

Special Specification 7190

Sanitary Sewer



- | 1. | DESCRIPTION |
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| 1.1. | <p>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.</p> <p>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.</p> |
| 1.2. | Definitions. |
| 1.2.1. | <p>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.</p> |
| 1.2.2. | <p>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.</p> |
| 1.2.3. | <p>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.</p> |
| 1.2.4. | <p>Point Repair. Point Repair is defines as the repair of a small length of pipe section of an existing sewer line which has deteriorated due to settlement or corrosion; is falling, missing, crushed, or broken; or has offset joints. Point repairs must be completed before rehabilitation by trenchless methods between two adjacent manholes is initiated.</p> |
| 1.2.5. | <p>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 sliplining with Centrifugally Cast Fiberglass Pipe (ASTM D-3262) or by sliplining with hollow Core I-Beam construction Closed Profile PVC Pipe (ASTM D-F794).</p> |
| 1.2.6. | <p>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 the Department's schedule. Contractors may, when appropriate, elect to use any material that is considered to be equal (i.e. a product that has structural and 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 before bid opening.</p> |
| 1.2.7. | <p>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.</p> <p>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.</p> |

- 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 must be cleaned using mechanical, hydraulically propelled, or high velocity sewer cleaning equipment. Debris generated by the cleaning process must be removed from the manhole, transported, and disposed of.
- 1.2.9. **Bypass Pumping.** Bypass Pumping is defined as bypass pumping of sewage flow for the purpose of preventing interference with the rehabilitation of the sanitary sewer manholes and mains as well as providing reliable sewer service to the building being served.
- 1.2.10. **Manhole Rehabilitation.** Manhole Rehabilitation is defined as substrate rehabilitation for the purpose of eliminating infiltration, providing corrosion protection, repair of voids, and restoration of the structural integrity of the manhole by applying a monolithic fiber-reinforced structural and structurally enhanced cementitious liner to the wall and bench surfaces of brick, concrete, or any other masonry construction material.
- 1.2.11. **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 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, must be kept to a minimum and all damage to surface and underground features, facilities, utilities, and improvements must be repaired.
- 1.2.12. **Sliplining.** 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.
- 1.2.13. **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 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. Grouting of sewer mains not under pavement will not be required unless noted on the plans.

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. Install materials as specified by the manufacturer.
- 2.1.1. **Rigid Pipe.** Ductile iron pipe will, for the purpose of this specification, be known as rigid pipe. Ductile iron pipe and fittings are for use on force mains and will not be allowed for use in gravity applications. All ductile iron pipe must be provided with corrosion resistant linings.

- 2.1.2. **Flexible Pipe.** Pipe consisting of materials other than those listed above.

Any flexible conduit 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, a "GO, NO-GO" Deflection Testing Mandrel built in accordance with the detail drawing, as shown in the plans, and 30 TAC § 217, must be furnished at the Contractor's expense and must 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.

Pipe stiffness must 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 must include all lateral piping as well.

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

When the trench width is greater than the outside diameter of the pipe plus 2 ft., the pipe will be covered with Class B concrete, in accordance with TxDOT Specification Item 421, or as shown on the plans.

- 2.1.3. **Concrete Pipe.** Concrete pipe must not be used.

- 2.1.4. **Asbestos-Cement (AC) Pipe.** AC pipe must not be used. Refer to the San Antonio Water System (saws.org) website for existing AC pipe and material handling.

- 2.1.5. **Fiberglass Reinforced Sewer Pipe, Non-Pressure Type.** Fiberglass reinforced sewer pipe, non-pressure type, must be a factory-formed conduit of polyester resin, continuous roving fiberglass and silica sand built up in laminates, and must conform to the requirements of ASTM D3262-11, including the appendix and subsequent specifications, and in accordance with San Antonio Water System's material specifications. Depths must comply with requirement of ASTM D3681-12.

Coupling Joints. Joints for pipe and fittings must be confined compression rubber gasket bell and spigot type joints conforming to the material and performance requirements of ASTM D4161-01. Depths must comply with requirement of ASTM D3681-12.

Fittings. Flanges, elbows, reducers, tees, wyes, laterals, and other fittings must 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 15 in. or larger, lateral openings 6 in. or greater in size must be made using PVC sewer saddles conforming to ASTM D2661-11 or service connections conforming to ASTM D3034-08.

Minimum pipe stiffness will not be less than 115 psi for direct bury applications.

- 2.1.6. **PMS PVC 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, PMS pipe, fittings, and joints must conform to ASTM D-3034, and elastomeric gasket joints must conform to D-3212, 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 27 in. in diameter must meet requirements of ASTM F-679.

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.

Mechanical or compression joints, concrete jointing collars, or non-reinforced rubber adaptors will be used only as approved by the Owner.

- 2.1.7. **Pressure Pipe/Force Mains.** Pipe must be made from Class 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 will be approved before the work is accepted. Pressure pipe/Force mains are required to have modified grade 5 material used as bedding. Pipes also will be hydrostatically tested at a minimum of 100 psi after their construction to ensure proper construction.

- 2.1.7.1. **HDPE (Polyethylene) Pipe.** High Density Polyethylene (HDPE) wastewater transmission and collection pipe must meet the specifications and requirements of AWWA C906, latest revision, in size 2 in. to 10 in., and be joined by means of a zero-leak rate, butt fusion, and approved mechanical joints. The polyethylene pipe and fittings must be made from prime virgin resins exhibiting a cell classification of PE 345434C as defined in ASTM D3350 with an established hydrostatic design basis of 1,600 psi for water at 73°F. The resin must be listed by the PPI in its pipe grade registry "TR-4". Pipe O.D. sizes must be the same as ductile iron pipe.

The net pressure capability must be the working pressure rating as follows:

DR 11 = Class 200/Class 250 DR 9 = Class 350

The wall thickness must follow the DR system prescribed in AWWA C906. The pipe must be joined by heat fusion or mechanical joints systems proven for HDPE pipe. Both pipe and fittings must be NSF approved, be listed, and marked. All pipe must be fused using the manufacturer's recommended procedures.

All pipe and fittings must be marked as prescribed by AWWA C906, latest revision, which includes the nominal size, O.D. base, DR, pressure class, WPR, manufacturer's name, and manufacturer's production code including month and year extruded. All pipe and fittings must have a date stamp less than 6 mo. old.

A restraint end must be fused on the ends of the PE pipe. This end can be used with a standard gland to achieve a restrained joint when connecting to the ductile iron long sleeves.

A restraint anchor must be fused on the ends of the PE pipe just before the restraint ends. This anchor must have concrete placed around the anchor and must be notched into the excavated ditch walls.

Trench depth will be such to maintain a minimum of 60-in. cover from the top of the pipe to finish grade. The bedding around the pipe must have a maximum particle size of 3/4 in. for manufactured and 1 in. for natural rock. Embedment must be hand placed. Special care must be exercised in the bedding and backfilling of PE pipe.

- 2.1.8. **Mechanical or Compression Joints.** Mechanical or compression joints, concrete jointing collars, or non-reinforced rubber adaptors must not be used unless approved.

- 2.1.9. **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 Standard 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 Standard A21.50/AWWA C150-08. Thickness design will 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 Standard A21/AWWA C111-12.

All ductile iron pipe and fittings must be cement mortar-lined or polyethylene-lined. The cement mortar lining must be in accordance with ANSI A21.4/AWWA C104-08.

The polyethylene lining material for pipe and fitting must be virgin polyethylene complying with ANSI/ASTM D1248-12, compounded with inert filler, and with enough carbon black to resist ultraviolet rays during storage of the pipe and fittings. The polyethylene must be bonded to the interior of the pipe or fitting by heat. Polyethylene lining in pipe and in fittings must be 40 mil nominal thickness. Minimum lining thickness must be 30 mil.

2.1.10. **Concrete Steel Cylinder Pipe.** Concrete Steel Cylinder Pipe must not be used.

2.1.11. **Pipe Testing.** All sanitary sewer pipe and fittings produced within the jurisdiction of the SARA will be tested by SARA-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.

2.1.12. **Ductile Iron Pipe with Polybond Lining.** The lining will be a composite lining utilizing a primer coating containing fusion bonded epoxy (FBE) and a surface coating containing fusion bonded polyethylene (FBP). The lining will be Polybond PLUS as manufactured by the American Cast Iron Pipe Company (Birmingham, AL) or an approved equal meeting the requirements of this specification. All lining application must be performed by the pipe manufacturer at the pipe manufacturer's facility. Linings applied by individuals other than the pipe manufacturer are unacceptable and will be rejected. Type and brand of lining must be marked on each pipe or fitting.

Primer. The primer must contain fusion bonded epoxy (FBE), which is applied in appropriate quantity to achieve a normal thickness of 5 mil for the pipe or fitting. The FBE material used in the primer formulation should be capable of meeting the following requirements as shown in Table 1.

Table 1

FBE Primer Requirements

TEST PARAMETER	ASTM TEST METHOD	TYPICAL VALUE
Tensile Strength	D-2370	9,300 psi
Compressive Strength	D-695	11,600 psi
Ultimate Elongation	D-2370	6.9%
Impact (1/8 in. x 3 in. x 3 in. panel) 5/8 in. diameter	G-14	160 in.-lb.

Surface layer. The surface layer will be comprised of medium density modified fusion bonded polyethylene (FBP) meeting the requirements of ANSI/ASTM D1248 and compounded with an inert filler. The FBP will be formulated to be ultra-violet (UV) resistant for a minimum of 3-yr. exposure. The color of the FBP must have a light reflective value (LRV) of at least 40% to aid in the in-situ inspection of the pipeline with video equipment.

The fusion-bonded polyethylene used in the surface coating material will be capable of meeting the following requirements as shown in Table 2.

Table 2

FBE Surface Coating Requirements

TEST PARAMETER	ASTM TEST METHOD	TYPICAL VALUE
Tensile Strength	D-638	1,650 psi
Ultimate Elongation	D-638	300%
Taber Abrasion Resistance	D-4060	25 mg wt. loss/1000 cyc. @ 1,000 g load
Notched Izod Impact		
@ 23°C	D-256	8 ft.-lb./in. (No break)
@ 60°C		6.1 ft.-lb./in. (No break)
Brittleness Temperature	D-746	-76°C

Thickness Requirements. Total thickness for the fusion-bonded epoxy/fusion-bonded polyethylene lining will be 60 mil nominal with a 50 mil minimum in the barrel of the pipe.

Lining Coverage. The fusion-bonded epoxy/fusion-bonded polyethylene lining will cover the interior surface of the pipe and fittings from the interior of the spigot end to a point adequately forward in the bell socket such that the Fastite gasket, in the assembled joint, seals over the end of the lining.

Joint Surface Coating. The joint surface coatings must be comprised of a two-component epoxy. The use of joint surface coatings containing coal tar is prohibited. Total thickness for the joint coating must be 8 mil nominal.

The joint surface coating must cover the spigot end across the end of the spigot bevel and extending over the outer surface of the spigot including the gasket sealing area. The joint surface coating must also cover the socket from the face of the bell, through the gasket sealing area overlapping onto the edge of the FBE/FBP lining.

For each production lot, the lining must be tested over 100% of the pipe barrel surface with a high voltage spark tester as recommended by ASTM Designation G-62 Method B of the latest version. The minimum test voltage will be as determined by Method B, as described in the ASTM Designation Section 11.2.3, which is the recommended voltage for all linings with possible areas thicker than 41 mil:

$$V = 1,250 \times T^{1/2} \quad \text{where "V" = voltage and}$$

$$\text{"T" = thickness of lining in mil.}$$

$$\text{Example: } V = 1,250 \times 60^{1/2} \text{ Minimum Voltage} = 9,683 \text{ volts}$$

If holidays are found in the lining by the above test at the manufacturing plant, the holiday must be repaired per the lining manufacturer's recommendation.

The holiday detector must be a commercially available detector available from holiday detection equipment manufacturers such as SPY, TINKER and RASOR, and ZORELCO.

Voltage Confirmation Test. To confirm that the above voltage is appropriate to detect holidays, the following voltage confirmation test should be performed for each shift or change in detector operator. The holiday detector should be set to the calculated minimum voltage shown above. A known holiday should be

made in the lining of a randomly selected pipe using a small sharp pin. The operator should demonstrate that the holiday can be consistently and satisfactorily located at this voltage setting and detector wand speed. If the holiday is not detected at the calculated voltage, then the voltage should be slowly increased until the known holiday is consistently detected by the operator. This voltage will then become the minimum voltage at which all pipe linings are tested.

Testing Voltage Meter. The detector's voltage (and voltage meter) must be tested once each day by a separate voltmeter and the results certified by the pipe manufacturer, to confirm the accuracy of the detector's voltage meter.

- 2.1.13. **High Density Polyethylene (HDPE) Pipe and Fittings.** All HDPE will have a minimum pressure rating of 200 psi and a dimension ratio of 9 (DR 9).

Where standard ductile iron mechanical joint fittings are coupled to plain-end (square-cut) HDPE pipe, mechanical joint adapters must be used. Use Driscopipe Mechanical Joint Adapter (DIPS) Kit or approved equal.

Ductile Iron Bends and Fittings for HDPE Pipe. All bends and fittings will be furnished with the type of joint and end combinations specified. Mechanical joint fittings will be furnished complete with glands, gaskets, and bolts. Flanged joint fittings will be furnished complete with gaskets and bolts. All bolts, glands, and gaskets will be in accordance with AWWA Standard Specification C111.

All fittings will be furnished with standard outside coatings consisting of coal tar or asphalt base bituminous materials. Fittings will be cement mortar lined and sealed in conformity with AWWA Standard Specification C104.

Pipe Joint Restraint System for HDPE Pipe. Restraint devices will be used where ductile iron mechanical joint bell fittings are coupled to plain-end (square-cut) HDPE pipe to prevent movement of pipe connections. The restraint system will have a minimum pressure rating of 250 psi. The restrainer must not be directionally sensitive.

Underwriter Laboratories and Factory Mutual certifications will be required on the restraint system. Each restraint device will be packaged individually and include installation instructions.

The pipe will be restrained by a split retainer band that will be cast ductile iron, meeting or exceeding ASTM A536 Grade 65-45-12. The inside face or contact surface of the band will be of ample width to incorporate machined non-directionally sensitive serrations to grip the outside circumference of the pipe. The serrations will provide full (360°) contact and maintain pipe roundness and avoid any points of localized stress. The split band casting will be designed to bottom-out before clamping forces (110 ft.-lb. minimum torque) can overstress the pipe, but will provide full non-directionally sensitive restraint at the rated pressure.

Bolts and nuts used to attach the split retainer ring will comply with ANSI B 18.2/18.2.2, SAE Grade 5. Tee bolts, nuts, and restraining rods will be fabricated from high strength, low-alloy steel in accordance with AWWA C111.

Restraint devices will be Uni-Flange Block Buster 1300C or approved equal.

Water Main Crossing. Where HDPE force main sewers are constructed in the vicinity of potable water mains, the requirements of the Texas Commission on Environmental Quality (30 TAC 217.53) will be met.

- 2.1.14. **Steel Casing Pipe.** The component materials, manufacture, and testing of all steel pipe will conform to AWWA Standard C-200 for "Steel Water Pipe 6 in. and Larger." The specified pipe size will be the actual inside diameter of the pipe, special, or fitting in inches. The diameter and wall thickness of all steel pipe will conform to those shown on the plans.

Pipe will be either Grade A or Grade B, conforming to ASTM Designation A-53.

Pipe ends will be beveled and suitable for field butt welding except as otherwise specified.

Pipe will receive a protective coating conforming to AWWA Standard C-203, "Coal-Tar Protective Coatings and Linings for Steel Pipelines – Enamel and Tape Hot Applied."

Pipe length will be nominal 40 ft. lengths except for specials or as otherwise specified on the plans. Standard and specials will be within 1/16 in.± of the specified or theoretical lengths.

- 2.1.15. **Stainless Steel Casing Spacer/Insulators.** This section covers casing spacers for use in water supply service. Casing spacers are used to facilitate installing a water pipe inside a casing pipe or tunnel. Casing spacers must consist of 2 or more segments of circular steel that bolt together forming a shell around the carrier pipe. Casing spacers should protect the carrier pipe and any protective coating or wrapping from damage during the installation, and properly support & electrically isolate the carrier pipe within the casing or tunnel. On occasion, multiple carrier pipes may be installed in one casing or tunnel.
- 2.1.15.1. **General Requirements.** The San Antonio River Authority reserves the right to limit the purchase of casing spacers from the manufacturers and to the models specified as shown in Table 3, providing such casing spacers conform to the provisions contained herein.

Table 3

Stainless Steel Casing Spacer/Insulators

MANUFACTURERS	LOCATIONS	MODEL NUMBERS
Pipeline Seal & Insulator, Inc.	Houston, TX	C8G-2 or SI8G-2
Pipeline Seal & Insulator, Inc.	Houston, TX	C12G-2 or SIIG-2
Advance Products & Systems, Inc.	Lafayette, LA	APS S18-2 APS SS18-2
Advance Products & Systems, Inc.	Lafayette, LA	APS S112-2 APS SS112-2
Advance Products & Systems, Inc.	Lafayette, LA	SI8M-2 SI12M-2 (Carbon Steel)
Power Seal Pipeline Products, Inc.	Wichita Falls, TX	4810 SS (Stainless steel) 4810 CS (Carbon steel)
J-Four Pipeline Products, Inc.	Broken Arrow, OK	M59 CS/SS M63 CS/SS
CCI Pipeline Systems	Breaux Bridge, LA	CSC 8 in. & 12 in. Wide CSS 8 in. & 12 in. Wide End Seals

Casing spacers must be 8 in. long for carrier pipes up to 16 in. 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. in diameter, or multiple carrier pipes in one casing or tunnel.

Casing spacers must have a minimum 14-gauge 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. Stainless steel (type 304) casing spacer is an acceptable alternative.

The fluidized bed fusion bonded PVC coating must be between 10 and 16 mil in thickness. The PVC coating must provide good resistance to acids and alkalis, and excellent resistance under ASTM B117 salt spray tests. The coating must have a minimum 1,380 volts/mil per ASTM D149-61 short time 0.01 in. 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-inch 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 must 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 must 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 must be attached to the band or riser by 3/8 of the wearing surface on the runner. The recess must be filled with a corrosion inhibiting filler. There must be 4 runners per casing spacer for carrier pipes up to 12 in. in diameter, 6 runners for 14 in. through 36 in. diameter pipes, and 8 or more runners for carrier pipes over 36 in. in diameter. Number of bottom runners must be multiples of 2. Number of top runners must be multiples of 2.

The band section must be bolted together with 5/16 in. cadmium-plated studs, nuts and washers. There must be 6 sets per 8 in. long casing spacer and 8 sets per 12 in. long spacer. 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 must 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 must 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.

- 2.1.15.2. **Quality Assurance.** All casing spacers must be manufactured in accordance to NACE International Recommend Practice RP 0286-97 (Isolation Spacers.) Each casing spacer must be manufactured in the USA at a facility that has a Registered ISO 9002 Quality Management System. Non-compliance to this registered commercial quality system requirement will result in removal of the manufacturer's product from Table 3 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 River Authority's specifications, at no charge to San Antonio River Authority.

- 2.1.16. **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.** Material for manholes will conform to the requirements of TxDOT Specification Item 465, "Manholes and Inlets", as described below 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. Manhole covers may be either watertight or water resistant, depending on their specific location. Every manhole cover located in an identified 100-yr. floodplain, or in the Edwards Aquifer Recharge Zone, must be watertight. Sewer manhole ring and cover castings must meet the current requirements of AASHTO Designation M306-10.

Unless otherwise shown in the contract documents or approved, standard sanitary sewer manholes must 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 will 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 must 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 must be as shown on the plans. Specifically, they must attach the ring and cover to the diameter adjustment section or cone. Manholes which differ from the above description must 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 must be provided for a sewer entering a manhole more than 30 in. above the invert. Both conditions will require prior approval.

2.2.1. **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.

2.2.2. **Doghouse Manholes.** Material for manholes will conform to the requirements of TxDOT Specification Item 465, "Manholes and Inlets," as described below 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. Manhole covers may be either watertight or water resistant, depending on their specific location. Every manhole cover located in an identified 100-yr. floodplain, or in the Edwards Aquifer Recharge Zone, must be watertight. 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" must 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.

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

2.2.4. **Manhole Ring and Cover.** The standard manhole ring and cover must be ductile iron and manufactured to the dimensions shown on the plans. The ring and cover must be hinged. Lifting slots cast into the covers must be provided for lifting purposes. A water-resistant (cam lock) ring and cover must be used in areas of minimal infiltration potential to allow venting. A watertight (bolt down) ring and cover must be used in areas of high infiltration potential, such as in the Edwards Aquifer Recharge Zone, an identified 100-yr. floodplain, or as otherwise directed.

The nominal cover diameter must be 32 in., with a 30 in. clear opening, as required by TCEQ. Rings must have a minimum of four 1-in. holes/slots for anchoring purposes. Rings must be a minimum of 4-1/2 in. in height, or as otherwise accepted. Slots for embedment/lightening are not allowed in ring flanges.

Water-resistant Rings and Covers. Rings and covers must have 2 hinges for added stability. The hinge must have a drain to allow for proper debris and foreign object removal. Before acceptance of the work, a stainless steel keyed "cam" lock must be provided by the Contractor to the Inspector. When the key is inserted in the cam, it must remain in the lid while the cam is in the open (unlocked) position. When in the closed (locked) position, the key can be removed. When not in use, the cam lock key hole must be covered with a plastic plug to prevent infiltration of debris. The cover must positively lock at 90° to prevent accidental closure and open fully to 120°. The cover must also include a single multi-tool lifting slot adjacent to the edge

of the cover to facilitate opening/lifting/prying once it is unlocked. Covers must be provided with a continuous vulcanized (one piece) EPDM gasket with a shore durometer of 70 ± 5 permanently attached to the cover.

Watertight Rings and Covers. Rings and covers must be the same as above for water-resistant version, except the covers must be bolted to the ring instead of secured with the cam lock mechanism. No vent hole(s) should be provided. A minimum of four 1/2-inch diameter, stainless steel, hex head bolts must be provided for each cover. The 4 bolt holes in the covers must be evenly spaced and provided with a minimum 1-1/2 inch diameter counter sink for the bolt heads. In the fastened and bolted position, the bolt heads must not extend above the surface of the cover. Washers of a size and material as approved must be provided for the bolts to insure air and water tightness.

The finished ring and cover must have the bearing surfaces machined ground and sets of rings and covers must be marked in such a way that they can be matched for assembly in the field. All covers must have the words "SAN ANTONIO RIVER AUTHORITY Sanitary Sewer" cast thereon.

Ring and cover must have the approved 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 and ASTM A536 or A536 80-55-06 to verify the materials used. Castings without proper markings will be rejected.

- 2.2.5. **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") in TxDOT Specification Item 421, "Hydraulic Cement Concrete." If concrete throat rings will be used, they must be used in conjunction with a UV-stabilized polyethylene liner. 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 790-10 Flexural Modulus, ASTM 648-07 Heat Deflection Temperature @IGEPAL, ASTM 1693-12 EsCR, and 100% IGEPAL/10% IGEPAL. A minimum of 2 and a maximum of 4 throat rings may be used at each manhole installed.
- 2.2.6. **Coating.** All manholes must be watertight and coated with a SARA approved sewer coating. Before coating, all manholes will be vacuum-tested and approved. For existing and rehabilitated manholes, apply a combination of both products with the cementitious coating first, followed by the epoxy coating. Kerneos SewperCoat 2000 HS regular, applied at the required 1-in. thick application, is the only product approved which does not require a subsequent epoxy coating. New manholes installed do not require the cementitious coating. Cementitious liner thickness will be measured by the penetration method at locations specified by SARA before the final setting of the material. Approved materials are as follows:
- Cementitious coating (with required 1-in. thick application):**
- Kerneos SewperCoat 2000 HS;
 - Refratta HAC 100; or
 - Approved Equal.
- Epoxy coating (with specified thickness application):**
- Raven 405 Series High Build Epoxy Liner (required thickness – 125 mil); or
 - Approved Equal.
- 2.3. **Manhole Rehabilitation.** The Contractor must submit descriptive information including technical data sheet and ASTM test results on each product proposed, indicating that the product conforms to and is suitable for its intended use per the specifications. The Contractor may, when appropriate, elect to use any material that is considered to be equal (i.e. a product that has structural and physical properties that are greater than or equal to those of the specified product). However, submittal to the Engineer is required no later than 10 days before bid opening. Should the Contractor elect to use any materials other than those contained herein, they should be completely and clearly identified when making the product submittal. This will expedite the review

process, in which the Engineer decides whether the products meet the Contract requirements and the specific use foreseen. The purpose of this process is to expedite review of Contractor product submittals.

Concrete must conform to TxDOT Specification Item 420, "Concrete Substructures."

Mortar must be composed of 1 part Portland cement, 1 part masonry cement (or 1/4 part hydrated lime), and masonry sand equal to 2.5 to 3 times the sum of the volumes of the cements and lime used.

Unless otherwise specified, all grouting must be done with non-shrinking grout.

Reinforcing steel must conform to the requirements of TxDOT Specification Item 440, "Reinforcement for Concrete."

Replacement brick for ring adjustment courses must be of first quality, sound, kiln fired, and new unbroken brick.

Structural or High Sulfate resistant lining for rehabilitation must be Raven 405 Series High Build Epoxy Liner (minimum 200 mil thick), Spray Wall polyurethane system (minimum 250 mil thick), or equal (i.e. a product that has structural and physical properties that are greater than or equal to those of the specified product).

2.4. **Cleaning Manholes and Mains.**

2.4.1. **Preparation.** The Contractor will be required to have all materials, equipment, and labor necessary to complete the cleaning of the sanitary sewer main and manholes on the job site before isolating the sewer manhole or main segment and beginning the cleaning process.

2.4.2. **Cleaning Materials.** Use only cleaning materials recommended by manufacturer of surface to be cleaned. Use each type of cleaning material on only those surfaces recommended by the cleaning materials manufacturer. Use only materials which will not create hazards to health or property, or affect treatment plant process.

2.5. **Concrete.** All concrete must meet the requirements of TxDOT Specification Item 421, "Hydraulic Cement Concrete." Unless otherwise shown on the plans or required by this specification, all concrete will be Class A.

2.6. **Mortar.** Mortar must be composed of 1 part Portland Cement, 2 parts sand, and enough 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.

2.7. **Reinforcing Steel.** Reinforcing steel and the placing thereof must conform to the requirements of TxDOT Specification Item 440, "Reinforcement for Concrete," except where welded wire is called for on the plans, the material will be welded wire flat sheets meeting ASTM A-185. Welded wire rolls will not be used.

2.8. **Cement Stabilized Backfill.** Cement stabilized backfill must be in accordance with TxDOT Specification Item 400, "Excavation and Backfill for Structures."

2.9. **Flowable Backfill.** When indicated on the plans, the trench must 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 Specification Item 401, "Flowable Backfill," or an acceptable mix as approved.

2.10. **Grout.** When shown on the plans for various applications, the grout must be a cement/sand/water mixture as approved. It will have a consistency such that it will flow into and completely fill all voids.

2.11. **Sewer Main Television Inspection.** The Contractor will 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 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.

Television inspection will be done one manhole section 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 must be reduced to allowable levels by temporarily plugging or blocking the flow or bypass pumping, as approved.

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 before 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 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.

Log Formats. Each DVD will be permanently labeled with the following:

- Project Name,
- Date Televised,
- Station to Station Location and Size of Sanitary Sewer,
- Street/Easement Location,
- Name of Contractor,
- Date DVD Submitted, and
- DVD Numbers.

Videotape Quality. If the Contractor produces a DVD of such poor quality that the Engineer is unable to evaluate the condition of the sanitary sewer main or locate the sanitary sewer service lateral connections, the Contractor will be required to re-televising the sanitary sewer main and provide a new DVD of good quality at no additional cost.

Equipment Required For TV Inspections. The Contractor will be required to have all materials, equipment, and labor necessary to complete all videotaping on the job site before isolating the sewer manhole segment and beginning videotaping operations. A camera with rotating or panning lens capabilities is required. 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. The camera height must be centered in the conduit being televised. The speed of the camera through the conduit must not exceed 40 ft. per minute.

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.

DVD Logs. The Contractor must provide, with each completed DVD, a TV inspection report which is a written log of all pipe defects, sags, points of root intrusion, offset points, and service connection locations & condition recorded on a footage basis. This log must denote the section being televised, flow & camera direction, position of taps or failures, pipe condition, and weather conditions.

2.12. **Polyethylene Wrapping Material.** Polyethylene wrapping material must be used to encapsulate all ductile and cast-iron fittings.

2.12.1. **General Requirements.** Polyethylene wrapping for ductile and cast-iron fittings must 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 must consist of an opaque cross-laminated high-density polyethylene sheet continuously thermally bonded to form a tubular section. The tubes can be supplied in bulk length on rolls or in individual pre-cut lengths. See Table 4 for size and length chart, in accordance with AWWA-C-105 (Table 1) for minimum requirements. When supplied in specific pipe lengths, the tubes must contain an additional 4-ft. minimum length in excess of the actual pipe length to allow for overlap.

The polyvinyl sheet of film for the tubular wrapping must be of virgin resins meeting raw and physical properties of ASTM D-1248 and AWWA C-105, latest edition. The material must be 4 mil cross-laminated high-density polyethylene of uniform film thickness and must be free of imperfections such as pin holes, etc., after being thermally seamed into tubular form. The finished product must have a nominal thickness of 4 mil, with tolerances of minus 10%.

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

- Mechanical: The polyethylene film must have a tensile strength of 6,300 psi minimum, per latest ASTM D-882 test. The film must have an elongation of at least 100% of the test strip per latest ASTM D-882 test. The film must have an impact resistance of 800 g minimum per ASTM D-1709 Method B. The film must have a propagation tear resistance of 250 gf minimum in machine and transverse direction (ASTM D1922).
- Dielectric: The film must have a dielectric strength of 800 V per mil thickness per ASTM D-149.

Inspection and Certification by Manufacturer:

- *Quality control and inspection.* The manufacturer will establish the necessary quality control and inspection practice to ensure compliance with this standard.
- *Manufacturer's statement.* The manufacturer will provide a sworn statement on each lot purchased that the inspection and all applicable material requirements of Section 2.12.1. 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.

2.12.2. **Marking Requirements.** The polyethylene film supplied must 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 sizes, and
- Warning-Corrosion Protection-Repair any Damage.

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

Table 4

4 Mil Polyethylene Wrapping Materials

SIZE & LENGTH (All sizes lay flat size)	
PIPE SIZE	PRODUCT SIZE WIDTH x LENGTH
4 in., 6 in. & 8 in.	20 in. x 200/500
8 in., 10 in. & 12 in.	27 in. x 200/500
16 in. & 18 in.	37 in. x 200/500
20 in.	41 in. x 200/500
24 in.	54 in. x 200/500
30 in.	67 in. x 140/500
36 in.	81 in. x 120/500
48 in.	95 in. x 100/500
54 in.	108 in. x 100/500

2.13.

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 in. 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 must 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 of NSF 61 certified rubber. Cover bolts must be alloy steel. Rolling seals must be furnished for non-metallic valves 2 in. and below.

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

The air release valve must 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 must be designed with the inlet and outlet of equal cross-sectional area where applicable. The valve must be capable of automatically allowing large quantities of air to be exhausted during the filling cycle and 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 must 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 in. 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 River Authority 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 will 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.

2.14. **Rehabilitation of Lines.**

2.14.1. **Point Repair Pipe.** Use pipe material for repairs in accordance with Section 2.1 "Sanitary Sewer Pipe." If point repair is located at a service connection, use a full-bodied fitting for the service connection. No field fabrication of fittings allowed.

2.14.2. **Joint Material.** Use flexible adapters secured with 1/2 in. 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.

2.15. **Cast-In-Place Pipe.**

This Item will provide for the reconstruction of existing sewer lines by forming a new pipe within an existing structurally deteriorated pipe which has generally maintained its original shape. The CIPP must provide flow capacity greater than or equal to 100% of the original pipe's flow capacity when new. The installation of the CIPP will be accomplished by the use of the Insituform Process, Inliner U.S.A., Inc., or approved equal process. The process is defined as the reconstruction of sewer line by installation of a thermosetting resin impregnated flexible felt fiber tube which is inverted into the existing sewer line utilizing a fluid column. Curing is accomplished by circulating hot water, or other approved liquid, throughout the length of the inverted tube to cure the thermosetting resin into a hard, impermeable pipe. The pipe must extend the full length of the original pipe and must provide a structurally sound, jointless, close fitting CIPP.

Patents. The inversion process is patented and is installed by licensed Contractors. The Contractor will warrant to the owner and the Engineer that the methods, materials, and equipment used herein, where covered by license, are furnished in accordance with such license; and the prices included in this proposal include applicable royalties and fees in accordance with such license. The Contractor will warrant and save harmless the owner of the sewer line (SARA) and the Engineer against all claims for patent infringement and any loss thereof.

The Contractor may propose a proven alternate method of CIPP, meeting all criteria of this specification. This alternate approval must come from the SARA Watershed Engineering Department.

The following information must be submitted to the Engineer a minimum of 20 days before construction operations:

- Product Data Design Criteria,
- Physical Properties,
- Limitations of Process,
- Material Specifications,
- List of Current and Previous Projects in USA (with size),
- List of Testing Methods,
- Third Party Test Data,
- List of References, and
- List of Currently Owned Equipment.

2.15.1. **Flexible Felt Fiber Tube.** The resin impregnated felt tube must be manufactured and fabricated, under quality controlled conditions set by the process manufacturer, to a size that, when installed, will snugly fit the internal circumference of the existing sewer, and provide the required thickness when cured with the liquid thermosetting resin, as described later. The minimum length will be as found necessary by the Contractor, to effectively and fully span the actual field distance between the manholes, with extra allowance as needed for proper stretching and shrinkage due to pressure, expansion, and for lateral service cuttings, etc. Measurement for payment will be made from the actual field measurements of distance between the centerlines of the manholes.

2.15.2. **Resin.** The liquid thermosetting resin used to impregnate the felt tube must produce a properly cured tube that will be resistant to abrasion and corrosion due to solids, grit, sand, acids, and gases such as hydrogen sulfide, methane, and carbon monoxide. The resin selected must have proven resistance to normal municipal sewage, especially sulfuric acid corrosion from hydrogen sulfide gas.

The resin system to be used must be manufactured by approved companies selected by the CIPP process manufacturer. Relevant information from the resin manufacturer must include specifications, characteristics, and properties, as well as methods of application. This data will be submitted for approval. A written certification that the resin material complies with the required application, along with curing temperature and duration of the temperature (step cooking temperature or hours at each and final stages) depending upon the sewer size and liner thickness, will be supplied. A blanket letter may not be enough in case of varying liner thickness and lengths, etc. This information is necessary for the Engineer to be satisfied that the curing is being done according to plan and procedure, and it is being checked accordingly in the field during installation.

The Engineer will also be informed, in advance, for verification and inspection of the resin material at the "wet out" of the felt tube. The inspection will be at the discretion of the Engineer, which will not relieve the Contractor of responsibility. The inversion and heating schedule or plan must be submitted at least 24 hours in advance. Heating must continue uninterrupted until the desired temperature is achieved. Temperatures must be measured at both ends by sensitive and accurate measuring devices.

Correction of failed liner, deemed unacceptable as a result of post-TV inspection or test reports for structural values, thickness, etc., must be repaired by the Contractor at the Contractor's expenses. The method of repair must be as approved, which may require field or workshop demonstration.

The minimum length will be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise specified. The Contractor must verify the lengths in the field before impregnation of the tube with resin. Individual inversion runs may be made over one or more manhole sections as determined in the field by the Contractor and as approved.

The outside of the tube, before installation, must have an impermeable plastic coating. This coating will form the inner layer of the finished pipe and is required for enhancement of corrosion, flow, and abrasion properties.

The layers which constitute the pipe wall must be such that when the thermosetting resin cures, the total wall thickness must be homogeneous with no internal layer of plastic which might weaken the pipe wall and allow internal shear. When cured, the CIPP must form a mechanical bond with the pipe.

The materials used must result in an installed CIPP flow capacity which is greater than or equal to 100% of the original pipe's low capacity when new.

The existing sewers, where designated or required, must be lined using materials and workmanship which can be adapted to the restrictions of the work site. The Contractor must not begin this phase of the work until enough materials are on hand to complete the job.

The Contractor must furnish to the Engineer, before use of the lining material, satisfactory certification from an approved testing laboratory as to the results of testing the proposed lining material.

2.16. **Repairs.** Pipe materials used for repairs must be in accordance with Section 2.1 "Sanitary Sewer Pipe."

2.17. **Bypass Pumping.** 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 sewer system (excluding manholes) at all times during construction. All materials, equipment, etc., must be in good condition, and should not have visible damage such as cracks, holes, foreign material, blisters, etc.

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. SARA will be notified in enough time to allow them to inspect the pipe joints during assembly.
- HDPE fusion welding must be performed by personnel certified as fusion technicians by the manufacturer of HDPE pipe and fusing equipment. SARA will examine welds before use in Bypass Pumping Plan (BPP) operations.
- Bypass Pumping Plan 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.

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. Plugs will be reviewed by the Inspector or Engineer for defects that might lead to failure before being installed. Contractor will 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 SARA of any plug that has provided an indication that its suitability for use in plugging may be suspect or compromised and allow SARA 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.

Plugs.

- 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, or 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.

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 to 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 enough sound attenuation measures to comply with City of San Antonio noise limitation requirements.

- 2.17.1. **Submittals.** All submittals will be in accordance with Owner's requirements and must be acknowledged by Owner before 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 before commencing any portion of the proposed scope of work and must be acknowledged by SARA before 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., and
 - 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 names, cell phone numbers, and titles of the people 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 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. If flow diversion to existing sewers is proposed by Contractor, all diversion flows must be contained within pipes. Use of excavated trenches is not allowable for diverting sanitary sewer flows.
- Certificate of Compliance that the BPP complies with all SARA 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, and 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 sizes and capacity, as well as the sizes and capacity of the suction/discharge piping. The description must also include manhole/structure depths and sizes 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 requirements. Contractor must provide SARA with adequate notification to allow SARA 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 SARA observed holidays). Contractor will reimburse SARA for the overtime costs required by his bypass pumping outside of SARA 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 elevations.
- Suction, discharge, and diversion piping materials and capacity to be used for the bypass pumping operation, including the materials for any bends or valves that will be used.
- A sketch showing the location of the pumps and the route of the suction, discharge, and diversion piping. If Contractor elects to use locations outside of the easements obtained by SARA 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. If different than shown in contract documents, the new sketch must be dimensioned and all-inclusive, showing all SARA manhole numbers that will be used for suction and discharge operations. If any other structure will be used for suction and discharge operations, then the nearest manholes must be labeled. The sketch must include the name of any streets and major intersections 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)) will likewise be addressed.
- Clear photographs of the manhole interiors 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 enough bypass capacity, restoration of flow through the sanitary sewer system, or other measures acceptable to SARA 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. Flow diversion pipes must have watertight seals at inlet and outlet connections with existing manholes or structures. The pipe must be capable of remaining in place during a 100-yr. 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 professional engineer that sealed the BPP Certificate of Compliance.

2.18. **Pipe Bursting/Crushing Replacement Process.**

2.18.1. **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 referred to as Drisco 1000, Drisco 8600, Quail Pipe, Poly Pipe, and Plexco Pipe that is in conformance with ASTM F714 and ASTM requirements stated herein are considered approved for this project. HDPE pipe on this project 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 SARA and TCEQ.

2.18.2. **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 PPI 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 SARA. The value for the Hydrostatic Design basis will not be less than 1,600 psi (11.03 MPA) per ASTM D 2837. Pipe will have ultraviolet protection.

2.18.3. **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 mil 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.

2.18.4. **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.

2.18.5. **Pipe Dimension Ratios.** The minimum wall thickness of the polyethylene pipe will meet the following requirements in Table 5, as based on the deepest portion of a particular pipe pull, typically between manholes:

Table 5

Minimum Pipe Wall Thickness

DEPTH OF COVER (FEET)	MINIMUM SDR OF PIPE
0-16	19
>16.1	17

Wall thickness must be as indicated on the plans and will be in accordance with Chevron Plexco Industrial Piping System Pipe Data and Pressure Rating Bulletin 301, or approved equal.

- 2.18.6. **Pipe Joining.** Solid wall pipe must be produced with plain end construction for heat-joining (butt fusion) conforming to ASTM D 2657.

The polyethylene pipe will be assembled and joined at the site using the thermal butt-fusion method to provide a leak proof and structurally sound joint. Threaded or solvent-cement joints and connections are not permitted. All equipment and procedures used will be in strict compliance with the manufacturer's recommendations. Fusing will be accomplished by personnel certified as fusion technicians by a manufacturer of polyethylene pipe or fusing equipment.

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 Engineer or his representative before insertion. All defective joints will be cut out and replaced at no cost to SARA. 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. However, a defective area of the pipe may be cut out and the joint fused in accordance with the procedures stated above. In addition, if in the opinion of the Engineer or his representative, any section of pipe has other defects, including those listed below, 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, or internal roughness characteristics; or any other defect of manufacturing or handling.

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-in. thick neoprene, grid-type gasket. Select clamps to fit outside diameter of pipe. Use minimum clamp length of 30 in. for replacement pipe 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 1/2 in.

- 2.18.7. **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 greater than or equal to the nominal pipe size indicated on the drawings.
- 2.18.8. **Augering Pipe.** HDPE pipe is not approved in applications requiring augering of sewer pipe.
- 2.18.9. **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.
- 2.18.10. **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 will 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.

2.19. **Sliplining.**

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

Acceptable manufacturer for FRP liner pipe: must conform to the current Standard Material Specifications accepted by the San Antonio Water System.

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

2.19.2. **FRP Liner Pipe and Fittings.** Pipe, joint, and fitting; ASTM D 3262m 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 D 2412. 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 D 3262.

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

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

Joints: Low-profile FRP jacking bell-and-spigot joints or flush bell and spigot joints, with elastomeric sealing gaskets for watertight joints meeting ASTM D 4161.

Dimensions and Tolerances:

- Pipe outside diameters and tolerances: Comply with ASTM D 3262, 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.
- FRP pipe minimum outside diameters and minimum wall thickness as shown in Table 6.

Table 6

FRP Diameter and Thickness

MINIMUM EXISTING SEWER NOMINAL DIAMETER	MINIMUM WALL LINER O.D.	MINIMUM WALL THICKNESS 46 PSI STIFFNESS	THICKNESS 72 PSI STIFFNESS
<u>Inches</u>	<u>Inches</u>	<u>Inches</u>	<u>Inches</u>
21	19.5	0.42	0.48
24	21.6	0.46	0.53
30	25.8	0.54	0.63
36	32	0.66	0.77
42	38.3	0.78	0.91
48	44.5	0.90	1.05
54	50.8	1.02	1.19
60	57.1	1.14	1.33
66	62.9	1.26	1.47
72	69.2	1.38	1.61
78	75.4	1.5	1.75

- Fabricate pipe ends square to pipe axis ± 0.25 in., or $\pm 0.5\%$ of nominal diameter, whichever is greater.

Fittings.

- 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.

2.19.3. **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.

2.19.4. **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 shown in Table 7.

Table 7

Clamp Length

LINER PIPE O.D. (Inches)	MINIMUM CLAMP LENGTH (Inches)
7.125	15
8.625	18
10.75 or greater	30

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

2.20. **Slip lining Grout.**

2.20.1. **Manufacturers/Application.** The applicator of the grout mix must be certified by the grout mix manufacturer and approved by the SARA Engineer. The certified applicator must be regularly engaged in the placement of grout, including completion of pipeline grouting installations having at least 1,000 cu. yd. in the past 3 yr.

2.20.2. **Materials.**

2.20.2.1. **Cement.** Comply with ASTM C 150. Pozzolans and other cementitious materials are permitted.

2.20.2.2. **Fly Ash.** Comply with ASTM C 618; either Type C or Type F must be used.

2.20.2.3. **Sand.** If provided, conform to ASTM C 144, except as modified in Table 8 below:

Table 8
Sand Gradation

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

2.20.2.4. **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.

2.20.2.5. **Admixtures.** Admixtures must be selected by the slip-lining grout manufacturer to meet performance requirements, improve pumpability, control set time, and reduce segregation.

2.20.2.5.1. **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 C 495 or C 109.

2.20.2.5.2. **Performance Requirements.** The Contractor must submit the proposed grout mixes, methods, plans, and criteria of the grouting operations. The grouting system must have enough gauges, monitoring devices, and tests to determine the effectiveness of the grouting operation and to ensure compliance with the liner pipe specifications and design parameters.

- 2.20.2.5.3. **Mix Designs.** One or more mixes must be developed to completely fill the annular space based on, but not restricted to, the following requirements:
- size of annular void,
 - void (size) of the surround soil,
 - absence or presence of groundwater,
 - enough strength and durability to prevent movement of the line pipe,
 - provide adequate retardation, and
 - provide less than 1% shrinkage by volume.
- 2.20.2.5.4. **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 sec. in accordance with ASTM C 939 unless otherwise approved by the SARA engineer.
- 2.21. **Bedding and Backfill.** Backfilling for sanitary sewers is divided into 3 separate zones. Bedding is the material in the bottom of the trench in direct contact with the bottom of the pipe. Initial Backfill is the backfill zone extending from the surface of the bedding to a point 1 ft. above the top of the pipe. Secondary Backfill is 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.
- 2.21.1. **Bedding.**
- Stable Material.** Existing stable material present during excavation including:
- Trench bottom free of water, muck, and debris;
- Rock in boulder, ledge, or coarse gravel formations with maximum particle size of 1-3/4 in.;
- Coarse sand and gravels with maximum particle size of 1-3/4 in., 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, and clay & gravel-clay mixtures.
- Unstable Material.** Existing unstable materials are: silt, muck, trash, or debris in the trench bottom bearing level; rock, in boulder, ledge, or coarse gravel formations with particle sizes larger than 1-3/4 in.
- 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 enough 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 9, unless modified by the Engineer in writing.

Table 9

Gravel Gradation

<u>SEWER GRAVEL</u>	<u>PERCENT</u>
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 due to removal of unstable material, the pipe must be concrete-encased. Encasement must extend from 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, 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 feet on each side of the pipe.

- 2.21.2. **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.

- 2.21.3. **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 will 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.

The secondary backfill material must be placed in maximum 12 in. loose lifts or as directed.

- 2.22. **Grouting of Sewer Mains.**

Submittals.

- Proposed Mix Design Report for grout.
- Submit manufacturer's 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 before commencing grouting activities, describing proposed sequence, access points, and other information pertinent for completion of work.

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 3 tests for same placement. Present at least 3 acceptable strength tests for proposed mix design in mix design report.

- 2.23. **Seepage Retainers.** To prevent piping or seepage along the bedding and initial backfill zones, where porous material including "Subgrade filler" is used for backfill, seepage retainers are required at an approximate spacing of 180 ft. Retainers are also required 20 ft. upstream and downstream of each manhole, as applicable. Seepage retainers must be 18 in. and extend the full height and width limit of bedding and initial backfill. Seepage retainers must consist of Class B concrete encasement. No separate payment for the seepage retainers is permitted. The cost for this work must be included in the bedding.

3. CONSTRUCTION

- 3.1. **Excavation.** Excavation as required to complete the work as outlined herein must be performed in accordance with TxDOT Specification Item 400, "Excavation and Backfill for Structures."
- 3.1.1. **Trench Excavation Protection.** Excavation greater than 5 ft. in depth must be protected as specified in TxDOT Specification Item 402, "Trench Excavation Protection," or TxDOT Specification Item 403, "Temporary Special Shoring." 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 feet 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 Section 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.
- 3.2. **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 as directed. 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, the under-cut trench must be restored to grade at no cost to SARA by replacement with a material conforming to the requirements of the bedding material or a material approved by the Engineer.
- 3.2.1. **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 will 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.
- 3.2.2. **Classification of Excavated Materials.** No classification of excavated materials will be made. Excavation and trench work must include the removal and subsequent handling of all materials excavated in accordance with TxDOT Item 400, "Excavation and Backfill for Structures."
- 3.2.3. **Grade of Trench Bottom.** The trench must 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 must then be met by the addition of a layer of approved bedding material as directed.

- 3.2.4. **Excavation Below Grade.** Any part of the bottom of the trench excavated below the limits specified in Section 3.2.3., "Grade of Trench Bottom," must be corrected with approved material and compacted as directed. Should excessive over-excavation occur, except at bell holes, the grade must be restored in accordance with the methods described in Section 3.2.5., "Unstable Conditions at Grade," at no cost to the Department.
- 3.2.5. **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 or fragments of inorganic materials, which in the judgment of the Engineer should be removed, the Contractor must excavate and remove such unsuitable material to a depth at least 6 in. below pipe. Before the pipe is laid, the grade must be restored by backfilling with an approved material in 3 in. layers before compaction. The layers must be slightly moistened and thoroughly compacted to provide a uniform and continuous bearing and support for the pipe at every point between bell or collar holes. The finished grade must 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.
- 3.2.6. **Caution in Excavation.** The Contractor must 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 existing underground utilities. The Contractor will be responsible for the repair of such structures and utilities when broken or damaged. The Contractor will 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 will make explorations and excavations for such purposes at his expense.

Backfill Material Derived from Excavation. Any excess excavated material, not used 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 approval.

- 3.2.7. **Trench 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 before final asphaltting.

All street work must be done in accordance with the latest Department 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.

- 3.2.8. **Pavement.** The Contractor must remove pavement and surfaces as a part of the trench excavation. The removal of pavement and surfaces and their restoration will be based on the minimum trench widths as specified, plus 6 in. either side or as otherwise provided herein. The Contractor must use methods such 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 will 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 must be replaced in kind as directed. Where, in the opinion of the Engineer, it is necessary to maintain traffic across a trench, the Contractor must install temporary metal bridges as necessary to facilitate the movement of traffic.

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

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

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

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

Expansion joint material must be provided where new construction abuts the existing curb or driveway if deemed necessary.

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

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

- 3.2.10. **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 will 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 will be included in the applicable contract price for the item to which the work pertains.

3.2.11.

Bedding and Backfill.

3.2.11.1.

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 must 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 must be such that the apparent dry density of each layer is 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 2%± optimum moisture content as determined by tests on samples as outlined in the latest provisions of TxDOT Testing Method Tex 113-E or 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, ± 2% points.

3.2.11.2.

Initial Backfill. Before 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 2 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 before placement of the 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 of the pipe, and over the pipe in 12 in. lifts to a minimum of 1 ft. above the top of the pipe. Consolidate the initial backfill material as specified for bedding.

3.2.11.3.

Secondary Backfill. The secondary backfill material must be placed in maximum 12 in. loose lifts or as directed.

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. Successful passage of the air and mandrel test (for flexible pipe, 30 days after installation), as described under TCEQ 30 TAC 217.53 Criteria, will be required for the acceptance of the mains.

After the trench has been carefully graded and all bell holes excavated, approval is required before placing the pipe therein.

All sewers must be laid in straight alignment, so that a light can be seen from one manhole to the other even for the smaller size of sewers. The pipe must be laid accurately to line and grade, with the spigot end downstream entering the bell to full depth and in such a manner as not to drag earth into the annular space. Pipes and fittings must be fitted together and matched so that they will form a sewer with a smooth and uniform invert. Special care must be taken to provide uniform bearing for the entire length of pipe.

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 (d) must be met.

Pipe and Fittings. Proper and suitable tools and appliances for the safe and convenient handling of the pipe and fittings must be provided and used. Care must be taken to prevent any damage to the pipe coating. All pipe and fittings must be examined for defects right before placing into the trench and no materials will be laid that are known to be defective.

Any defective pipe discovered after being laid must be removed and replaced with acceptable pipe at the Contractor's expense. Wherever the pipe requires cutting, it must be done with a standard wheel pipe cutter for pipe 12 in. and smaller. Cutting methods for larger pipes will be as approved. Each cut must be smooth and at right angles to the axis of the pipe.

Pipe Laying. The Contractor will be required to commence construction and laying of pipe at the downstream end of the sanitary sewer outfall line and proceed non-stop in a forward upstream direction.

No pipe will be laid within 10 ft. of any point where excavation is in progress. Pipe laying will proceed with the tongue or spigot pointing in the 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 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.

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 adequate 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 mains enter and exit a manhole or structure.

No pipe will be installed in tunnels except as provided on the plans, or with permission. If the Contractor finds it necessary to install pipe in tunnels not provided on the plans, he must submit to the Engineer, before 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.

When constructing the line within 10 ft. of a CPS Energy power pole or guide wires, it is the responsibility of the Contractor to coordinate with CPS Energy for bracing of the power pole and guide wires during construction of the pipe in the local area.

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

- 3.3.2. **Service Connections (Sanitary Sewer Laterals).** Sanitary sewer laterals fittings and appurtenances must conform to the Sanitary Sewer specifications and must be installed by the Contractor as specified herein, or as directed, and in accordance with the plans. Where the lateral is within the Edwards Underground Recharge Zone, it must be installed in accordance with details.

Service Line Installation. All service line installations will 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 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 must be as specified herein.

Service Connections:

- Provide reconnections of all existing sewer service laterals to new lines installed or provide connections of new laterals to existing sanitary sewer mains. Locate laterals and insure service is not interrupted to homes or other establishments.
- Wyes, bends, tees, stacks, and other hardware required must be installed for service laterals as shown on the plans or as directed.

- 3.3.3. **HDPE Pipe Joining.** Bending of HDPE pipe will be done in accordance with the manufacturer's instructions.

- 3.3.4. **Pipe Joint Restraint System for HDPE Pipe.** Restraint devices will be used where ductile iron mechanical joint bell fittings are coupled to plain-end (square-cut) HDPE pipe, to prevent movement of pipe connections. Mechanical joint adapters will be required for the HDPE pipe.

All restraint devices will be installed in accordance with the manufacturer's instructions.

A restraint end must be heat fused on the lift station end of the PE pipe at the connection point. This end can be used with a standard gland to achieve a restrained joint when connecting to the ductile iron fitting. The restraint end must have a stainless steel insert to prevent pipe misshaping.

Before the restraint end is attached, the Contractor must install an anchor collar with a stainless steel insert. An anchor collar must be installed on both ends. The anchor collar must be installed with adequate distance to allow installation of concrete around the collar without getting on long sleeve or fitting. Concrete must be cast across the ditch and act as a deadman against polyethylene pipe movement caused by temperature variances.

- 3.3.5. **Coating and Wrapping Underground Steel Pipe.** Exterior surfaces of all steel pipe fittings and specials which will be installed underground and which will not be encased in concrete will be cleaned to bare metal by wire brushing with a power driven wire brush, sand blasting, or other approved methods. A prime coat compatible to the polyvinyl tape to be used will then be applied to the pipe. Following the application of the prime coat, the pipe will be wrapped with Scotchrap, Trantex V-10 polyvinyl tape, or approved equal. The tape will not be applied until the prime coat is completely dry.

The tape will be spirally and tightly wrapped on each section of the pipe with a 50% lap. The joint will be protected with tape 8 in. in width on pipe greater than 12 in. in size.

Each section of pipe will be cleaned, primed, and wrapped to within 6 in. of each end. The priming and wrapping will be completed, and the bare pipe wrapped with tape lapped 3 in. over the originally taped sections.

- 3.3.6. **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 SARA 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.

- 3.3.7. **Force Main.** A restraint end must be fused on the ends of the PE pipe. This end can be used with a standard gland to achieve a restrained joint when connecting to the ductile iron long sleeves.

The PE anchor must be like a pipe collar and be formed with the PE pipe and have a stainless steel insert. The concrete around the anchor must consist of mixed concrete anchored horizontally in the ditch notch. Anchor must lock into the surrounding ground perpendicular to the carrier pipe.

All fittings used for force main routing must be PE fused fittings except those used to attach to the existing force main and outfall manhole.

- 3.4. **Bypass Pumping.** 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 SARA Inspections Department 72 hr. before commencing the bypass pumping operations.

The Contractor must have full time (24-hr.), qualified pump personnel onsite, 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 will 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 will be assigned to the pump operation, and one additional attendant will be assigned to walk and monitor the pipeline.

Before installing any plugs, the Contractor and SARA 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 locations. Afford SARA an opportunity to confirm that the locations of plugs are 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 a continuous supply of on-site fuel storage adequate for 24-hr. 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, 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 SARA sanitary sewer manhole before disassembly and removal of the system from the construction site. The intent is to prevent spillage of sewage.

SARA will not be responsible for additional traffic control measures that might be required by City of San Antonio, Bexar County, the Texas Department of Transportation, or any other public entity having jurisdiction of the project location.

Flow Tracking.

Logs will be provided by the SARA Inspector in order to continuously track all flows being bypassed.

- 3.5. **Manhole Construction.** Manhole construction must be in accordance with TxDOT Specification Item 465, "Manholes and Inlets," and as specified herein.

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 must be constructed and shaped accurately so as to be smooth, uniform, and cause minimum resistance to flow. The bench must 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 must be removed flush to the inside manhole walls.

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

Concrete cradles are required for new pre-cast manholes. Concrete cradles must be provided for all influent and effluent pipes on new monolithic manhole and sewer pipe systems. Concrete cradles must 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 or as shown in the contract documents, and inspected before backfilling.

Where connections to existing manholes are required, the adjacent pipe bedding must 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 must be kept out of new or existing manholes or mains.

Throat rings must be mortared between all bearing surfaces to provide a minimum in-place mortar thickness of 1/4 in. No more than 4 throat rings may be used on any manhole. There will be no more than 21 in. from the top of the cone to the top of the ring and cover.

Manhole Ring Encasement. All manhole rings must be encased with 4,000 psi reinforced Class B concrete as shown on the plans or as approved. Manhole ring encasements must extend 6 in. below the top of the cone and have a minimum thickness of 1 ft. when measured at the manhole ring. The surface of the encasement must 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 or proposed roadways and where directed or shown on the plans, the exterior exposed surfaces of the ring, mortar, throat rings, and manhole surface must be coated with a 1/8 in. minimum thickness of mastic or plastic before placement of concrete.

- 3.6. **Manhole Rehabilitation.** Described are procedures for cleaning, preparation, application, and testing. The Applicator, approved and trained by the manufacturer, must furnish all labor, equipment and materials for applying a cementitious mix to form a monolithic liner of a minimum 1/2 in. thickness, with machinery specially designed for the application. All aspects of the installation must be in accordance with the manufacturer's recommendation and as per this specification, which includes:

- the removal of any loose and unsound material,
- cleaning of the area to be restored with high pressure water,
- repair and filling of voids,
- repair and sealing of invert and benches,
- elimination of active infiltration before making the application, and
- spray application of a cementitious mix to form a structural or structurally enhanced monolithic liner.

Certification. Manufacturer must certify that Applicator has been trained and approved in the handling, mixing, and application of the products to be used. Equipment to be used for applying the products by the Applicator must be certified and approved by the Manufacturer. Five recent references of Applicator indicating successful application of proposed liner on projects of similar size and scope must be submitted by Contractor.

Surface Preparation. Proper surface preparation procedures must be followed to ensure adequate bond strength to any surface to be coated. Applicator must inspect all surfaces specified to receive a liner before surface preparation. Applicator must notify Owner of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the repair mortar or liners. Concrete that is not sound or has been damaged by chemical exposure must be removed to a sound, concrete surface. All containments, including all oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants must be removed. Surface preparation methods must be based upon the condition of the substrate and the requirements of the liner to be applied.

Surface to receive liner must be cleaned and abraded to produce a sound concrete surface with adequate profile and porosity to provide a strong bond between the protective coating and substrate. High pressure cleaning with a minimum of 4,000 psi and 4 gal./min. using a rotating pencil nozzle, must be used to clean and free all foreign material within the manhole. Detergent water and cleaning or muriatic acid must be used when grease and oil are present. All materials resulting from the cleaning of manhole must be removed before application of coating.

Active water infiltration must be stopped by using a cementitious water plug or hydro-active grout such as Strong-Seal Strong Plug, Quadex Hydra-Plug, or approved equal which is compatible with the specified coating. Prepared surfaces should be tested after cleaning and before application of the coating, if a specific pH or moisture content of the concrete is required according to manufacturer's recommendations.

Product Handling and Rehabilitation Conditions. Protective coating materials must be handled according to their material safety data sheets. Materials must be kept dry, protected from weather, and stored under cover.

Repair and under-coat materials must be accepted and approved by the protective coating manufacturer for compatibility with the specified liner and must be used to fill voids, structurally reinforce and rebuild surfaces, etc., as determined necessary. The Engineer will determine type of manhole rehabilitation to be used according to the following:

Condition. The manhole is assured to be exhibiting severe structural fatigue and collapse is imminent. Conditions indicating this degree of deterioration would be distortion beyond 10%, severe corrosion (exposed reinforcing), or large section (greater than 30%) of the structure is missing. An approved structural liner followed by a compatible approved non-structural (sulfate resistant) protective liner must be used to rehabilitate the manhole. A letter from the manufacturer will be submitted certifying the compatibility of the structural liner with the corrosion resistant protective coating.

Liner Application. Application procedure must conform to the recommendations of the liner manufacturer, including materials handling, mixing, environmental controls during application, safety, and equipment. The liner application equipment must be specifically designed to accurately apply the specified liner material and must be regularly maintained and in proper working order. The liner material must be applied by a Certified Applicator of the liner manufacturer. The liner must be applied to minimum thickness or as specified according to the Owner's requirements and Manufacturer's recommendations. Temperature of the surface to be coated must be maintained between 40°F and 120°F during application. Before and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures exist, care should be taken to apply the liner when the temperature is falling versus rising (late afternoon into evening versus early morning into afternoon).

Warranty. Contractor will warrant to the Owner all work against defect in materials and workmanship for a period of 2 yr., unless otherwise noted, from the date of final acceptance of the project. Applicator must, within a reasonable time after receipt of written notice thereof, repair defects in material or workmanship which may develop during the 2 yr. period and any damage to other work caused by such defects for the repairing of same, at their own expense and without cost to the Owner.

3.7.

Cleaning Manholes and Mains.

The sanitary sewer lines and structures that will be rehabilitated must be cleaned using mechanical, hydraulically propelled, or high velocity sewer cleaning equipment. The cleaning process must remove all grease, sand, silts, solids, debris, etc. from each sewer segment, including the manholes. Selection of cleaning equipment and method for cleaning must be based on the condition of the sanitary sewer mains at the time work commences and will be subject to approval. All cleaning equipment and devices must be operated by experienced personnel. Satisfactory precautions must be taken to protect the sanitary sewer mains and manholes from damage that might be inflicted through the improper use of the cleaning process or equipment. Any damage done to a sewer by the Contractor must be repaired by the Contractor at the Contractor's expense, to satisfaction. Cleaning must also include washing of the manhole wall by high pressure water jet.

During construction the Contractor will keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish.

Keep dust-generating areas wetted down.

Provide suitable containers for storage of waste materials, debris, and rubbish until time of disposal.

Dispose of waste, debris, and rubbish off site at legal disposal areas.

Remove and dispose of all excess or waste materials, debris, and rubbish from the site, structures, and all facilities at the end of working hours.

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 tools which retard the flow of water in the sanitary sewer lines are used, precautions must be taken to insure 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 used 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 will 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 mains.

Hydraulic Cleaning. Hydraulic propelled devices which require a head of water to operate must use a collapsible dam. The dam must be easily collapsible to prevent damage to the sewer, surrounding property, etc. When using hydraulically propelled devices, precautions must be taken to insure that the water pressure created does not cause damage or flooding to 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 main must be used to provide necessary fluid for hydraulic cleaning devices whenever possible.

High Velocity Cleaning. Cleaning equipment that uses a high velocity water jet for moving debris must be capable of producing a minimum volume of 50 gpm with a pressure of 1,500 psi for the sanitary sewer line and 3,500 psi for the (manhole) structure at the pump. Any variations to this pumping rate must be approved in advance. To prevent damage to older sewer mains 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. 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 reduce anytime the hose is held 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, which must be followed strictly, unless modified. All equipment and devices must be operated by experienced operators so that they do not damage the pipe in the process of cleaning. Buckets, scrappers, scooters, porcupines, kites, heavy duty brushes, metal pigs and other debris removing equipment and 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, kites, porcupines, root saws, snakes, scooters, sewer balls and other approved equipment, in conjunction with hand winching device, or gas or electric rod propelled devices, will be considered normal cleaning equipment.

3.8. **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 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 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 will 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.

The pipe must be jacked from downstream end. Permissible lateral or vertical variation in the final position of the pipe from line and grade will be as shown on the plans 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.

Boring. Excavation for "Boring" pits and installation of shoring must 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 would make the use of tunneling more satisfactory than "Jacking" or "Boring." The excavation for pits and the installation of shoring must 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," must 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.

When jacking, boring or tunneling the line within 10 ft. of a CPS Energy power pole or guide wires, it is the responsibility of the Contractor to coordinate with CPS Energy for bracing of the power pole and guide wires during construction of the pipe in the local area.

3.9. **Concrete Encasement, Cradles, Saddles and Collars.**

Concrete Encasement. When concrete encasement is shown on the plans or when directed, the trench must be excavated and fine graded to a depth conforming to the details and sections shown on the plans. The pipe must be supported by pre-cast concrete blocks of the same strength as the concrete for encasement and securely tied down to prevent floatation. Encasement concrete must be placed to a depth and width conforming to details and sections shown on the plans.

Concrete Cradles. When concrete cradles are shown on the plans or when directed, the trench must be prepared and the pipe supported in the same manner as described in concrete encasement 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 must be backfilled to the spring line in accordance with Section 3.2., "Trenches" of this specification, 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 must be constructed in accordance with details and sections shown on the plans.

- 3.10. **Adjust or Abandon Manholes.** Existing manholes must be adjusted or abandoned in accordance with TxDOT Specification 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 must 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 must 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 by the Contractor at his own expense. If concrete throat rings will 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 must 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 to the City of San Antonio Utility Excavation Criteria Manual Standard Drawing No. 8.8, but must first be directed by the Engineer. All manholes will then be raised or lowered an adequate height 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 2 and a maximum of 6 throat rings will be used at each adjusted manhole. All excess materials must be disposed of by the Contractor at his own expense in an approved location.

The standard manhole ring and cover must be ductile iron and manufactured to the dimensions shown in the plans. The ring and cover must be hinged. Lifting slots cast into the covers must be provided for lifting purposes. A water-resistant (cam lock) hinged cover must be used in areas of minimal infiltration potential to allow venting. A watertight (bolt down) ring and cover must be used in areas of high infiltration potential, such as in the Edwards Aquifer Recharge Zone, an identified 100-yr. floodplain, or as otherwise directed. The nominal cover diameter must be 32 in., with a 30 in. clear opening, as required by TCEQ. Rings must have a minimum of four 1-in. holes/slots for anchoring purposes. Rings must be a minimum of 4-1/2 in. in height or as otherwise accepted. Slots for embedment/lightening are not allowed in ring flanges.

Water-Resistant Rings and Covers. Rings and covers must have 2 hinges for added stability. The hinges must have a drain to allow for proper debris and foreign object removal. Before acceptance of the work, a stainless steel keyed "cam" lock must be provided by the Contractor to the Inspector. When the key is inserted in the cam, it must remain in the lid while the cam is in the open (unlocked) position. When in the closed (locked) position, the key can be removed. When not in use, the cam lock key hole must be covered with a plastic plug to prevent infiltration of debris. The cover must positively lock at 90° to prevent accidental closure and open fully to 120°. The cover must also include a single multi-tool lifting slot adjacent to the edge of the cover to facilitate opening/lifting/prying once it is unlocked. Covers must be provided with a continuous vulcanized (one piece) EPDM gasket with a shore durometer of 70 ±5 permanently attached to the cover.

Watertight Rings and Covers. Rings and covers must be the same as above for water-resistant version, except the covers will be bolted to the ring instead of secured with the cam lock mechanism. No vent holes will be provided. A minimum of four 1/2 inch diameter, stainless steel, hex head bolts must be provided for each cover. The 4 bolt holes in the covers must be evenly spaced and provided with a minimum 1-1/2 inch diameter counter sink for the bolt heads. In the fastened and bolted position, the bolt heads must not extend above the surface of the cover. Washers of a size and material as approved must be provided for the bolts to insure air and water tightness.

The finished ring and cover must have the bearing surfaces machined ground and sets of rings and covers must be marked in such a way that they can be matched for assembly in the field. All covers must have the words "SAN ANTONIO RIVER AUTHORITY Sanitary Sewer" cast thereon. Ring and cover must have the approved 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 and ASTM A536 or A536 80-55-06 to verify the materials used. Castings without proper markings will be rejected.

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 will be classified as "Abandon Manhole." Work required on an abandoned manhole will 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 manhole must be removed and delivered to Sanitary Sewer Owner's facility designated by the Engineer. If directed, drainage holes must be drilled in the bottom of manhole walls before backfilling.

When adjusting or abandoning manholes on the line within 10 ft. of a CPS Energy power pole or guide wires, it is the responsibility of the Contractor to coordinate with CPS Energy for bracing of the power pole and guide wires during construction of the pipe in the local area.

- 3.11. **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 Specification 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.

- 3.12. **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 will be a part of sewer work. Removal must be in accordance with TxDOT Specification Item 104, "Removing Concrete." Replacement must be in accordance with the plans and with TxDOT Specification Item 529, "Concrete Curb, Gutter, and Combined Curb and Gutter," TxDOT Specification Item 530, "Intersections, Driveways, and Turnouts," TxDOT Specification Item 531, "Sidewalks," and TxDOT Specification 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 not approved in advance will not be measured for payment but will be restored at the Contractor's expense.

- 3.13. **Removing and Replacing Chain-Link or Wire Fence.** Existing chain link or wire fences required to be removed solely for sewer installation must 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 will be restored at the Contractor's expense.

- 3.14. **Abandon Sewer Lines.** Abandonment of existing sewer lines must be in accordance with the requirements under Section 3.22., "Grouting of Sewer Mains" of this Special Specification. When abandoning lines within 10 ft. of a CPS Energy power pole or guide wires, it is the responsibility of the Contractor to coordinate with CPS Energy for bracing of the power pole and guide wires during the abandonment.

- 3.15. **Television Inspection.** Immediately upon cleaning the sanitary sewers, all new sewer mains must be televised and videotaped to determine the condition of the line and to locate service connections. The Engineer, Inspector, and Contractor will observe the TV inspection in progress. The Contractor must submit 1 copy of a color DVD of the recordings and logs of the televised inspection to the Engineer.

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 / SARA Job # / Work Order #;
- Date of television inspection;
- Station to station location and size of sanitary sewer;
- Street/easement location;
- Name of Contractor;
- Date DVD submitted;
- DVD number; and
- SARA Inspector Name.

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 before 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.

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 methods used for securing passage of the camera are at the discretion of the Contractor, as approved by SARA. 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 may have been hung up, destroyed, or lost during the operation.

- 3.15.1. **Post-Construction Television Inspection.** TV inspection must be done 1 manhole (structure) section at a time. 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 must be reduced to allowable levels by temporarily plugging or blocking the flow or bypass pumping, as approved.

- 3.15.2. **Obstructions and Hindrances.** All sections of the new sewer main must be televised. Contractor must insure the main is clean and clear of obstructions before performing televising activities. Any abnormalities such as, but not limited to, misaligned joints, cracked/defected pipe, or rolled gaskets, must be repaired by the Contractor at his expense. Sections requiring repair must be re-televised to verify condition of repair. No additional payment will be made for additional set-ups required or delays due to repairs or removal of obstructions.

- 3.15.3. **Bypass Pumping.** The Contractor will perform bypass pumping operations in accordance with Sections 2.17. and 3.4., "Bypass Pumping" in 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.

The Contractor will be required to provide adequate pumping equipment and force mains in order to maintain reliable sanitary sewer service in all sanitary sewer lines involved in this project. The Contractor must notify the Inspector should a surcharge occur during the televising process which results in overflows of sewage. In

case of bypass equipment failure, the Contractor must discontinue work and release sewer flows until such time as equipment failure is corrected. The location of the pumps, force mains, and discharge points will be approved by SARA. Under no circumstances will the flow be interrupted or stopped, such that damage is done to either private or public property, or sewage flows or overflows into a storm sewer or natural waterway.

The Contractor must provide bypass pumping of sewage around each segment of pipe that will be televised, and will be responsible for all required bulkheads, pumps, equipment, piping, and other related appurtenances to accomplish the sequence of pumping. A qualified person must man the pumps, on-site, at all times during the bypassing procedure.

All piping, joints, and accessories must be designed to withstand the maximum bypass system pressure, or a minimum of 50 psi, whichever is greater. During bypass pumping, no sewage will be leaked, dumped, or spilled into or onto any area outside of the existing sanitary sewer system. When bypass pumping operations are complete, all piping must be drained into the sanitary sewer before disassembly. The Contractor must demonstrate that the pumping system is in good working order and can successfully handle flows during cleaning and televising operations, before commencing with the cleaning and televising of the system.

3.15.4. **Video Equipment Operations.** The Contractor will be responsible for the TV inspection equipment having an accurate footage counter which displays on the monitor the distance of the camera from the centerline of the starting manhole. The camera height must be adjusted such that the camera lens is always centered (1/2 ID or higher) in the pipe being televised. In no case will the television camera be pulled or propelled through the line at a speed greater than 40 ft./min.

3.15.5. **Post-Repair TV Inspection.** Upon completion of any repairs required, the Contractor will re-televiser the sewer and submit these DVDs to the Inspector. These DVDs must be permanently labeled as described in Section 3.15., "Television Inspection," and will be used as a portion of the acceptance criteria. This post-repair TV inspection must 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 will be provided at the Contractor's expense.

3.15.6. **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.

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

Manholes must be raised or lowered by replacing the existing cone and manhole sections as required for installation to the finished surface course. The Contractor will be required to backfill all manholes with an approved flowable fill up to 1 ft. above the cone section in accordance with all requirements of the right-of-way owner having jurisdiction over the project scope. 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 acceptable to the San Antonio River Authority's Inspector. If a new manhole cover or ring, or a reconstructed manhole is damaged by the Contractor, it will be replaced by the Contractor at his expense, as directed by the San Antonio River Authority Inspector. All installed concrete throat rings 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 Melt Flow index, ASTM 638 Tensile Strength @ Yield (50mm/mm), ASTM 790 Flexural Modulus, ASTM 648 Heat Deflection temperature @IGEPAL, ASTM 1693 EsCR, 100% IGEPAL/10% IGEPAL.

For reconstructed existing manholes, apply a combination of both products below with the cementitious coating first, followed by the epoxy coating. Kerneos SewperCoat 2000 HR regular, applied at the required 1-in. thick application, is the only product approved which does not require a subsequent epoxy coating. For cementitious material a minimum of a 10-yr. warranty is required. Approved materials are as follows:

Cementitious coating (with required 1-in. thick application):

- Kerneos SewperCoat 2000 HR;
- Refratta HAC 100; or
- Approved Equal.

Epoxy coating (with specified thickness application):

- Raven 405 Series High Build Epoxy Liner (required thickness – 125 mil); or
- Approved Equal.

Existing monolithic manholes will not be reconstructed but replaced.

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

3.18. **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 used 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 Standard Drawings DD-839 Series. In all cases, the design of thrust blocking must be of adequate 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 will 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.

Sand Backfilling of Cross Trenches and Open Holes. Air release valves, copper tubing, meter boxes, or other specials will be backfilled with pit run sand which is free from clay lumps, organic material, and other deleterious substances, and will be thoroughly consolidated by saturating with water, unless otherwise directed. The use of mechanical tamping equipment for compaction of backfill will not be permitted at such locations. Disposal of surplus excavated material and placement of sand will be considered subsidiary to trenching and backfilling and will not be paid for directly.

3.19. **Rehabilitation of Lines.**

- 3.19.1. **Special Construction Conditions.** For Work activities impacted by the size and shape of the existing pipe, the Contractor is herein informed that the pipe is not exactly circular and a normal diameter has been approximated.

On lines designated for a combination of repair and other specified rehabilitation work, the repair must be accomplished before the other rehabilitation work.

Due to the age of the sanitary sewer lines to be rehabilitated, and location of sewer lines & manholes in public rights-of-way, soil conditions may arise which have not been anticipated by the plans and specification. In such a case, the Contractor must submit a proposed construction method to solve specific situations and issues not covered by the plans and specifications for approval before proceeding with the proposed work.

If the specified method of rehabilitation is not the most effective method available to obtain the desired result, the Engineer reserves the right to propose an alternate method of rehabilitation.

Once work has begun at a specific location, the Contractor must diligently pursue the work to be done until the rehabilitation is complete. The Contractor must schedule work such that sewer rehabilitation at each site is complete before moving to another location. Should the work not progress on schedule, the Engineer may direct the Contractor to dispatch additional crews or equipment to the jobsites. The time limit for completion of this work will be strictly enforced. Such direction will not be cause for additional payment to the Contractor and will not serve as the basis of a claim for acceleration.

- 3.19.2. **General.** All pipe to be used must have a corrosion resistant inner surface. All pipes, joints, and fitting supplies must conform, at a minimum, to the requirements of any and all applicable ASTM or AWWA standard specifications for such procedure. A certificate of "Compliance with Specifications" must be furnished for all piping materials supplied.

The interior and exterior surfaces of the pipe must be free from pinholes, cracks, pits or delamination detrimental to the intended use of the product. No pipe having apparent holes or openings which could permit the passage of water or gases through the pipe wall will be installed.

Any visible repairs to the pipe performed by the manufacturer before shipment to the job site must be recorded on a pipe inventory log and submitted to the Engineer. The log must reference the repaired unit as per the manufacturer's pipe numbering system.

On-site repairs will not be allowed without approval. All repairs must be accomplished as per the manufacturer's recommended procedures, and must be done by an approved manufacturer's certified repairman.

Repairs on the outside surfaces will be allowed if the remaining thickness of the wall laminate is greater than 80% of minimum wall thickness.

Pipe must be field-connected with joints meeting the performance requirements, as a minimum, of any applicable ASTM or AWWA standard specifications for such products so as to maintain water tightness. Joint materials must be chemically resistant to the fluids to be conveyed and gases generated by the sewer. Joint must provide a leak-proof seal when deflected as per the manufacturer's recommended maximum deflection or as per the applicable ASTM or AWWA standard specification and must have a rating equivalent to the pipe itself.

Stiffening ribs or rings within the lining inner diameter will not be allowed. Pipe must have a smooth inner lining.

The Contractor must provide enough data from the pipe manufacturer to demonstrate that the pipe supplied provides a 50-yr. service life for the various loading conditions. This data must be submitted as required.

A higher pipe stiffness will be acceptable if recommended by the manufacturer to meet the performance specifications in a particular situation.

The Engineer will have the right to modify or change the required liner thickness, depending upon the field conditions determined from the video tape. An analysis of design criteria and calculations for the liner thickness must be provided for approval. Liner thickness may vary for the same size sewer depending upon field condition of the pipes and depths. Physical characteristics and properties of the felt tube must also be submitted if required.

The CIPP liner thickness required must be calculated using standard resin and the Design Criteria and Values tables in the above referenced standards. The thickness will be rounded to the next highest multiple of 1/16 in. after adding an allowance of 5% to the design thickness for resin migration. Contractor must also verify the table for correctness and must have any modifications approved. These calculations must be based on the following physical conditions of the existing pipe:

All pipes will be considered fully deteriorated.

All pipes will be subject to full soil load of 120 lb./cf., with applicable live load, and water table 5 ft. below the top of the ground.

All pipes will be considered to have a minimum of 2% ovality in the circumference.

The liner inside diameter must be a minimum of 36 in. A minimum clearance of 5% of the liner pipe O.D. should be allowed between O.D. of the liner pipe and the I.D. of the existing pipe.

Any reduced clearance (less than 5%) between the O.D. of the liner and the I.D. of the existing pipe may be allowed if the Contractor submits, as required, a statement demonstrating that the liner pipe manufacturer recommends and certifies the sliplining installation procedures with less than 5%, and as approved. Such clearance must not be less than 1 in. (all around the pipe) between the O.D. of the liner and the I.D. of the existing pipe.

Any flexible pipe used must be Fiberglass Reinforced Plastic (FRP) slipliner pipe and must have a minimum pipe stiffness (PS) requirement of 36 psi based on the short term Modulus of Elasticity, at 5% deflection when tested in accordance with the applicable ASTM or AWWA standard specifications.

The pipe must be furnished in a maximum of 20 ft. lengths.

The thickness of the pipe wall at joint must be designed to be safely capable of withstanding all loading conditions including, but not limited to, insertion, grouting of annular space, external hydrostatic pressure above the pipe centerline, and internal pressure rating.

3.19.3. **Equipment.** The Contractor must provide the Engineer with satisfactory evidence, upon request, that the equipment to be used on the rehabilitation work is adequate, has functioned effectively on previous similar work, and any damage to sanitary sewer lines, appurtenances, and surrounding property caused by the use of the equipment will be repaired or replaced by the Contractor at the Contractor's expense and to the satisfaction of the Engineer.

3.19.4. **Sewer Flow Control.** Flow through the sewer, as measured at the manhole, must not exceed 30% of pipe diameter during any construction operations.

Flow depths above the maximum allowable requirements must be reduced to within allowable limits by plugging or bypass pumping as required.

Wastewater flow must be blocked with a pneumatic sewer plug inserted into the line upstream of the section being worked. The plug must be so designed that all or any portion of flow can be released as required. The Contractor must station an observer at the manhole immediately upstream of the plug during the entire

period that the line is plugged to constantly watch for flooding and sewage backup of upstream lines. Full flow must be restored by plug removal as soon as possible after work has been completed.

When flow in a sewer line is plugged or bypassed, adequate precautions must be taken to protect the sewer lines from damage that might result from sewer surcharging. Precautions must be taken to insure that sewer flow control operations do not cause flooding or damage to public or private property served by the sewers involved.

Contractor must release flow or install a bypass pump should surcharging result in sewage bypassing into a storm sewer through indirect or direct cross connections between adjacent sanitary and storm sewer.

No sewer main will be plugged during Contractor non-working hours. A temporary tie-in must be made between the end of the new and existing main. Plugs at manholes must be removed to allow the flow of sewage until work is resumed.

- 3.19.5. **Bypass Pumping.** Where required, the Contractor must furnish all labor, supervision, plant equipment, appliances, and materials to perform all operations in connections with bypass pumping of sewage for the purpose of preventing interference with the rehabilitation of the sanitary sewer system and providing reliable sewer service to the occupants of the buildings being served. Contractor must submit bypass pumping plan to SARA for approval.

The Contractor must notify the Engineer and the property owners at least 72 hr. in advance of work which will affect their business or residence sewer service. The Contractor must coordinate with all property owners to ensure that no damage will be caused to their property during any and all sewer rehabilitation work.

- 3.19.6. **Pre-Installations.** Before commencement of field operations, the Contractor must furnish, for approval, a detailed schedule of all planned operation sequences and any other procedures that may be necessary to complete the job. Additionally, all inner diameter dimensions and distances between existing manholes must be verified by the contractor before ordering and manufacturing rehabilitation materials.

- 3.19.7. **Pumps and Force Mains.** The Contractor must have adequate pumps and force mains with backup systems on the project site, as specified in the "Sanitary Sewer (By-Pass Pumping)" item of this specification, in order to maintain reliable sanitary sewer service in case of any emergency that may arise during the rehabilitation operations.

- 3.19.8. **Safety.** The Contractor must conduct all operations in strict accordance with all applicable federal, state, and local safety codes and statues and must be fully responsible and obligated to maintain procedures for the safety of all work, personnel, and equipment involved in the work.

Particular attention is drawn to those safety requirements involving work on an elevated platform or entry into a confined space.

The Contractor is advised that sewage encountered may contain harmful viruses and bacteria and may be detrimental to the health of workers. Utmost care is urged to prevent contraction of potentially dangerous diseases. The existing line is known to contain quantities of hazardous gases and caution is advised.

The areas occupied by workmen must be protected by the best available devices for the detection of oxygen depletion and lethal & combustible gases. Such devices must be frequently tested to assure functional capability.

All safety measures, including but not limited to safety personnel, first aid equipment, ventilating equipment, and safety equipment are considered the responsibility of the Contractor. No direct payment will be made for these measures.

No sewer main trenches, manhole excavation, or any other opening will be left open during non-working hours without proper protection.

- 3.19.9. **Pre-Rehabilitation Cleaning.** It will be the responsibility of the Contractor to remove all loose debris which is located within the sewer pipe. This work will not be paid for separately, but will be considered subsidiary to this item.
- 3.19.10. **Pre-Rehabilitation Inspection.** Inspection of sewer pipe must be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television inspection. The interior of the pipe must be carefully inspected to determine the location of any conditions which may prevent proper installation of the rehabilitation materials. A videotape and suitable log must be kept for later reference by the Engineer and the Contractor. This work will be paid under the item "Sanitary Sewer (Television Inspection)."
- 3.19.11. **Bypassing Sewage.** When required for acceptable completion of a rehabilitation task, the Contractor must provide for sewage flow maintenance around the section or sections of pipe designated for rehabilitation. The bypass will be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines must be of adequate capacity and size to handle the flow. Payment for this work will be made under the item "Sanitary Sewer Bypass Pumping."
- 3.19.12. **Line Obstructions.** If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, such as heavy solids, dropped joints, protruding service connections, or collapsed pipe that will prevent completion of the rehabilitation process, a repair excavation must be made by the Contractor to uncover and remove or repair the obstruction. Payment for this work will be made under the item "Sanitary Sewer Repair."
- 3.19.13. **Sewer Service Line Reconnections.** Service line reconnections will not be required as part of the rehabilitation of sanitary sewer lines. All existing laterals must be connected to the new, adjacent sewer main.
- 3.19.14. **Utilities.** The Contractor must contact the appropriate utility companies to locate the existing underground facilities at the job site 48 hr. before the beginning of construction.
- The Contractor must accommodate site specific utility locations and construction constraints. It is the responsibility of the Contractor to locate, protect, and work around existing utility conditions.
- 3.19.15. **Contractor Mobilization Area.** The Contractor will be solely responsible for providing all storage sites, access to the sites, or temporary right-of-way which may be required for proper completion of work.
- 3.19.16. **Wet Out.** The Contractor must designate a location where the tube will be impregnated ("wet out") with resin using distribution roller and vacuum to thoroughly saturate the tube felt fiber before installation. The Contractor must allow the Engineer to inspect the materials and wet out procedure. A catalyst system compatible with the resin and tube must be used.
- 3.19.17. **Insertion.** The wet out tube must be inserted through an existing manhole or other approved access by means of an inversion process and the application of a water column ample enough to fully extend it to the next designated manhole or termination point. The tube end must initially be turned out and attached to a platform ring or standpipe. The inversion water column will be adjusted to be of adequate height to cause the impregnated tube to invert from manhole to manhole and hold the tube tight against the existing pipe wall, produce dimples at side connections, and flared ends at the manholes. The Contractor will not be allowed to pull the wet out in place unless the Contractor can prove that this method of installation does not result in tears or abrasion of the tube or uneven redistribution of the resin.
- 3.19.18. **Curing.** After the insertion is completed, the Contractor must supply a suitable heat source and water recirculation system capable of delivering hot water uniformly throughout the section to effect a consistent cure of the resin. The curing temperature must be that recommended by the resin or catalyst system manufacturer. The heat source must be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another gauge must be placed between the impregnated tube and the invert of the original pipe at the manholes to determine the temperature during the resin curing process.

Initial cure will be considered completed when the exposed portions of the CIPP appear to be hard and the remote temperature sensing device indicates the cure period to be of adequate duration as recommended by the resin or catalyst system manufacturer and modified for the inversion process.

- 3.19.19. **Cool Down.** The Contractor must cool the hardened CIPP to a temperature below 100°F before relieving the water column. Cool water may be added to the water column while draining hot water from a small hole at the opposite end of the CIPP so that a constant water column height is maintained until cool down is completed. Care must be taken in the release of the water column so that a vacuum will not be developed that could damage the newly installed CIPP.
- 3.19.20. **Test Period.** The finished CIPP must be continuous over the entire length of an inversion run and be free, as commercially practical, of visual defects such as foreign inclusions, dry spots, pinholes, and delamination. It must also meet the leakage requirements and pressure tests as specified. During the test period, which is defined as 12 calendar mo. after acceptance of the work, any defect which will affect the integrity or strength of the CIPP must be repaired at the Contractor's expenses in a manner approved.
- 3.19.21. **Sealing at Manholes.** The CIPP liner must make a tight seal at the manhole opening with no annular gaps. Under all circumstances, a 1/2 in. diameter activated Oakum bank soaked in Scotchseal 5600, or approved equal, must be applied all around for a seal, unless otherwise approved. All large annular space must be sealed by using activated Oakum soaked in Scotchseal 5600, or approved equal, and later covered with a cementitious mortar. This procedure must be completed before proceeding to the next manhole section. This work will not be paid for separately, but will be considered subsidiary to this item.
- 3.19.22. **Installation: Insertion Pits.** The Contractor must provide all necessary pits to completely reline the sewers. The location of insertion pits will be subject to approval. The number of insertion pits must be minimized. Insertion pits and lateral reconnection pits, if required, must be constructed to the minimum size necessary for insertion of sliplining pipe or reconnection of service laterals. All pits must be constructed with properly applied vertical side support.
- 3.19.23. **Pipe Stockpiling and Handling.** Pipe and fittings must be stockpiled in a safe manner at each Contractor staging area or pit location. The stockpiling must be arranged to cause a minimum of interference to pedestrian and vehicular traffic. When handling sliplining pipe, the Contractor must take all precautions necessary to avoid damage to the pipe.
- Pipe with deep cuts, scratches, or gouges will be rejected and replaced. If the pipe is found to have developed an irregular shape that will not allow pipe joining or insertion without the use of outside forces to bring pipe to a round shape, it will be rejected and replaced. An irregularly shaped pipe that would necessitate the use of undue force that could cause damage to the pipe or joints will be rejected and replaced.
- 3.19.24. **Liner Pipe Installation.** The sliplining pipe installation will be the responsibility of the Contractor. The Contractor must adhere to the manufacturer's pipe installation procedures. Sliplining pipe grade must be maintained parallel to the grade of the sewer being relined. As the work progresses, the interior of the pipe must be cleared of all dirt and debris.
- The Contractor must make all necessary arrangements and provide all necessary equipment to maintain sewage flows at all times. A combination of flow diversion or bypass pumping may be used to control the level of sewage flows during sliplining operations. It may be necessary to increase the weir height in the diversion box and discontinue flow diversion before sliplining operations to provide a level of flow conducive to sliplining. The Contractor will divert or reinstate flows only with approval.
- 3.19.25. **Sliplining Pipe Insertion.** Within the insertion pit, the top half of the exposed pipe must be removed to the springline. The bottom half must be left in place, where it will serve as a cradle for the sliplining pipe. The sliplining pipe will be pushed into the existing pipe. A tapered guide may be attached to the leading pipe of each section to be installed to help pipe clear small obstructions. A push ring must be used to distribute load as per the manufacturer's recommendations for installation of the sliplining pipe. For each section to be lined, insertion must be one continuous operation until the planned termination point is reached. Closure in the

insertion pit after installation may be accomplished using a long bell closure kit or other methods as approved.

- 3.19.26. **Manhole Replacement.** In those places where the entrance pit is excavated at an existing manhole, the manhole must be repaired or replaced with a new manhole conforming to the specifications on manhole construction and in accordance with standard details included in the plans. This work will be paid under the item "Sanitary Sewer (Manhole Rehabilitation)."
- 3.19.27. **Manholes.** After insertion and grouting, the sliplining pipe must be cut out at manholes as detailed. The method of cutting must be as to leave a smooth, clean, straight edge. Where detailed or required, mild steel ties must be provided as needed to tie the sliplining to the manhole benching. This work will not be paid for separately, but will be subsidiary to this item.
- 3.19.28. **Pipe Grade.** Pipe grade must be maintained within the limits shown on the plans. The Contractor will be responsible for and take all necessary precautions to ensure that no adverse pipe grades result, nor collapses of the sliplining pipe occur during grouting operations.
- 3.19.29. **Annular Space Grouting.** If TV inspection shows caverns above or around the deteriorated pipe, the Contractor must take care not to cause the ground to collapse over the deteriorated pipe.
- After rehabilitation is in place, the Contractor must fill the caverns with grout to prevent any future settling or collapse of the existing ground. Grout mix and grouting pressure will be as approved before placement. This work will not be paid for separately, but will be considered subsidiary to this item.
- 3.19.30. **Testing.** The Contractor will provide to the Engineer and the City of San Antonio a video tape showing the completed work. Such videotape must be of a quality to permit close-up viewing of the restored taps and the liner. A TV camera with a 360° articulating lens must be used to produce such videotape. Similar videotape must be provided, when requested, during the test period. This work will be paid under the item "Sanitary Sewer (Television Inspection)."

3.20. **Point Repairs.**

- 3.20.1. **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 SARA 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 a minimum of two 1,750 cfm blowers designed specifically for smoke testing of sewers. Place blowers on the upstream and downstream manholes 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. Use 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.

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.

Replace all identified damaged pipe for point repairs unless otherwise directed by the Inspector.

- 3.20.1.1. **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.

Before replacing a damaged section 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 of 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 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 before 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 Section 3.15., "Television Inspection." 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.

- 3.20.1.2. **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 will not be performed.

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

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

- 3.20.1.3. **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 SARA 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 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 SARA 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 feet 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 SARA 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.

3.20.2. **Bypass 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.

3.20.3. **Pipe Bursting/Crushing Replacement.**

3.20.3.1. **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.

3.20.3.2. **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 must 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 will 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.

3.20.3.3. **Equipment.** The Contractor must use 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 ton for 8.625 in. O.D.; 10 ton for 10.75 in. O.D.; 17 ton for 14 in. O.D.; 23 ton for 16 in. O.D.; 28 ton 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.

3.20.3.4. **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.

3.20.3.5. **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.

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

Provide barricades, warning lights, and signs for excavations created by point repairs. Conform to requirements of the Texas Department of Transportation, City of San Antonio, and 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.

3.20.3.7. **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 4 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 8 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 6 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.

3.20.4. **Sliplining.**

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

- 3.20.4.2. **Bypass 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.
- 3.20.4.3. **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 SARA.
- 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.
- 3.20.4.4. **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 1°.
- 3.20.4.5. **Clamp Installation.** Where excavations for liner pipe insertion are made between two manholes, cut ends of liner pipe smooth and square to pipe axis. Join liner pipes with appropriately sized stainless steel universal clamp couplings. Butt together the gap between the ends of liner pipes with the space between the ends not exceeding 2 in.
- Install bedding in accordance with this specification.
- 3.20.4.6. **FRP Collar/Closure.** Install FRP collar closure pieces in accordance with manufacturer's recommendations.
- 3.20.4.7. **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.
- Refer to Section 4.2., "Low Pressure Air Testing" and Section 4.4., "Deflection Testing" for applicable test procedures.
- 3.20.4.8. **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 1/2 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 SARA 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.

- 3.20.4.9. **Grouting Annular Space.** Provide grouting plan and obtain approval of grouting plan from SARA 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.

- 3.20.4.10. **Post Installation Videotape Recording.** Provide the SARA Engineer with DVD showing completed work including condition of restored connections. Comply with requirements of "Television Inspection" of this specification.

- 3.20.4.11. **Final Clean-up.** Upon completion of installation and testing, clean and restore project area affected by work of this section. No separate pay item.

- 3.21. **Cleaning Manhole and Mains.** 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 before 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, 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 manholes 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 SARA 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 will be repaired by the Contractor at no additional cost and to the satisfaction of SARA. Cleaning must also include the manhole or structure wall washing by a high pressure water jet.

- 3.21.1. **Hydraulic Cleaning.** Hydraulic-propelled devices which require a head of water to operate must use 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 insure 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 will be used to provide necessary fluid for hydraulic cleaning devices whenever possible.

- 3.21.2. **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.

- 3.21.3. **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, or gas or electric rod propelled devices, will be considered normal cleaning equipment.

- 3.21.4. **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 will 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 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 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 tools which retard the flow of water in the sanitary sewer mains are used, precautions must be taken to insure 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 to 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 used 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 will 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.

- 3.22. **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 will 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 freestanding wastewater in compliance with TCEQ and EARZ requirements before 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 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 adequate 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 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. 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-hr. period to compensate for absorption and evaporation losses. At the conclusion of the 24-hr. saturation period, the manhole must be filled to the top and observed. Any measureable loss within a 30-min. period will be considered an unsuccessful test and thus require the Contractor to assess the needed repairs, perform such repairs (subject to approval), 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 or proposed) in place. Drop connections and gas sealing connections must be installed before 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. Before 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 will be placed in horizontal joints before 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 will be drawn and the vacuum pump will be turned off. With the valve closed, the level vacuum will 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 min.

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 will only do so in the presence of the Inspector.

Repairs to Existing Manholes: Any existing manhole which fails to pass the vacuum test will 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 SARA-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 must 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 SARA.

- 4.2. **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 must 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./min. at 100 lb./sq. in.

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 must 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.

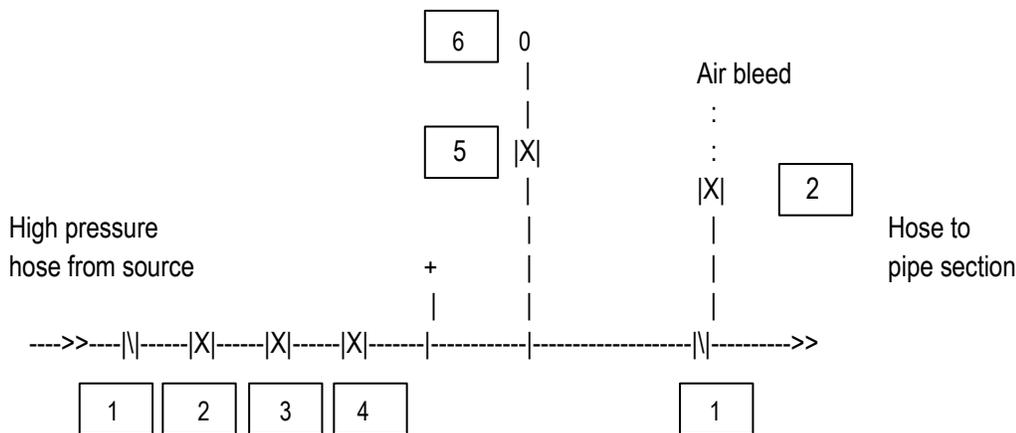


Figure 1
Air Testing Equipment Assembly Order

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 must 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 will 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 will be computed from the following equation:

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

T = Time for pressure to drop 1 lb./sq. in. gauge in seconds

K = $0.000419 \times D \times L$, but not less than 1

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 cu. ft./min./sq. ft. internal surface will be used since a K value of less than 1 will not be used.

There are minimum testing times for each pipe diameter as shown in Table 10.

Table 10
Minimum Testing Times

Pipe Diameter	Minimum Time	Length for Minimum Time	Time for Longer Length
In.	Sec./Ft.	Ft.	Sec./Ft.
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 sec. 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 must 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 must 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 will be 10 sec.

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

- 4.3. **Infiltration/Exfiltration Test.** The total exfiltration, as determined by a hydrostatic head test, must not exceed 50 gal. per inch 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. per inch 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, or at least 2 ft. above the existing groundwater level, whichever is greater. For construction work occurring within a 25-yr. floodplain, the infiltration or exfiltration must not exceed 10 gal. per inch of 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. **Deflection Testing.**

Deflection Testing:

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 mains with an inside diameter 27 in. and greater, an approved method will 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 will exceed a deflection of 5%. 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 area's 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 Licensed Professional Engineer appointed by the Owner, will 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, will be the average outside diameter minus 2 minimum wall thicknesses for O.D. controlled pipe, and the average inside diameter for I.D. controlled pipe. All dimensions will 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 9 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 Manhole Rehabilitation.**

Testing for manhole rehabilitation: Structural & Low Sulfate and Structural Lining & Moderate Sulfate must consist of the following:

Visually verify the absence of leaks.

Perform an exfiltration test.

- For manholes 0 to 6 ft. deep, if water loss is 1 in. or less in 5 min., manhole passes the exfiltration test.
- For manholes over 6 ft. deep, if water loss is 1 in. (plus 1/8 in. per additional foot of depth) or less in 5 min., manhole passes the exfiltration test.

Perform a vacuum test on randomly selected manholes on every 5 manholes that are rehabilitated.

Testing for manhole rehabilitation: Non-Structural Lining or High Sulfate and Structural Lining High Sulfate must be tested as described above with the following additional requirement:

For every 5 manholes that are rehabilitated, 1 manhole must be inspected 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 procedures must follow the protective coating manufacturer's recommendations.

If a manhole fails to pass the above test, 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 the Owner. If more than 20% of the manholes fail to pass any testing requirement, all manholes must be vacuum tested and holiday tested as appropriate at no additional cost to the Owner.

- 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 before beginning testing and throughout performance of the work.

Contractor must prove to the Owner that the equipment, materials, and all operational aspects & appurtenances related to the BPP are in good condition before 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 SARA Inspections Department 48 hr. before commencing any testing. Any flows excessively surcharging the sanitary sewer system during the test or during actual bypass periods will deem the BPP to be unacceptable and it 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 testing or operations are underway during the project. No testing of the bypass pumping operation will be conducted between Thursday and Sunday, unless approved by SARA. If bypass pumping will take place outside normal work hours which are between 8 am to 5 pm Mondays through Fridays (except for SARA observed holidays), Contractor must reimburse SARA for the overtime costs required by his bypass pumping outside of SARA 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-hr. test run must be satisfactorily performed before commencing any construction work. The Inspector must provide acknowledgment first. Contractor must provide both a strobe light type high level alarm and alarm notification to Contractor cell phones, as well as other appointed personnel to be identified by SARA, and insure adequate alarm notification is attained before actual startup of the test period.

During the testing period, the Contractor must install a Float Monitoring System in the upstream manhole 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 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 SARA 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 min.) the flows during both the test and actual bypass pumping periods. Contractor must submit a copy of Testing Float Monitoring System Data log to SARA 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.

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 before the test is initiated again. Any effort by SARA 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.

- 4.7. **TV Camera Testing.** After the vacuum tests on the manholes and the air tests on the sewer lines are performed by the Contractor, the San Antonio River Authority (SARA) reserves the right to perform a TV Camera Test with their forces and equipment on the completed sewer lines. The TV test will be observed by State and Contractor personnel as the camera is run through the sewer lines.

Any sections in the sewer lines determined to be damaged or abnormal as found by the camera, such as broken pipe, misaligned pipe joints that could result in a leak, etc., must be repaired or replaced by the Contractor at his expense.

- 4.8. **Sewer Force Main Flushing and Testing.**

- 4.8.1. **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.

- 4.8.2. **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.

- 4.8.3. **Hydrostatic Tests.** All new mains will be hydrostatically field tested at a maximum test pressure of 200 psi before acceptance.

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 before 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 Contractor 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. 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 11, "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 before beginning the test, and the San Antonio River Authority's Inspector will be present during the pressure test.

Table 11
Hydrostatic Test Leakage Allowances Table
(Maximum) @ 200 psi

Nominal Diameter- Pipe Type	Allowable Leakage in Gallons Per Hour (GPH) Pipe Length in Feet									
	100	200	400	600	800	1000	2000	3000	4000	5000
16 in. HDPE	0.34	0.68	1.36	2.04	2.72	3.4	6.8	10.2	13.6	17
20 in. HDPE	0.43	0.85	1.7	2.55	3.4	4.25	8.5	12.75	17	21.25

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

Example No. 1: The maximum leakage allowances for 6,000 ft. of 20 in. HDPE pipe would be the sum of the values for 5,000 ft. and 1,000 ft., or 21.25 GPH plus 4.25 GPH equals 25.5 GPH.

- 4.8.4. **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.
- 4.8.5. **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 Section 2.21., "Bedding and Backfill" and Section 3.2.7., "Trench Restoration."
- 4.9. **Rehabilitation of Lines Testing.** The Contractor must provide to the Engineer and the City of San Antonio a DVD showing the completed work. Such DVD must be of a quality to permit close-up viewing of the restored taps and the liner. A TV camera with a 360° articulating lens must be used to produce the DVD. Similar DVD must be provided, when requested, during the test period. This work will be paid for under the Item "Television Inspection".
- 4.9.1. **Quality Control.** No change or alteration during the course of the contract will be allowed without prior written approval. Physical properties of the approved resin components of the materials as well as the cured liner must conform to the minimum structural values listed below:
- Flexural Strength - 4,500 psi ASTM D-790
 - Modulus of Elasticity - 250,000 psi ASTM D-790

Certified copies of all test reports on the properties of the selected resin and (after placement) on the cured liner coupons performed by and for the Contractor must be submitted. Results of additional product testing, normally performed for in-house quality control and process improvement, must also be provided to the Engineer at no additional cost. The Contractor must inform the Engineer, in writing, of the name and designation of all in-house quality control tests and the sampling frequency of the tests on the resin and liner materials. The Engineer will also have the right to require the testing to be done at designated liner locations within the scope of the Contract. The Engineer may also run tests on random samples at no additional cost to the Contractor. Whenever possible, a short section of sewer pipe very similar to the existing pipe may be placed in the manhole to run the liner under restrained conditions for later testing and thickness measurements, at no additional payment. All samples must be labeled before shipment for testing, and a duplicate piece must also be provided, if requested, for inspection and testing by an independent laboratory, if required.

- 4.9.2. **Reference Standards.** This specification references Insituform Technologies, Inc. (ITI) Standard Test Methods which are made a part hereof by such reference and must be the latest editions and revisions thereof. ASTM F1216, "Standard Practice of Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube" will govern when this specification does not address installation methods and materials.
- 4.10. **General Corrosion Requirements.** The CIPP must be fabricated from materials which when cured will be chemically resistant to internal exposure to domestic sewage.
- 4.11. **Water Analysis (Industrial Areas Only).** In industrial areas where sewers are subject to possible organic and inorganic wastes other than normal domestic sewage, the Engineer will obtain samples of the dry weather sewage for chemical content analysis. This analysis will be supplied to the Contractor for their information.
- 4.12. **Submittals.** The Contractor must submit, along with the bid proposal, a copy of the recommended pipe installation procedures, certified by the pipe manufacturer.
- 4.13. **Pipe Bursting/Crushing Replacement 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 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 TCEQ Chapter 317 requirements for gravity sewer construction testing (§317.a.4). 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 will be specified. Copies of all test results will 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 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. 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 gal. 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 yr. flood plain, the infiltration or exfiltration must not exceed 10 gal. per inch 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 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 restore 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**5.1. Sewer Excavation and Non-stabilized Backfill**

Sewer excavation and non-stabilized backfill will be measured in accordance with TxDOT Specification Item 400, "Excavation and Backfill for Structures" but will not be measured for payment and will be considered subsidiary to the sewer line installation.

5.2. Trench Excavation Protection

Trench excavation protection will be measured by the foot along the centerline of the trench where the depth exceeds 5 ft.

5.3. 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 foot actually installed in accordance with plans.

5.4. Sanitary Sewer Laterals

The lengths of laterals will be measured from the centerline of the sewer main to the connection at or within the customer's property line or premises. 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.

5.5. 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 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.

5.6. Jacking, Boring, or Tunneling

Jacking, Boring, or Tunneling will be measured by the 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 foot of pipe installed from end to end of pipe to the limits shown on the plans.

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

“Pipe Sewer Main (Steel Casing) (Open Cut)” and “Pipe Sewer Main (Steel Casing) (Split)” for sewer pipe of the various sizes shown on the plans will be measured by the foot.

5.7. **Vertical Stacks**

Vertical Stacks will be measured by the foot. Footage will be measured from the finish grade elevation (centerline) minus invert elevation minus 8 ft..

5.8. **Manhole Structures**

Manholes 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.

5.9. **Pre-Cast Manholes**

Manholes 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 feet in excess of 6 ft. as measured vertically.

5.10. **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 feet in excess of 6 ft. as measured vertically.

5.11. **Adjusted or Abandoned Manholes**

Manholes adjusted or abandoned as prescribed herein, will be measured by each manhole. The excavation and backfill required and the I&I Barrier for Adjust Manholes will not be measured for payment, but will be considered subsidiary to this Item.

5.12. **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.

5.13. **Flowable Backfill**

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

5.14. **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.

5.15. **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.

5.16. **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.

5.17. **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.

5.18. **Removing and Replacing Chain-Link or Wire Fence**

This work will be measured by the foot of fence removed and replaced, regardless of the type or height of the fence, complete in place. The existing fence materials may be reused unless the existing materials were damaged during removal and should not be reused. If existing materials were damaged during removal, the Contractor must provide new material for the replacement work at his expense.

5.19. **Television Inspection**

This item will be measured by the foot of main televised for TV inspection. The foot measurement will be determined as the distance from the center of sewer manhole to the center of sewer manhole.

5.20. **Reconstruct Existing Manholes**

Manholes completely reconstructed as prescribed herein will be measured by the unit of each manhole (any type or size), regardless of the type shown on the plans.

5.21. **Automatic Air Release Valve**

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

5.22. **Ductile-Iron Fittings**

Ductile-Iron Fittings will be measured by the weight to the nearest 1/100 of a ton of the various sizes installed as shown in Table 12 below.

Table 12

Weights of Gray Iron and Ductile Iron Fittings (LB.)

BENDS							
Size (Inches)	MJ Compact (C153)	MJ (C110)	FLG SB	Size (Inches)	MJ Compact (C153)	MJ (C110)	FLG SB
1/4 Bend (90°)				1/8 Bend (45°)			
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	1,105	1,085	24	441	777	730
30	979	1,740	1,755	30	775	1,393	1,355
36	1,501	2,507	2,135	36	1,140	2,163	1,755
42	2,277	3,410	3,055	42	1,652	2,955	2,600
48	3,016	4,595	4,095	48	2,157	4,080	3,580
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°)				1/32 Bend (11-1/4°)			
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	1,500	1,385	30	603	1,410	1,395
36	963	2,182	1,790	36	830	2,195	1,805
42	1,354	3,020	2,665	42	1,210	3,035	2,680
48	1,790	4,170	3,665	48	1,523	4,190	3,695

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)				
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	1,068	1,005

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)				
TEES				
Size (Inches)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	466	1,035	1,089
	8	487	1,047	1,060
	12	539	1,075	1,125
	16	625	1,109	1,070
	20	729	1,504	1,510
	24	785	1,617	1,685
30	8	739	1,808	-
	12	800	1,842	1,801
	16	959	1,885	-
	20	1,026	1,941	-
	24	1,228	2,496	2,475
	30	1,373	2,531	2,615
36	24	1,548	2,710	2,255
	30	1,901	3,545	3,000
	36	2,012	3,686	3,160
42	24	2,272	3,690	3,245
	30	2,512	4,650	4,125
	36	3,048	5,119	5,360
	42	3,225	6,320	5,580
48	24	2,934	4,995	4,385
	30	3,147	5,140	4,455
	36	4,046	6,280	5,555
	42	4,249	8,130	7,195
	48	4,469	8,420	7,385

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)				
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	1,117	1,085
	20	598	1,274	1,230

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)				
CROSSES				
Size (Inches)		Weight		
Run	Branch	MJ Compact (C153)	MJ (C110)	FLG Short Body
24	6	566	1,025	-
	8	578	1,085	1,045
	12	610	1,153	1,110
	16	663	1,256	1,200
	20	975	1,733	1,675
	24	907	1,906	1,835
30	8	650	1,795	-
	12	870	1,925	1,865
	16	900	1,950	-
	20	1,220	2,060	-
	24	1,497	2,776	2,675
	30	1,808	3,188	3,075
36	24	1,853	2,928	2,980
	30	2,580	3,965	-
	36	2,698	4,370	4,370
42	24	2,415	3,910	-
	30	2,920	5,040	-
	36	3,788	5,835	-
	42	3,908	6,493	7,145
48	24	3,435	5,210	-
	30	4,145	5,495	-
	36	4,873	6,790	-
	42	5,465	8,815	-
	48	5,588	9,380	-

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)				
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	1,322	1,200	1,222
48	1,076	1,737	1,550	1,597

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)				
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	1,005
36	725	960	947	1,374
42	877	1,209	1,187	1,628
48	1,406	1,516	1,472	2,033

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)			
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	1,027
30	20	599	1,085
30	24	492	1,204
36	20	1042	1,459
36	24	785	1,580
36	30	655	1,868
42	24	1,356	2,060
42	30	1,112	2,370
42	36	1,116	2,695
48	30	1,722	3,005
48	36	1,650	3,370
48	42	1,429	3,750

TABLE 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)		
2 In. 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 12 CONTINUATION - WEIGHTS OF GRAY IRON AND DUCTILE IRON FITTINGS (LB.)		
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	-	1,025
20 x 24	-	1,245

5.23. **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.

5.24. **Rehabilitation of Lines**

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.

5.25. **Point Repair**

This item will be measured on an each basis. The minimum length of pipe to be replaced at each repair locations will be 9 ft.

5.26. **Sanitary Sewer Bypass Pumping**

This item will be measured by the "Lump Sum" as the work progresses. No additional measurement or payment will be made for conditions caused by the Contractor during construction.

5.27. **Rehabilitation of Manholes**

This item will be measured by each.

5.28. **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.

5.29. **Sliplining**

Measurement for Sliplining is on a by foot basis for installed liner pipe, measured 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.

5.30. **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 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.

5.31. **CPS Energy Power Pole and Guide Wire Bracing**

All power pole and guide wire bracing including coordination with CPS Energy will be measured per pole and any attached guide wires to that pole are included in the cost.

5.32. **Remove Existing Manholes**

Existing manhole structures to be completely abandoned and removed as identified on the plans will be measured for each manhole removed.

6. PAYMENT

6.1. **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.

6.2. **Trench Excavation Protection.** Payment will be made at the unit price bid 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 is 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.

6.3. **Sanitary Sewers.** Payment made at the unit price bid 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 force mains 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" of the size and type 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 foot, complete in place.

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

- 6.4. **Sanitary Sewer Laterals.** Payment will be made at the unit price bid which 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 foot, complete in place.

- 6.5. **Jacking, Boring, or Tunneling.** "Sanitary Sewer (Jack, Bore, or Tunnel)" will be paid for at the contract unit price bid per foot of jacking, boring, or tunneling, which 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 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 foot of steel casing or liner installed and measured as prescribed above.

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

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

- 6.7. **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 which will be full compensation for all labor, equipment, materials, tools, and incidentals, complete in place.

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

Payment for Extra Depth structures will be made at the unit price bid per foot as measured vertically.

- 6.9. **Pre-Cast Manholes.** Payment for Pre-Cast manholes, including the stack, rings, watertight covers, steps, concrete ring encasement, and I&I Barriers will be made at the unit price bid for "Sanitary Sewer Precast Manholes" of the type specified 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 foot as measured vertically.

- 6.10. **Doghouse Manholes.** Payment for doghouse manholes, including the stack, rings, watertight covers, steps, concrete ring encasement, and I&I Barriers will be made at the unit price bid for "Sanitary Sewer Manhole (Doghouse)" of the type specified 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 foot as measured vertically.

- 6.11. **Abandon Manholes.** Manholes abandoned will be paid for at the unit price bid for "Sanitary Sewer Abandon 4 FT Diameter Manhole" which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

- 6.12. **Adjust Manholes.** Manholes adjusted will be paid for at the unit price bid for “Sanitary Sewer Adjust Manhole” which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.
- 6.13. **Select Backfill.**
Cement Stabilized Backfill. Payment will be made for “Cement Stabilized Backfill” at the unit price bid for “Sanitary Sewer (Cement Stabilized Backfill)” which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.
- 6.14. **Flowable Backfill.**
Payment for flowable backfill will be made at the unit price bid for “Sanitary Sewer Flowable Backfill” 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)”. The select bedding for flexible pipes will not be paid for directly but will be subsidiary to the flexible pipe.
- 6.15. **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” which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.
- 6.16. **Concrete Curbs, Driveways, Sidewalks, Islands, and Medians.** Payment for replacement of curbs, driveways, sidewalks, islands, and medians will be made at the unit price bid for “Sanitary Sewer (Concrete Sidewalk),” “Sanitary Sewer (Concrete Driveway),” “Sanitary Sewer (Concrete Islands),” “Sanitary Sewer (Concrete Medians),” and “Sanitary Sewer (Concrete Curb)” which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.
- 6.17. **Cut and Restore Pavement.** Payment will be made at the unit price bid for “Sanitary Sewer (Cut and Restore Pavement)” which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.
- 6.18. **Remove and Replace Chain-Link and/or Wire Fence.** Payment will be made at the unit price bid for “Sanitary Sewer (Remove and Replace Fence)” which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.
- 6.19. **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 Post Television Inspection.” This price will be full compensation all labor, materials, equipment, tools, logging, and all incidentals necessary to complete the work.
Testing Sanitary Sewers for leakage, including all labor, materials, and equipment necessary to perform the tests, will not be paid for directly but will be considered incidental to the various Sanitary Sewer pay items.
- 6.20. **Reconstruct Manholes.** Payment for reconstructed manholes, complete in place will be made at the unit price bid for “Sanitary Sewer Reconstruct Existing Manhole” which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.
- 6.21. **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)” 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.
- 6.22. **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 12 "Weights of Ductile-Iron and Cast-Iron Fittings."

- 6.23. **Hydrostatic Pressure Test.** Payment for "Hydrostatic Pressure Test" will be made at the unit price bid for "Sanitary Sewer (Hydrostatic Pressure Test)" 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.

- 6.24. **Rehabilitation of Lines.** 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 (Line Rehabilitation)." 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 rights-of-way 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.

- 6.25. **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 and Obstruction Removal," 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 including removal of obstructions.

Payment for sewer line extra length will be in accordance with this item and will be paid for at the unit price bid for "Sanitary Sewer (Point Repair sewer line extra length)," 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.

- 6.26. **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 "Sanitary Sewer (Bypass Pumping)." 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 disassembly of all components of the BPP, including site cleanup as applicable to stationary bypass pumping to include flow diversion if used.

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

6.27. **Rehabilitation of Manholes.** 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 (Manhole Rehabilitation)". This price will be full compensation for materials, labor, equipment, tools, testing, and all incidentals necessary to complete the work.

6.28. **Cleaning Manholes and Mains.** All work described by this item will be subsidiary to rehabilitation of manholes and lines.

6.29. **Pipe Bursting/Crushing Replacement.**

The inserted pipe will be paid for per 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.

Services. Locating and reconstruction of services and all connections of services will be paid for per each connection made, which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work, including fittings and pipe. Payment for abandoned services will be on an each connection made basis.

Point Repairs. Point repairs will be paid for on a per each basis, as needed, which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work. Extra length point repair will be paid based on the length of pipe replaced per repair beyond the length established for each single point repair item, as needed. Abandoned point repairs will be paid on a cubic yard basis, as needed.

Obstruction Removal. Obstruction removal will be paid for on a per each basis, as needed, which will be full compensation for all labor, equipment, materials, tools, and incidentals to complete the work.

Storm Water Pollution Prevention and Erosion Control Plan. Payment for this item will be based on the items and quantities of control measures included in the proposal on the basis indicated in the respective specification sections.

Site Restoration. Except as associated with point repairs and obstruction removals, site restoration for all impacts to surface improvements will be on a foot basis of the rehabilitated line segment. For point repairs and obstruction removals, site repair will be on a per each basis.

Television Inspection. Payment will be made for television inspection of the sewer line before pipe rehabilitation in accordance with this specification. There will be no additional or separate payment for post-rehabilitation TV video inspection, documentation, required submittals, and associated or related work.

Bypass Pumping. The cost of any necessary bypass pumping will be considered subsidiary to the appropriate pay items for pipe installation, television inspection, repair, or related work and will not be a separate pay item.

6.30. **Sliplining.**

Payment will be made at the unit price bid which 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 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 & 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.

6.31. **Grouting of Sewer Mains**

Payment for "Grout Abandonment Sewer Main" will be made on the contract unit price per 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.

6.32. **CPS Energy Power Pole and Guide Wire Bracing**

All power pole and guide wire bracing including coordination with CPS Energy will be paid at the unit price per pole which includes any attached guidewires.

6.33. **Remove Existing Manholes**

The work performed and materials furnished in accordance with this item and measured as provided under "Measurement" herein will be paid for at the unit price bid for "REMOVE EXISTING MANHOLE (SAN SWR)." This payment will be for all labor, materials, plugs (temporary and permanent), excavation and backfill, cement stabilized backfill, groundwater dewatering, removal, disposal of materials, and all other incidentals necessary to complete the work in accordance with the plans and specifications.