

Special Specification 7227

Sanitary Sewer



1. DESCRIPTION

This Item will govern for all materials and work necessary for the installation of all sanitary sewer mains, fittings, connections, service lines, and other appurtenances necessary for a complete and operating system to be constructed within the existing right-of-way under this contract. Placement of sanitary sewer mains and appurtenances, both as to horizontal and vertical location, will be subject to minor adjustments in the field. Final location will be determined by the Engineer to conform to field conditions.

1.1. References. When referring to the standards listed below, use the latest standard or tentative standard in effect on the date of proposal.

- ASTM A48—Gray Iron Castings
- ASTM C923—Resilient Connector between Manhole Structures and Pipes
- ASTM C1244—Standard Test Method for Sewer Manholes by Negative Air Pressure (Vacuum) Test
- ASTM D-2412—Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
- ASTM D-695—Test Methods for Compressive Properties of Rigid Plastics
- ASTM D-2584—Test Method for Ignition Loss of Cured Reinforced Resins
- ASTM D-790—Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and electrical Insulating Materials
- ASTM D-2583—Test Method for Indentation Hardness of Rigid Plastics by means of a Barcol Impressor
- AASHTO H-20—Axial Loading
- ANSI/AWWA C104/A21.4—Cement Mortar Lining for Ductile Iron and Gray Iron pipe and fittings for water.
- ANSI/AWWA C153/A21.53—Ductile Iron Compact fittings for 3 in. through 16 in. for water and other liquids.
- ASTM D1784—Polyvinyl Chloride (PVC) Plastic pipe, compounds and Chlorinated Polyvinyl chloride (CPVC) Compounds.
- ASTM D2241—Polyvinyl chloride (PVC) pressure rated pipe (SDR series).
- ASTM D2321—Practice for Underground Installation of Flexible Thermoplastic Pipe.
- ASTM D2412—External Loading Properties of Plastic Pipe by Parallel - Plate Loading.
- ASTM D3034—Type PSM Polyvinyl chloride (PVC) Plastic Sewer Pipe and fittings (SDR26).
- ASTM D3139—Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals.
- ASTM D3212—Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.
- ASTM F477—Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- ASTM F789—Polyvinyl chloride (PVC) Plastic Gravity Sewer Pipe and fittings (type PS46).
- 30 TAC 217 (C)—Texas Administrative Code, Volume 30, Chapter 217, Design Criteria for Domestic Wastewater Systems, Subchapter C: Conventional Collection Systems.
- ASTM C478—Precast Reinforced Concrete Manhole Sections
- 30 TAC 217.55—Texas Administrative Code, Volume 30, Chapter 217, Design Criteria for Domestic Wastewater Systems. 217.55—Manholes and Related Structures.
- 30 TAC 217.58—Texas Administrative Code, Volume 30, Chapter 217, Design Criteria for Domestic Wastewater Systems. 217.58—Testing Requirements for Manholes.
- ASTM C33—Coarse Aggregates.
- ASTM D698—Moisture-Density Relations of Soil (Standard).

- ASTM D1557—Test for Moisture-Density Relations of Soil (Modified).
- ASTM D2321—Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity – Flow Applications.
- ASTM D2487—Classification of Soils for Engineering Purposes.
- ASTM D4254—Minimum Index Density and Unit Weight of Soils and Calculations of Relative Density.
- ASTM D4318—Test for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- OSHA—Occupational Safety and Health Administration and Related Regulations.

1.2. Submittals.

1.2.1. Sanitary Sewer System. Required Submittals:

- **Product Data.** Manufacturer's product data sheets on all materials incorporated into Work.
- **Certificates.** Manufacturers certificates attesting compliance with applicable Specifications for grades, types, classes, and other listed properties.
- **Project Record Documents.** Submit documentation in accordance with applicable specifications. Accurate record drawings showing installed locations of manholes, cleanouts, valves, piping, service connections, and other accessories.

1.2.2. Precast Concrete Sanitary Sewer Manholes and Covers. Required Submittals:

- **Submittals:** Refer to applicable specifications for material submittals.
- **Product Data:** Provide manhole covers, component construction, features, configuration, dimensions and manufacturer name and address.

1.2.3. Excavation, Backfilling and Compacting for Utilities. Required Submittals:

- One (1) set to materials testing lab for classification.
- One (1) set to Engineer for approval.

1.3. Definitions. Definitions are as follows:

- **Sanitary Sewer Main.** Sanitary Sewer Main is defined as that portion of the sanitary sewer system which collects the effluent from the service laterals, including stub outs from the nearest manhole, to the point of final destination.
- **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 effluent being carried by the system to the sanitary sewer main, including the connection into the sanitary sewer main system.
- **Television Inspection.** Television Inspection is defined as furnishing all labor, materials, equipment, tools, logging and incidentals necessary to provide the televising and videotaping of sewer lines utilizing a color closed circuit television inspection unit to determine the condition of the lines. All new sewer mains will not carry flow until the Engineer approves and accepts the mains for service.
- **By-Pass Pumping.** By-Pass Pumping is defined as furnishing all labor, materials, equipment, tools, appliances and incidentals necessary to perform all operations in connection with by-pass pumping of sewage flow for the purpose of preventing interference with the construction of the sanitary sewer manholes and mains as well as providing reliable sewer service to the areas 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 case of equipment failure, the Contractor will have on the job site backup pumps and force mains. 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 will provide by-pass pumping of sewage around each segment of pipe that is to be televised or replaced and will be responsible for all required bulkheads, pumps, equipment, piping, and other related appurtenances to accomplish the sequence of pumping. A qualified person will man the pumps, on-site, at all times during the by-pass procedure.

All piping, joints and accessories will be designed to withstand the maximum by-pass system pressure, or a minimum of 50 psi, whichever is greater. During by-pass pumping, no sewage will be leaked, dumped, or spilled in or onto any area outside of the existing sanitary sewer system. When by-pass pumping operations are complete, all piping will be drained into the sanitary sewer before disassembly.

- **Bedding.** Includes the area from the trench bottom to the bottom of the pipe where material is placed to bring the trench bottom up to grade. A compacted depth of approximately 4 to 6 in. is generally enough bedding thickness.
- **Haunching.** Includes the area from the bottom of the pipe to the spring line of the pipe. Material in this area must be placed and consolidated to provide adequate side support while avoiding both vertical and lateral displacement of the pipe. The type and density of the material in this area are the most important factors affecting the performance and deflection of the pipe.
- **Initial Backfill.** Includes the area from the spring line of the pipe to a point at least 6 in. over the top of the pipe.
- **Final Backfill.** Includes the area above the initial backfill, up to final grade or the bottom of the flexible base material in the pavement section.
- **Pipe Zone.** Includes areas of bedding, haunching, and initial backfill as defined above.
- **DR-Dimension Ratio** as defined by the above references.
- **SDR-Standard Dimension Ratio.**
- **PVC-Polyvinyl Chloride** as in pipe.

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 System.

2.1.1. Pipe. PVC sewer pipe will be integral bell and spigot-type joints

SDR 26 (ASTM D3034). Pipe will be manufactured from Cell Class 12454 (ASTM D1784).

Tracer Wire. Tracer wire will be considered subsidiary and installed with all sanitary sewer pipe and service lines.

2.1.2. Joints. Joints will be flexible gasketed, elastomeric-type joints.

Gaskets will be compression-type, confined in a machined groove in the spigot or bell and meet ASTM F477.

Joints will conform to ASTM D3212.

2.1.3. Adapters. When joining dissimilar pipe materials or repairing pipe, suitable adapters will be used. The adapters will be insert or bond-coupling type and will meet the strength and chemical requirements of ASTM C594.

2.1.4. Fittings. SDR 26. Fittings will be push-on type, ASTM D3034 type PSM.

PS 46. Fittings will be push-on type meeting ASTM F789 and will be furnished by the pipe manufacturer.

Ribbed Gravity Sewer. Fittings will be push-on type meeting ASTM D794 and will be furnished by the pipe manufacturer.

Corrugated Gravity Sewer. Fittings will be push-on type meeting ASTM F949 and will be furnished by the pipe manufacturer.

2.1.5. **Manholes.** Furnish and install 48 in. diameter precast concrete manholes in accordance with applicable portions of this specification.

2.1.6. **Cleanouts.** Cleanouts. Line-type with lacquered cast iron body and round epoxy-coated gasketed cover. Use Trinity Valley Model No. 1884, Dallas Foundry Casting No. C-339, or Engineer approved equivalent substitution.

2.2. **Precast Concrete Sanitary Sewer Manholes and Covers.**

2.2.1. **Ring and Cover Manufacturers.** Western Industrial Model 380-24TF Manhole.

Tyler Model #8070.

Bass and Hayes 300-24.

Engineer approved equivalent.

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

2.2.2. **Concrete Manhole Sections.** Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923.

2.2.3. **Seals.** Bituminous or non-shrink grout-forming water tight seal as approved.

2.2.4. **Resilient Connectors.** A-Lock or Engineer approved equal.

2.2.5. **Antimicrobial Additive.** Will be used to render the concrete uninhabitable for bacteria growth and will have the following requirements:

- **Manufacturers:**
 - Conmic Shield®
 - Or Engineer approved equivalent.
- The liquid antibacterial additive will be an EPA registered material and the registration number will be submitted for approval before use in the project.
- The amount to be used will be as recommended by the manufacturer of the antibacterial additive. This amount will be included in the total water content of the concrete mix design.
- The antibacterial additive will have successfully demonstrated prevention of microbiologically induced corrosion in sanitary sewers for ten or more years.
- Acceptance will be a letter of certification from the concrete provider to the project owner stating that the correct amount and correct mixing procedure were followed for all antimicrobial concrete.
- Field repairs to the precast concrete will be made using an antimicrobial additive grout that is pre-portioned and factory packaged that requires the addition of no other components. The repair grout may be used for filling joints, lift holes, damaged areas, benches and similar.

2.2.6.

Components. Components will have the following Requirements:

- Lid and Ring - ASTM A48, Class 30B cast iron construction, machined flat bearing surface, removable lid, ring and lid will weigh at least 350 lb.; live load rating of 20,000 lb. wheel load; sealing gasket; lid molded with manufacturer's name; and the words "Sanitary Sewer".
 - A manhole cover must be constructed of impervious material.
 - A manhole cover that is located in a roadway must meet or exceed the AASHTO standard M-306 for load bearing.
- Precast concrete base pads will meet the requirements of ASTM C478.

2.3.

Excavation, Backfilling, and Compacting for Utilities.

2.3.1.

Pipe Zone. Materials for use within the pipe zone and within 24 in. of fiberglass structures will be in accordance with following Table 2.1:

**TABLE 2.1
DESCRIPTION OF MATERIAL CLASSIFICATION
(as defined in ASTM D2321)**

Class	Type	Soil Group Symbol	Description ASTM D2487	% Passing Sieve Sizes			Atterberg Limits		Coefficients	
				1½ in (40 mm)	#4 (4.75 mm)	#200 (0.075 mm)	LL ^b	PI ^c	Uniformity C _u	Curvature C _c
I	Manufactured, Processed Aggregate; dense-graded, clean	None	Angular, granular, crushed stone or rock, crushed gravel, and stone/sand mixtures with gradations selected to minimize migration of adjacent soils; contain little or no fines	100%	≤50%0	<5%	Non Plastic			
II	Coarse-Grained Soils, clean	GW	Well-graded gravels and gravel-sand mixtures; little or no fines	100%	<50% of Coarse Fraction	<5%	Non-Plastic		>4	1 to 3
		GP	Poorly-graded gravels and gravel-sand mixtures; little or no fines						<4	<1 or >3
		SW	Well-graded sands and gravelly sands; little or no fines		>50% of Coarse Fraction				>6	1 to 3
		SP	Poorly-graded sands and gravelly sands; little or no fines		<6				<1 or >3	
	Coarse-Grained Soils, borderline clean to w/fines	e.g. GW-GC, SP-SM.	Sands and gravels which are borderline between clean and with fines	100%	Varies	5% to 12%	Same as for GW, GP, SW and SP			
III	Coarse-Grained Soils with Fines	GM	Silty gravels, gravel-sand-silt mixtures	100%	<50% of Coarse Fraction	>12% to <50%		<4 or <"A" Line		
		GC	Clayey gravels, gravel-sand-clay mixtures					<7 and >"A" Line		
		SM	Silty sands, sand-silt mixtures		>50% of Coarse Fraction			>4 or <"A" Line		
		SC	Clayey sands, sand-clay mixtures					>7 and >"A" Line		

^a Includes Test Method ASTM D2487 borderline classifications and dual symbols depending on plasticity and liquid limits.

^b LL = Liquid Limit.

^c PI = Plasticity Index.

In addition to the materials included in Table 2.1, the following materials are approved for the pipe zone or within 24 in. of fiberglass structures where shown: Lean Concrete: Free-flowing grout, mixed one (1) sack of cement per cubic yard of sand.

2.3.2. **Structural Concrete.** Concrete for encasement will be 3,000 psi compressive strength as specified.

2.3.3. **Earth Backfill.** Earth backfill may be excavated and reused from trench or obtained from an approved borrow area. Material will be processed to ensure that only select material is used for backfilling operations. Material will be free of lumps, clods, large rocks, debris, trash, organic, spongy or otherwise objectionable material. The presence of such material in the backfill may preclude uniform compaction and result in excessive localized point loads on or deflections in the piping system or fiberglass structure.

All materials included in Table 2.1 above are approved for final backfill.

3. CONSTRUCTION

3.1. Sanitary Sewer System.

- 3.1.1. **Preparation.** Stake locations of manholes, cleanouts, fittings, valves (where applicable) and other accessories before installation for Engineer to review.

Before installation, remove foreign matter from within pipes, manholes, cleanouts, fittings, and valves. Verify material is in satisfactory condition and the valves and other mechanical devices function properly.

Do not lay pipe in water, or when trench or weather is unsuitable for work. Keep water out of trench until jointing is complete and bedding is placed to the top of pipe. When work is not in progress, close end of pipe and fittings securely so that no trench water, earth or other substances will enter pipes or fittings.

Keep inside of pipe free from foreign matter during operations by plugging or other approved method.

Place pipe so that full length of each section rests solidly upon pipe bedding, with recesses excavated to accommodate bells and joints. Take up and re-lay pipe when grade or joint is disturbed after laying.

Handle pipe and accessories so that pipe placed in trench is sound and undamaged. Take particular care not to injure pipe coating when applicable.

Cut pipe neatly, using approved type mechanical cutter without damaging pipe. Use cutters when practicable.

Pipe will be installed in compliance with Manufacturer's Specifications, and ASTM Standard D-2321-72 for "Underground Installation of Flexible Thermoplastic Sewer Pipe".

By-Pass pumping will be subsidiary to the line item for sewer installation.

- 3.1.2. **Bedding and Backfill.** Backfill compaction will be in accordance with plan details and specifications.

Do not exceed 75% of pipe manufacturer's recommendations for deflections from straight line or grade as required by vertical curves, horizontal curves, or offsets. If alignment requires deflections in excess of these limitations, use fittings.

Intersecting lines will be joined by an appropriate fitting.

Any adjustment to obtain correct line will be made by tamping or removing soil and in no case by wedging or blocking pipe.

- 3.1.3. **Placing and Laying.** Set and bury lines accurately to grades as shown.

- 3.1.4. **Joints.** Install mechanical and flanged joints in accordance with manufacturer's recommendations.

Make push-on joints in accordance with manufacturer's recommendations. Lay spigot ends downstream and push-on to full depth.

- 3.1.5. **Water Line Crossing.** No sanitary sewer line will be installed within 9-ft. (in all directions) of potable water line. Where the 9-ft. separation distance is not possible, contractor will refer to TCEQ §217.53 and coordinate with Engineer.

- 3.1.6. **Service Connections.** Service connections will be installed at each house, building, or other locations as shown.

The actual location of each service connection will be verified by the Contractor. The Contractor will confirm the location of the service connections with Engineer.

When the service line is to be terminated at the property line, the Engineer will determine the point of termination.

A service connection will consist of a 4-in. outlet wye. The outlet will be installed in the main with the branch tilted up at an angle of 30 or 45°.

Connection: Unless otherwise noted, the service will be 4-in. diameter, SDR-26 (PS 46) PVC Pipe. Tracer wire will be installed subsidiary to each service connection. This service line will extend to the property line where it will terminate or be connected to an existing service line. The service will be installed on a minimum grade of 0.75%. If the service line is terminated, the Contractor will close the line with a PVC Stopper tightly set with solvent. The Contractor will mark all terminated service lines with a 2 x 4 wooden stake or other approved suitable marker. The stake (marker) will extend from the end of the service line to 18-in. above grade.

No connections will be made to an existing service line until the affected main and all new mains downstream of the connections have been properly tested, accepted, and approved or use by the Engineer.

- 3.1.7. **Testing.** The following described testing will be required for all new gravity sewer lines. Upon completion of the required testing, Contractor will provide a signed and notarized affidavit certifying that the system has been tested and meet the applicable requirements.

- 3.1.8. **Low-pressure Air Tests.** A low-pressure air test will be performed after completing a section of sewer line.

The exfiltration test will conform to 30 TAC 217.57(a)(1) using procedures described in ASTM F1417 (Polyvinyl Chloride PVC) except for testing times. Testing times will be calculated based on 30 TAC 217.57(a)(1)(B)(ii).

The tests will be performed under the observation of the Owner and Engineer.

If the exfiltration exceeds the maximum allowable amount, the Contractor will replace the section of the sewer line necessary to meet the specified limits.

- 3.1.9. **Gravity Systems (Infiltration or Exfiltration).** The pipe will be laid so that infiltration/exfiltration does not exceed 50 gal. per inch of diameter per mile of line for a 24-hr. period.

The Contractor will furnish a pump of enough capacity to remove the infiltration. The infiltration will be measured by pumping a known volume in a known amount of time.

Hydrostatic Tests for gravity systems will be performed in accordance with 30 TAC 217.57(a)(2) and as directed.

If the infiltration/exfiltration exceeds the maximum allowable amount, the Contractor will replace or repair the section of the sewer line necessary to meet the specified limits.

- 3.1.10. **Deflection Tests.** A deflection test will be performed on all flexible pipes (PVC).

The deflection test will conform to the requirements of 30 TAC 217.57(b) including testing after the final backfill has been in place for at least 30 days.

If the deflection exceeds the maximum allowable amount, the Contractor will replace or repair the section of the sewer line necessary to meet the specified limits.

If the deflection exceeds the maximum allowable amount, the Contractor will replace or repair the section of the sewer line necessary to meet the specified limits.

- 3.1.11. **System Flushing.** Upon completion of each sewer line, the Contractor will flush the sewer line with enough quantity of clean water. The flushing will be performed until the water runs clear and clean.

The quantity of water will be enough to properly flush the line and will not be less than 200 gal. per minute.

- 3.1.12. **Television Inspection.** Upon completion of each sewer line, the Contractor will provide video inspection service of the sewer system. All defects found will be repaired by the Contractor at his own expense.

Payment for this service will be subsidiary to the line item for sewer installation.

The video inspection will be provided to the City for their record.

- 3.1.13. **Final Inspection.** Before final inspection, the Contractor will complete all work on the portion of the line to be tested. The ditches will be dressed and debris removed.

The final inspection will include the entire length of the line and include cleanup.

All defects noted will be repaired by the Contractor at his own expense before final payment.

- 3.2. **Precast Concrete Sanitary Sewer Manholes and Covers.**

- 3.2.1. **Configuration.** Shaft Construction will be concentric with concentric cone top section; lipped male/female dry joints; sleeved to receive pipe. Shape will be cylindrical with minimal inside clear diameter dimensions of 48-in. Design depth will be as indicated. Clear lid opening will be 30-in. minimum or as indicated. Provide pipe entry openings as required.

Pipe Connections:

- A manhole-pipe connection must use watertight, size-on-size resilient connectors that allow for differential settlement and must conform to American Society for Testing and Materials C-923.
- Resilient connectors will be cast into the wall of precast bases

Manhole Inverts:

- Inverts must meet the requirements of 30 TAC 217.55 (l)(2).
- The bottom of a manhole must contain a U-shaped channel that is a smooth continuation of the inlet and outlet pipes.
- A manhole connected to a pipe less than 15-in. in diameter must have a channel depth equal to at least half the largest pipe's diameter.
- A manhole connected to a pipe at least 15-in. in diameter but not more than 24-in. in diameter must have a channel depth equal to at least 3/4 of the largest pipe's diameter.
- A manhole with pipes of different sizes must have the tops of the pipes at the same elevation and flow channels in the invert sloped on an even slope from pipe to pipe.
- A bench provided above a channel must slope at a minimum of 0.5-in. per foot.
- An invert must be filleted to prevent solids from being deposited if a wastewater collection system pipe enters a manhole higher than 24-in. above a manhole invert.
- A wastewater collection system pipe entering a manhole more than 24-in. above an invert must have a drop pipe.

- 3.2.2. **Examination.** Verify items provided by other sections of work are properly sized and located.

Verify that built-in-items are in proper location, and ready for roughing into work.

Verify that excavation for manholes is correct.

Precast concrete sections will be inspected when delivered and all cracked or otherwise visible defective units will be rejected. Remove rejected materials from the project.

3.2.3. **Preparation.** Coordinate placement of inlet and outlet pipes required by other sections.

3.2.4. **Placing Manhole Sections.** Subgrade materials will be excavated to a uniform depth needed to permit the installation of Class II material, as specified and shown, to attain proper line and grade.

The elevation of the Class II material will be adjusted as required to attain proper grade and alignment of the base section.

Grout manhole inverts to achieve slope to exit piping. Grout will be installed monolithically.

The connecting pipe for installation with resilient connectors will be plain end, square cut spigots, which will not protrude more than 1-in. inside the manhole wall.

Stubs for further connections will be provided at the locations shown and be between three (3) and four (4) ft. in length and terminated in a bell and plug.

Set rings and covers level to correct elevations.

Coordinate with other sections of work to provide correct size, shape and location.

Manhole height will be adjusted by using variable height riser set as the bottom section.

The finished elevation will be attained by constructing a neck or chimney using precast concrete rings.

3.2.5. **Testing.** Manholes will be tested for leakage separately and independently of the wastewater lines by hydrostatic exfiltration testing, vacuum testing, or other approved methods.

The maximum leakage for hydrostatic testing will be 0.025 gal.-per-ft. diameter-per-ft. of manhole depth per hr. Alternate test methods must ensure compliance with the above allowable leakage.

If a manhole fails a leakage test, the manhole must be made water-tight and retested at the Contractor's expense.

Testing must meet the requirements of 30 TAC 217.58.

3.3. **Excavation, Backfilling, and Compacting for Utilities.**

3.3.1. **Protection and/or Removal of Existing Utilities.** The Contractor will anticipate all underground obstructions, such as but not limited to, water mains, gas lines, storm and sanitary sewers, telephone or electric light or power ducts, concrete and debris. Any such lines or obstructions indicated on the Drawings show only the approximate locations and will be verified in the field by the Contractor. The Owner and Engineer will endeavor to familiarize the Contractor with all known utilities and obstructions, but this will not relieve the Contractor from full responsibility in anticipating all underground obstructions whether or not shown on the Drawings.

The Contractor will, at his own expense, maintain in proper working order and without interruption of service all existing utilities and services which may be encountered in the work. With the consent of the Engineer and utility owner such service connections may be temporarily interrupted to permit the Contractor to remove designated lines or to make temporary changes in the locations of services. The cost of making any temporary changes will be at the Contractor's expense.

Notify all utility companies involved to have their utilities located and marked in the field. All underground utilities in a particular segment of the project will then be uncovered to verify location and elevation before construction begins in that segment of the project.

The Contractor will obtain necessary permits, except County right-of-way permits, required for completion of the project.

- 3.3.2. **Examination and Preparation.** Examine utility routes and coordinate excavation work to eliminate installation conflict.

Allow room for stockpiling excavated material and utility construction material during utility construction.

- 3.3.3. **Trench Excavation.** Procedure:

- Trenches will be excavated to indicated or specified depths by open cut method.
- During excavation, stockpile material suitable for backfilling in an orderly manner far enough from the bank of the trench to avoid overloading, slides, or cave-ins.
- Grade as necessary to prevent surface water from flowing into trenches or other excavations.
- Cut walls of trench as close to vertical as the stability of the material and trench safety will allow. Remove stones as necessary to avoid point-bearing. Over-excavate wet or unstable soil from the trench bottom to permit construction of a more stable bed for pipe. Over excavation will be filled and tamped with clean dry sand, pea gravel, or other approved material to the required grade.
- Excavate the trench the proper width as shown, or as required by the Contractor's Trench Safety Program. If the trench width below the top of pipe is wider than specified in this section or shown, install additional backfill. No additional payment will be made for additional material or work required for installation.
- Accurately grade the trench bottom to provide proper bedding as required for pipe installation.
- If any excavation is carried beyond the lines and grades required or authorized, the Contractor will, at his own expense, fill such space with suitable material and properly compact the material as directed. No additional payment will be made.

- 3.3.4. **Sheeting and Bracing.** If trench safety methods do not include sloping of trench walls, install sheeting and bracing; or use appropriate trench box necessary to support the sides of trenches and other excavations with vertical sides, as required by current OSHA regulations.

- 3.3.5. **Water in Excavation.** Keep work free from ground or surface water at all times. Provide pumps of adequate capacity or other approved method to remove water from the excavation in such a manner that it will not interfere with the progress of the work or the proper placing of other work.

- 3.3.6. **Trenching Progress.** Trenching operations for any individual utility work crew will not be in excess of 100-ft. ahead of pipe laying operations in city streets or 2,000-ft. in open country. Not more than two (2) consecutive cross-streets may be closed to traffic by any individual utility work crew at any given time. Ensure no trenches are left open when work is not in progress. Temporarily backfill any open trenches with un-compacted material and install proper barricades at the end of each work day.

- 3.3.7. **Existing Lawns and Shrubbery.** The Contractor will take particular care to preserve existing lawns and shrubbery. Make minor pipe alignment as may be necessary.

- 3.3.8. **Existing Pavement.** Existing pavement over trenches will be removed to a width of 6-in. outside of the trench on each side. Remove to a neat line by sawing method. Take appropriate measures to prevent damage to existing pavement adjacent to the trench by wheels, tracks and/or stabilizers of excavating equipment. Remove brick pavement by hand, deliver and stack as directed.

- 3.3.9. **Temporary Pavement.** Place a temporary pavement over an open-cut trench pavement section within the confines of an existing roadway pavement section including, but not limited to, asphalt (cold mix) and unimproved streets and roadways.

Place and compact 6-in. of flexible base course under temporary pavement sections within roadways as shown on the drawings. Apply 2-ft. Type D Cold Mix on top of flexible base course.

Pavement replacement will be paid for by the linear foot, which will be total payment for tamping the backfill, placing, and compacting the base material, finishing and replacing the pavement as per the section.

3.4. **Pipe Bedding.**

3.4.1. **Within the Pipe Zone and/or Adjacent to Fiberglass Structures. Adhere to the following:**

- Accurately grade the bottom of the trench 4-in. below the bottom of the pipe and to the limits of the clear space on either side of the pipe.
- Install materials which comply with Table 2.1 above and in accordance with "Pipe Bedding Detail" shown on the Drawing.
- The initial layer of embedment material placed to receive the pipe will be brought up to a grade slightly higher than that required for the bottom of the pipe and the pipe will be placed thereon and brought to grade by tamping, or by removal of the slight excess amount of embedment under the pipe.
- Adjustment to grade line will be made by scraping away or filling with embedment materials. Wedging or blocking up of pipe will not be permitted.
- Each pipe section will have a uniform bearing on the embedment for the full length of the pipe, except immediately at the joint.
- After each pipe has been graded, aligned, placed in final position on the bedding material and joint made, sufficient embedment material will be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe jointing and embedment operations.
- Sheeting and shoring will not be allowed in the pipe zone during or after installation of the pipe or embedment material, unless special provisions are made to ensure the specified compaction of bedding and pipe alignment is maintained after removal of sheeting and shoring.
- Minimum compaction effort within the pipe zone and adjacent to fiberglass structures will be in accordance with the following Table 3.4 based on the class of bedding material used:

Table 3.4
Minimum Required Compaction

Classification of Bedding Material	Standard Proctor Density ^a (Relative Density ^b shown in parentheses)
Class I	Dumped
Class II	≥85% standard (≥40% relative)
Class III	≥90% standard (≥55% relative)
Class IV	Not approved for bedding material
Class V	Not approved for bedding material

^a Standard Proctor Density per ASTM D698, moisture content will be ± 2% of optimum.

^b Relative Density per ASTM D4254.

- 3.4.2. **Utility Installation. Water Lines and Sanitary Sewers.** Limit clear on either side of the pipe to 12-in. above the pipe, cut as wide as necessary to sheet and brace and properly perform the work. Provide class of bedding as shown. Install piping and appurtenances as specified.

Excavation for Appurtenances. Excavate sufficiently for valves, fittings, manholes, valve vaults, utility pull boxes and similar structures to leave at least 18-in. clear between the outer surfaces and the embankment or shoring that may be used to hold and protect the embankment wall. Install valves, fittings, manholes or valve

vault structure, piping and appurtenances as specified. Any other-depth excavation will be refilled with lean concrete or other suitable compacted material approved by the Engineer, at no additional cost to the Owner.

- 3.4.3. **Final Backfill.** Backfill trenches to ground surface with material as specified. Reopen trenches improperly backfilled to depth required for proper compaction. Refill and compact as specified, or otherwise correct the condition in an approved manner.

Take care to avoid contacting pipe or structure to be backfilled with compaction equipment. Do not use compaction equipment directly over the pipe until enough initial backfill has been placed to assure such equipment will not be damage or disturb the pipe.

All forms, lumber, trash, and debris will be removed from trenches, manholes, and other utility structures before backfilling.

Dispose of unacceptable backfill material and provide suitable material for backfill at no additional cost to the Owner.

- 3.4.4. **Open Areas.** Above the pipe zone, deposit earth backfill from excavated material, compact to minimum of 85% of maximum density per ASTM D698, while maintaining moisture within $\pm 2\%$ of optimum. Excavated material placed will be free of rock greater than 2-in. in any direction.

Backfill for valves, fittings, manholes, utility pull boxes and other utility structures will be placed in accordance with applicable Specification Sections.

- 3.4.5. **Pavement Section.** Above the pipe zone to below the flexible base material, deposit earth backfill from excavated material, compact to minimum of 95% of maximum density per ASTM D698, while maintaining moisture within $\pm 2\%$ of optimum; or deposit ASTM D2487 Class II material in 6-in. lifts, compact to 40% relative density according to ASTM D4254.

For valves, fittings, manholes, valve vaults or boxes in pavement sections, backfill with Class II material to bottom of proposed pavement. Backfill material will be deposited in 6-in. lifts. Class II material must be compacted to 40% relative density according to ASTM D4254.

- 3.4.6. **Disposal of Excess Material.** Remove waste and excess excavated material from the construction site before final inspection. Legally dispose of material:

- At a licensed and approved site.
- On adjacent private property with written and notarized permission from the property owner.
- On Owner property with written and notarized permission from the Owner.
- All costs associated with waste material removal and disposal will be paid for by the Contractor.

4. MEASUREMENT

Measurements and Payment will include the following terms:

- Remove Structural Manhole - Each,
- 48" Precast Concrete Manhole (0'-4') - Each,
- 48" Precast Concrete Manhole (4'-8') - Each,
- 48" Precast Concrete Manhole (8'-12') - Each,
- 48" Precast Concrete Manhole (12'-16') - Each,
- Reconnect Existing Sewer Mains - Each,
- Tie-In to Existing Manhole - Each,
- 4" SDR-26 PVC Gravity Sewer Line - Linear Foot,
- 6" SDR-26 PVC Gravity Sewer Line - Linear Foot,
- 8" SDR-26 PVC Gravity Sewer Line - Linear Foot,

- 15" SDR-26 PVC Gravity Sewer Line - Linear Foot,
- Encasement for 4" Sewer Line (Bore or Open-Cut) - Linear Foot,
- Encasement for 6" Sewer Line (Bore or Open-Cut) - Linear Foot,
- Encasement for 8" Sewer Line (Bore or Open-Cut) - Linear Foot,
- Encasement for 15" Sewer Line (Bore or Open-Cut) - Linear Foot,
- Remove or Abandon/ Pressure Grout Exist. Sewer Line (2"-12") - Linear Foot,
- Trench Safety (Depths Greater than 5 ft.) - Linear Foot,
- Temporary Pavement Replacement - Linear Foot,
- Pre/Post Television Inspection - Linear Foot,
- Flowable Backfill - Cubic Yards,
- Sewage Service Line - Each, and
- Plug Wastewater Line - Each.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for the various items of the work. The price is full compensation for removal of existing sewer components (line, manholes, and appurtenances), furnishing, hauling, placing, and installing the materials; for inspecting, disinfection, and testing; and for other materials, labor, equipment, tools, and incidentals. All fittings, connections, tracer wire, etc. are considered subsidiary to the individual line items for sewer line installation.