	193
16	175	354	315	16	153	354	315
20	314	550	505	20	265	553	505
24	414	809	528	24	339	815	760
30	668	1500	1385	30	603	1410	1395
36	963	2182	1790	36	830	2195	1805
42	1354	3020	2665	42	1210	3035	2680
48	1790	4170	3665	48	1523	4190	3695

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
TEES				
Size (Inches)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	26	56	53
4	3	31	76	54
	4	33	80	60
6	4	49	114	90
	6	60	124	98
8	4	65	163	155
	6	76	175	148
	8	89	188	179
12	4	99	316	322
	6	115	325	297
	8	127	339	346
	12	162	407	369
16	6	226	563	573
	8	240	565	555
	12	283	615	590
	16	326	676	635
20	6	344	750	773
	8	371	766	720
	12	427	799	816
	16	503	975	950
	20	566	1068	1005

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
TEES				
Size (Inches)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	466	1035	1089
	8	487	1047	1060
	12	539	1075	1125
	16	625	1109	1070
	20	729	1504	1510
	24	785	1617	1685
30	8	739	1808	-
	12	800	1842	1801
	16	959	1885	-
	20	1026	1941	-
	24	1228	2496	2475
	30	1373	2531	2615
36	24	1548	2710	2255
	30	1901	3545	3000
	36	2012	3686	3160
42	24	2272	3690	3245
	30	2512	4650	4125
	36	3048	5119	5360
	42	3225	6320	5580
48	24	2934	4995	4385
	30	3147	5140	4455
	36	4046	6280	5555
	42	4249	8130	7195
	48	4469	8420	7385

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
CROSSES				
Size (Inches)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
3	3	34	70	-
4	3	42	90	-
	4	46	105	-
6	4	63	140	-
	6	74	160	160
8	4	88	185	185
	6	97	205	205
	8	105	239	234
12	4	114	340	-
	6	135	360	360
	8	151	382	385
	12	199	493	495
16	6	250	590	575
	8	270	619	605
	12	332	685	-
	16	409	811	790
20	6	358	760	-
	8	379	822	790
	12	413	883	860
	16	550	1117	1085
	20	598	1274	1230

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
CROSSES				
Size (Inches)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	566	1025	-
	8	578	1085	1045
	12	610	1153	1110
	16	663	1256	1200
	20	975	1733	1675
	24	907	1906	1835
30	8	650	1795	-
	12	870	1925	1865
	16	900	1950	-
	20	1220	2060	-
	24	1497	2776	2675
	30	1808	3188	3075
36	24	1853	2928	2980
	30	2580	3965	-
	36	2698	4370	4370
42	24	2415	3910	-
	30	2920	5040	-
	36	3788	5835	-
	42	3908	6493	7145
48	24	3435	5210	-
	30	4145	5495	-
	36	4873	6790	-
	42	5465	8815	-
	48	5588	9380	-

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
CAPS			PLUGS	
Size (Inches)	MJ Compact (C153)	MJ (C110)	MJ Compact (C153)	MJ (C110)
4	10	17	12	16
6	16	29	19	28
8	24	45	30	46
12	45	82	54	85
16	95	160	97	146
20	141	235	146	218
24	193	346	197	350
30	362	644	381	626
36	627	912	688	884
42	893	1322	1200	1222
48	1076	1737	1550	1597

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)				
SOLID SLEEVES				
Size (Inches)	Weight			
	MJ Short Compact (C153)	MJ Long Compact (C153)	MJ Short (C110)	MJ Long (C110)
4	17	21	35	46
6	28	35	45	65
8	38	48	65	86
12	57	77	113	143
16	127	172	192	257
20	201	258	258	359
24	264	337	340	474
30	500	651	690	1005
36	725	960	947	1374
42	877	1209	1187	1628
48	1406	1516	1472	2033

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)			
CONCENTRIC REDUCERS			
Size (Inches)			Weight
Large End	Small End	MJ Compact (C153)	MJ (C110)
6	4	27	59
8	4	38	81
8	6	41	95
12	4	70	136
12	6	69	150
12	8	70	167
16	6	134	234
16	8	136	258
16	12	126	310
20	12	213	427
20	16	221	492
24	12	304	562
24	16	315	633
24	20	315	727
30	16	596	1027
30	20	599	1085
30	24	492	1204
36	20	1042	1459
36	24	785	1580
36	30	655	1868
42	24	1356	2060
42	30	1112	2370
42	36	1116	2695
48	30	1722	3005
48	36	1650	3370
48	42	1429	3750

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)		
2" Tapped Tees and Crosses		
Size (Inches)	Weight	
	MJ Compact (C153)	MJ (C110)
4	24	47
6	36	71
8	54	97
10	69	130
12	87	169
20	-	259
24	-	320

TABLE 10 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LBS.)		
OFFSETS		
Size (Inches)	Weight	
	MJ Compact (C153)	MJ (C110)
4 x 6	35	75
4 x 12	55	83
6 x 6	35	110
6 x 12	67	138
6 x 24	96	189
8 x 6	82	164
8 x 12	98	209
8 x 24	141	280
12 x 6	121	320
12 x 12	178	420
12 x 24	240	645
20 x 12	-	1025
20 x 24	-	1245

Hydrostatic Pressure Test

Hydrostatic Pressure Test will be measured as each successful test conducted on sanitary sewer force mains only. Hydrostatic testing of manholes will not be measured for payment.

Rehabilitation of Sanitary Sewer by Cured-In-Place Pipe

This Item will be measured by the foot, based on the measured distance of existing sanitary sewer line to be rehabilitated from centerline of manhole to centerline of manhole.

Point Repair

Measurement for sewer line point repair is on a unit price basis for each repair performed. Minimum length of pipe to be replaced for each repair, determined by depth of sewer line measured from natural ground to flow line at point of repair. 9 ft. minimum length. Measurement for sewer line extra length point repair is on a linear foot basis in excess of minimum replacement length specified above.

Obstruction Removal

Obstruction removal by excavation will be paid per each obstruction removal performed. Obstruction removal can be submitted for payment when the obstruction has been cleared from the sewer line to be lined. Liner work must proceed at least 6-ft. before payment for removal of another obstruction will be considered (i.e., all obstruction within a distance of 6-ft. is considered to be part of the same obstruction).

Reconstruction of Existing Manholes

All reconstructed manholes will be measured by the unit of each manhole (any type or size) regardless of the type shown in the contract documents.

Existing Manhole Adjustments

Manholes completely adjusted, as prescribed above, will be measured by the unit of each manhole adjusted. The excavation and the amount of flowable fill, reinforced concrete, or any other material as necessary to fill the area excavated, will not be measured for payment.

Cleaning Manhole and Mains

Sanitary sewer manhole and mainline cleaning will not be measured for payment and will be subsidiary to rehabilitation of manholes and lines.

Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process

All pipe bursting installations will be measured from center of manhole to center of manhole or end of main. Measurement will be continuous through any fittings in the main.

Slip-lining Sanitary Sewers.

Measurement for sliplining is on a by foot basis for installed liner pipe, measure from center line of upstream manhole to center line of downstream manhole. Depth range for payment is based on depth measured at sewer main from natural ground level to flow line of sanitary sewer for each pipeline segment.

Grouting of Sewer Mains

All type of pipe abandonment with grout, including asbestos-concrete pipe, will be paid for at the contract bid price per linear foot for each size diameter of pipe, irrespective of the depth of the main, which will include the cost of removing the content within the pipe, cleaning, grouting, plugging, capping and abandoning all pipe, pipe bend section and all other appurtenances, and for dewatering, trenching, excavation and backfill, removal, transportation and disposal and all material or work necessary to properly abandon the pipe.

6. PAYMENT

Sewer Excavation. Payment for sewer excavation and non-stabilized backfilling in accordance with these specifications will not be paid for directly but will be included in the unit price bid for the sanitary sewer pipe installation. Select bedding and stabilized backfill will be paid for under their own items of work.

Trench Excavation Protection. Payment will be made at the unit price bid per linear foot for "Sanitary Sewer Trench Excavation Protection" in place. This price will be full compensation for all labor, equipment, materials, tools, all components of the trench protection system which can include but not limited to sloping, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering/diversion of water to provide adequate/acceptable drainage, any additional excavation or backfill required, jacking, jack removal, removal of the trench support after completion and all other labor, materials, tools, equipment and incidentals necessary to complete the work.

Sanitary Sewers. Payment will be made at the unit price bid per linear foot will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sanitary Sewers" of the size, and type (when a specific type is required) specified on the plans complete in place.

Sanitary sewer service connections will be paid for at the unit price bid which will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sanitary Sewers Lateral Pipe)" of the size specified per linear foot complete in place.

Casings installed in open cut trenches will be paid for per linear foot at the contract unit price bid for "Sanitary Sewer Casing Open Cut" per linear foot which will be full compensation of casing installed and measured as prescribed above.

Sanitary Sewer Laterals. Payment will be made at the unit price bid will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sanitary Sewer Lateral" of the size and type (when a specific type is required) specified on the plans per linear foot complete in place.

Force Mains. Force mains will be paid for at the unit price bid will be full compensation for all labor, equipment, materials, tools, and incidentals for "Force Mains" of the size and type specified on the plans per linear foot, complete in place.

Jacking, Boring or Tunneling. "Sanitary Sewer (Jack, Bore, or Tunnel)" will be paid for at the contract unit price bid per linear foot of jacking, boring or tunneling, which price will be full compensation for furnishing all materials (except carrier pipe, casings or liners), labor, tools, equipment and incidentals necessary to complete the work, including excavation, grouting, backfilling, restoration to original ground conditions, and disposal of surplus materials.

Carrier pipe will be paid for at the contract unit price bid which will be full compensation for "Sanitary Sewer Carrier Pipe in Casing" per linear foot of pipe installed and measured as prescribed above.

Steel casings or liners will be paid for at the contract unit price bid which will be full compensation for "Sanitary Sewer Jack, Bore, Tunnel Pipe (STEEL)" or "Liner" per linear foot of steel casing or liner installed and measured as prescribed above.

Steel Casing Installed in Open Cut. Steel casings installed via open cut will be paid for at the contract unit price bid which will be full compensation for "Pipe Sewer Main (Steel Casing) (Open Cut)" per linear foot for the various sizes shown on the plans and measured as prescribed above.

Vertical Stacks. Payment will be made at the unit price bid per vertical foot which will be full compensation for all labor, equipment, materials, tools, and incidentals complete in place.

Sanitary Sewer Cleanouts. Payment will be made at the unit bid price for "Sanitary Sewer Cleanout" of the size and type (when a specific type is required) specified on the plans per each which will be full compensation for all labor, equipment, materials, tools, and incidentals complete in place.

Sanitary Sewer Structures. Payment for Manholes structures, including the stack, rings, watertight covers, steps and concrete ring encasement, I&I Barriers, will be made at the unit price bid for "Sanitary Sewer Structures" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for Extra depth structures will be made at the unit bid per linear foot as measured.

Pre-Cast Manholes. Payment for Pre-Cast manholes, including the stack, rings, watertight covers, steps and concrete ring encasement, I&I Barriers, will be made at the unit price bid for "Sanitary Sewer Precast Manholes" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for Extra depth manholes will be made at the unit price bid per linear foot as measured.

FRP Manholes. Payment for FRP manholes, including the stack, rings, watertight covers, and concrete ring encasement, I&I Barriers, will be made at the unit price bid for "Sanitary Sewer FRP Manholes" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for Extra depth FRP manholes will be made at the unit price bid per linear foot as measured.

Doghouse Manholes. Payment for doghouse manholes, including the stack, rings, watertight covers, steps and concrete ring encasement, I&I Barriers, will be made at the unit price bid for "Sanitary Sewer Manhole (Doghouse)" of the type specified per each which will be full compensation for all labor, equipment, materials, tools, and incidentals.

Payment for Extra depth manholes will be made at the unit price bid per linear foot as measured.

Abandoned Manholes. Manholes abandoned will not be paid for separately.

Sanitary Sewer Bypass Pumping. The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for the unit price bid for "Bypass Pumping for Small Diameter Sanitary Sewers" or "Bypass Pumping for Large Diameter Sanitary Sewers" per each. Payment of the "Lump Sum" bid for Bypass Pumping will be in accordance with the following: Any effort required for multiple set-ups and operations will be included in the lump sum price.

- When initial set-up and operation of the bypass pumping system begins (including a successful test), 20% of the "Lump Sum" cost will be paid as applicable to stationary bypass pumping to include flow diversion if used.
- 60% of the "Lump Sum" cost will be paid over equal monthly payments (estimated from the BPP or other documentation approved by the Inspector) during the course of the bypass pumping operation as applicable to stationary bypass pumping to include flow diversion if used.
- 20% of the remaining "Lump Sum" cost will be paid upon an acceptable removal and/or disassembly of all components of the BPP, including site cleanup as applicable to stationary bypass pumping to include flow diversion if used.add

For multi-bypass pumping setups, payment will be proportional to the overall amount of the established bid line item.

Select Backfill. Payment will be made for "Cement Stabilized Backfill" at the unit price bid for "Sanitary Sewer (Cement Stabilized Backfill)" per cubic yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

Flowable Fill. Payment for flowable backfill will be made at the unit price bid for "Sanitary Sewer Flowable Fill" per cubic yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

Select Bedding Material. Payment for "Select Bedding Material" for rigid pipe installations will be made at the unit price bid for "Sanitary Sewer (Select Bedding)" per cubic yard. The select bedding for flexible pipes will not be paid for directly but will be subsidiary to the flexible pipe.

Concrete Encasement, Cradles, Saddles and Collars. Payment will be made at the unit price bid for "Concrete Encasement," "Concrete Cradles," "Concrete Saddles," and "Concrete Collars" per cubic yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

Concrete Curbs, Driveways, Sidewalks, Islands or Medians. Payment for replacement of curbs, driveways, sidewalks, islands and medians will be made at the unit price bid for "Sanitary Sewers (Concrete Sidewalk)", "Sanitary Sewers (Concrete Driveway)", "Sanitary Sewers (Concrete Islands)", "Sanitary Sewers (Concrete Medians)" and "Sanitary Sewer (Concrete Curb)" per square yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

Cut and Restore Pavement. Payment will be made at the unit price bid for "Sanitary Sewers (Cut and Restore Pavement)" per square yard which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

Television Inspection. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Sanitary Sewer Pre Television Inspection" or "Sanitary Sewer Post Television Inspection" per linear foot of the pipe sizes shown in the plans. This price will be full compensation all labor, materials, equipment, tools, logging, and all incidentals necessary to complete the work.

Automatic Air Release Valve. Payment for "Automatic Air Release Valve" will be made at the unit price bid for "Sanitary Sewer (Automatic Air Release Valve) (Complete)" per each and will be full compensation for each assembly of the various sizes installed in accordance with the details shown on the plans. This payment will also include selected embedment material, anti-corrosion embedment when specified, blocking and various sizes and types of meter boxes.

Ductile-Iron Fittings. Payment for "Ductile-Iron Fittings" will be made at the unit price bid for "Sanitary Sewer (Ductile-Iron Fittings)" and will be full compensation for each ton of fittings of all sizes and types installed and will be based upon the weights of fittings shown in Table 10 "Weights of Ductile-Iron and Cast-Iron Fittings".

Hydrostatic Pressure Test. Payment made for "Hydrostatic Pressure Test" will be made at the unit price bid for "Sanitary Sewer (Hydrostatic Pressure Test)" per each and will be full compensation for each successful test conducted on sanitary sewer force mains only. No direct payment will be made for hydrostatic testing manholes.

No direct payment will be made for concrete blocking of sanitary sewer force mains; furnishing and installing the joint restraint system; coating and wrapping pipe joints; polyethylene wrapping; trench excavation below specified limits; excavation and removal of unsuitable material at bottom of trench grade and restoration with approved material; supporting pipe or conduits of public utilities; and flushing sanitary sewer force mains. This work will be considered subsidiary to the various bid items.

Rehabilitation of Sanitary Sewer by Cured-in-Place Pipe. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement", will be paid for at the unit price for "Rehabilitation of Sanitary Sewer by Cured-in-Place Pipe " per linear foot. This price will be full compensation for all labor, equipment, materials, tools, pre-rehabilitation line cleaning, water, clean-up, dump sites and hauling of debris, labor, materials and equipment used in replacing bases and pavements, access to right-of-ways and easements as necessary, removal of equipment due to bad ground or poor pipe conditions, and other incidentals necessary to complete the work for either method of sanitary sewer line rehabilitation.

Point Repair. The work performed and materials furnished in accordance with this Item and measured under "Measurement" will be paid for at the unit price bid for "Sanitary Sewer Point Repair", per each for sizes and types constructed (when a specific type is required), regardless of depth. This price will include all materials, including pipe, trenching, pumping, shoring and bracing, sand cushion, concrete plugs, laying and jointing, backfilling, tapping, water, labor, tools, equipment, pavement work and all incidentals necessary to complete the work.

Payment for sewer line extra length will be in accordance with this Item and measured under "Measurement" will be paid for at the unit price bid for "Sanitary Sewer (Point Repair sewer line extra length)," per linear foot for sizes and types constructed (when a specific type is required), regardless of depth. This price will include all materials, including pipe, trenching, pumping, shoring and bracing, sand cushion, concrete plugs, laying and jointing, backfilling, tapping, water, labor, tools, equipment, pavement work and all incidentals necessary to complete the work.

Obstruction Removal. The work performed and materials furnished in accordance with this Item and measured under "Measurement" will be paid per each for at the unit price bid for "Sanitary Sewer Obstruction

Removal", for sizes and types constructed (when a specific type is required), regardless of depth. This price will include all materials, labor, tools, equipment, pavement work and all incidentals necessary to remove obstructions.

Reconstruction of Existing Manholes. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement", will be paid for per each at the unit price bid for "Reconstruction of Existing Manholes". This price will be full compensation for materials, labor, equipment, tools, testing and all incidentals necessary to complete the work.

Existing Manhole Adjustments. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement", will be paid for at the unit price bid for "Existing Manhole Adjustments" per each. This price will be full compensation for materials, labor, equipment, tools, testing and all incidentals necessary to complete the work.

Cleaning Manholes and Mains. All work described by this Item will be subsidiary rehabilitation of manholes and lines.

Reconstruction of Sanitary Sewer by Pipe Bursting Replacement Process. The inserted pipe will be paid for per linear foot of pipe installed using pipe-bursting/crushing method for the pipe diameter, type, quantity, and depth specified and will be full compensation for all labor, equipment, materials, tools, incidentals, all pipe installation materials, all submittals, sealing materials at manholes and annulus (if required), launching pits, receiving pits, post testing, shoring, bedding, backfill, and all necessary, corresponding, and related work specified herein.

Sliplining. Payment will be made at the unit price bid per linear foot will be full compensation for all labor, equipment, materials, tools, and incidentals for "Sliplining" of the size and type (when a specific type is required) specified on the plans per linear foot complete in place.

Insertion pits, access pits, clamp installation, embedment (bedding, haunching and initial backfill), field quality control (testing), sealing liner at manholes, grouting annular space, building up, shaping and reworking manhole inverts and benches, and pre-installation and post-installation cleaning and television inspection of completed work are included in sliplining unit price and not paid for separately.

Excavations initially begun as obstruction removals or point repairs which the Contractor later decides to use as insertion pits are considered as insertion pits and not paid for separately.

Trench safety systems, well pointing and other applicable bid items associated with insertion pits will be paid for at their respective contract unit prices.

Grouting of Sewer Mains. Payment for "Grout Abandonment Sewer Main" will be made on the contract unit price per linear foot per each size diameter of pipe complete in place at locations shown on the plans. Said price will be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work.