

SECTION 2

SANITARY SEWER CONSTRUCTION

GRAVITY MAINS AND FORCE MAINS

PIPE INSTALLATION

1. GENERAL: The Contractor shall not lay pipe until the Engineer has checked and approved the grade. Any pipe laid without the approval of the Engineer shall be removed and relaid if directed.

Whenever the Engineer authorizes the use of wood blocks or "Mud Sills" for supporting the pipe, such sills shall be at least 6" longer than the O.D. of the pipe and in section shall be at least 2" by 10" for 12" and larger pipe. No extra compensation shall be allowed for the use of such material.

Pipe shall not be laid in water, and water shall not be allowed to flow against or over the joints until they have properly set.

The pipe and specials shall be so laid in the trench such that after the sewer is completed, the invert of the pipe shall conform accurately to line and grade.

Previous to being lowered into the trench, each pipe shall be carefully inspected by the contractor's foreman and/or the District's inspector, and all faulty pipe shall be rejected and removed from the job-site.

A bell hole shall be dug for each pocket. Bell holes shall be no larger than necessary for making the joint. The bottom of the trench shall be shaped to fit the bottom quarter of the pipe to insure a firm even bearing on undisturbed earth of the entire length of the pipe.

The interior of the bell of the last pipe laid and the spigot of the next pipe shall be wiped clean and dry as each joint is laid.

Rubber gaskets shall be installed, lubricated and protected strictly as recommended by the pipe and/or gasket manufacturer. In case pressure from the compressed gasket tends to open the joint after it is made, the Contractor will provide a positive means of holding pipe joints after installation to hold the joint as made.

All sewer gravity main lines that are 3' to 14' in depth shall use PVC sch. 35 piping unless otherwise noted. Any sewer gravity main lines that are 0' to 3' in cover and all lines over 14' in depth shall have interior coated ductile iron piping (see Section 1-2) or may be installed inside of an appropriate sized steel casement pipe.

2. HDPE – Guided Boring Installation:

A. Scope: This section includes the installation of the sewer main by guided boring, including connecting to the new water main. The contractor will furnish all labor, components, materials, tools, and appurtenances necessary or proper for the performance and completion of the contract.

B. General Description of Method: Guided boring is a method of trenchless construction using a surface launched steerable drilling tool controlled from a mobile drilling frame, and includes a field power unit, mud mixing system, and mobile spoils extraction system. The drilling frame is sited and aligned to bore a pilot borehole that conforms to the planned installation of the main. The drilling frame is set back from an access pit that has been dug (typically at the location of the proposed water main or other appurtenances) and a high-pressure fluidjet toolhead that uses a mixture of bentonite clay and water is launched. Pits are normally dug at the start point and endpoint of the proposed pipe installation and are used to align the toolhead, attach other equipment, and to collect and remove excess spoils. Using an electronic guidance system, the toolhead is guided through the soil to create a pilot borehole. Upon reaching the endpoint joint, the toolhead is removed and a reamer with the product pipe attached is joined to the drill string and pulled back through the borehole. In large diameter installations, pre-reaming of the borehole will usually be done prior to attaching the product pipe for the final pullback. A vacuum spoils extraction system removes any excess spoils generated during the installation. The connections, manholes, or other appurtenances are then completed at both the start point and endpoint locations and the surface restored to its original condition.

C. Qualifications:

1. Guided boring contractors shall have actively engaged in the installation of pipe using guided boring for a minimum of three years.
2. Field supervisory personnel employed by the guided boring contractor will have at least three years experience in the performance of the work and tasks as stated in the contract document.

D. Submittals:

1. Submit documentation showing three years of guided boring experience. Information must include, but not be limited to; date and duration of work, location, pipe information (i.e., length, diameter, depth of installation, pipe material, etc.), project owner information, (i.e., name, address, telephone number, contact person), and the contents handled by the pipeline (water, wastewater, etc.).
2. Submit a list of field supervisory personnel and their experience with guided boring operations. At least one of the field supervisors listed must be at the site and be responsible for all work at all times when guided boring

operations are in progress. Guided boring operations will not proceed until the resume(s) of the contractor's field supervisory personnel have been received and reviewed by the Project Engineer.

3. Submit the following drawings and documents:

- a. Working drawings and written procedure describing in detail the proposed method of installation. This will include, but not be limited to; size, capacity and setup requirements of equipment, location and siting of drilling and receiving pits, dewatering if applicable, method of fusion and type of equipment for joining pipe, type of cutting tool head, and method of monitoring and controlling line and depth. If the contractor determines that modifications to the method and equipment as stated in the submittal is necessary during construction, the contractor will submit a plan describing such modifications, including the reasons for the modification.
- b. Bentonite drilling mud products information (MSDS); special precautions necessary; method of mixing and application; and method of removing spoils.

E. Site Conditions:

1. Drilling operations must not interfere with, interrupt or endanger surface and activity upon the surface.
2. Contractor must comply with all applicable jurisdictional codes and OSHA requirements.
3. The contractor shall conduct pre-bid and pre-drill investigations of each individual site and make a determination as to the existing conditions.
4. When rock stratum, boulders, underground obstructions, or other soil conditions that impede the progress of drilling operations are encountered, the contractor shall change from a conventional drilling bit to one suitable for drilling in rock formations. This change in equipment shall be at no additional cost to the District.

3. HDPE – Drilling Fluid:

- A. Drilling fluid will be a mixture of water and bentonite clay. The fluid will be inert. The fluid should remain in the tunnel to ensure the stability of the tunnel, reduce drag on the pulled pipe, and provide backfill with the annulus of the pipe and tunnel.
- B. Disposal of excess drilling fluid and spoils will be the responsibility of the

contractor who must comply with all relevant regulations, right-of-way, work space, and permit agreements unless otherwise agreed upon before hand with District personnel. Excess drilling fluid and spoils will be disposed at an approved location.

- C. The contractor is responsible for transporting all excess drilling fluid and spoils to the disposal site and paying any disposal costs. Excess drilling fluid and spoils will be transported in a manner that prevents accidental spillage onto roadways. Excess drilling fluid and spoils will not be discharged into sanitary or storm drain systems, ditches, or waterways.
- D. Drilling fluid returns (caused by fracturing of formations) at locations other than the entry and exit points will be minimized. The contractor will immediately clean up any drilling fluid which surfaces through fracturing.
- E. Mobile spoils removal equipment capable of quickly removing spoils from entry or exit pits and areas with returns caused by fracturing will be present during drilling operations to fulfill the requirements of paragraphs b and c above.
- F. The contractor will be responsible for making provisions for a clean water supply for the mixing of drilling fluid.

4. HDPE – Installation:

A. General:

- 1. The Engineer shall be notified immediately if any obstruction is encountered that stops the forward progress of drilling operations.
- 2. The type of dewatering method will be at the option of the contractor. However, the dewatering of pits and excavations must meet all requirements of OSHA and the general conditions, special provisions, and specifications of the District. When water is encountered, the contractor, unless otherwise agreed upon beforehand, must provide a dewatering system of sufficient capacity to remove water, keeping any excavations free of water until the backfill operation is in progress. Dewatering shall be performed in a manner that removal of soil particles is held to a minimum.

B. Preparation:

- 1. Excavate required pits in accordance with the working drawings.
- 2. The drilling procedures and equipment shall provide protection of workers, particularly against electrical shock. As a minimum, grounding mats, grounded equipment, hot boots, hot gloves, safety glasses, and hard hats

shall be used by crewmembers. The drilling equipment shall have an audible alarm system capable of detecting electrical current.

3. Removal of trees, landscaping, pavement or concrete shall be performed by the contractor unless otherwise agreed upon beforehand.

C. Guided Boring Operations:

1. Equipment:

- a. The drilling equipment must be capable of placing the pipe within the limits indicated on the contract plans.
- b. Guided boring equipment shall consist of a surface launched steerable drilling tool controlled from a mobile drilling frame, and include a field power unit, mud mixing system and mobile spoils extraction system.
- c. The number of access pits shall be kept to a minimum and the equipment must be capable of boring the following lengths in a single bore. The guided boring system will have the capacity of boring and installing a continuous run without intermediate pits of a minimum distance for the following pipe diameters:

<u>Product Pipe Size</u>	<u>Minimum Boring Distance</u>
1 – 1 ½ inches	500 feet
2 – 4 inches	450 feet
6 inches	400 feet
8 inches	350 feet
10-16 inches	300 feet

- d. The guidance system shall have the capability of measuring vertical (depth) position, horizontal position and roll. The guidance system must meet the following specifications in soft homogenous soils:

Accuracy

Vertical position:	± 1 inch at	18-96	inches of depth
	± 2 inches at	97-144	inches of depth
	± 4 inches at	145-180	inches of depth
	± 6 inches at	181-300	inches of depth
	± 10 inches at	301-480	inches of depth
Horizontal position:	± 2 inches at	18-96	inches of depth
	± 4 inches at	97-144	inches of depth

± 6 inches at	145-180	inches of depth
± 12 inches at	181-300	inches of depth
± 24 inches at	301-480	inches of depth

- e. Equipment set-up requirements shall be prepared by the contractor and submitted to the Engineer per the requirements as stated under “Submittals.”
- f. Required Safety Equipment: **During drilling operations all equipment shall be effectively grounded and incorporate a system that protects operating personnel from electrical hazards. The system shall be equipped with an audible alarm that can sense if contact is made with an energized electric cable. Proper operation of the alarm system will be confirmed prior to the drilling of each tunnel. All equipment will be connected to ground with a copper conductor capable of handling the maximum anticipated fault current. Crew members operating drilling equipment and handling rods will do so while standing on grounded wire mesh mats, ensuring that all equipment is grounded, and wearing hot boots, hot gloves, safety glasses and hard hats. Crewmembers operating handheld locating equipment will wear hot boots.**

2. Pit Hole Boring:

- a. The entry angle of the pilot hole and the boring process will maintain a curvature that does not exceed the allowable bending radii of the product pipe.
- b. Alignment Adjustments and Restarts:
 - 1. The contractor shall follow the pipeline alignment as shown on the drawings, within the specifications stated. If adjustments are required, the contractor shall notify the engineer for approval prior to making the adjustments.

3. Installing Product Pipe:

- a. After the pilot hole is completed, the contractor shall install a swivel to the reamer and commence pullback operations. Pre-reaming of the tunnel may be necessary and is at the option of the contractor.
- b. Reaming diameter will not exceed 1.5 times the diameter of the product pipe being installed.

- c. The product pipe being pulled into the tunnel will be protected and supported so that it moves freely and is not damaged by stones and debris on the ground during installation.
- d. Pullback forces will not exceed the allowable pulling forces for the product pipe.
- e. The contractor shall allow sufficient lengths of product pipe to extend past the termination point to allow connections to the diffuser assembly. Pulled pipe will be allowed 24 hours of stabilization prior to making tie-ins. The length of extra product pipe will be at the contractor's discretion.

4. Clean-up:

The contractor shall maintain the work site in a neat and orderly condition throughout the period of work. After completing the work at each site, the contractor shall remove debris, surplus material, and temporary structures erected by the contractor. The site shall be restored to a condition equal to the existing condition prior to being disturbed.

5. PIPE BEDDING REQUIREMENTS (Gravity Mains): The following are minimum bedding requirements for gravity sewers. See the special provisions of this contract for any revisions to these minimum requirements.

A. Ductile Iron or Concrete Piping: Pipe shall be bedded in 3/4" maximum diameter granular material placed on the flat trench bottom.

1. Pipe Depth 0-14 Feet: The granular bedding shall have a minimum thickness of 1/4 the outside diameter of the pipe, and shall be no less than 4" thick below the pipe barrel and shall be back-filled with stone to a depth of 1/3 the outside diameter of the pipe. The backfill for a minimum of 24" over the top of the pipe shall be carefully compacted material brought up on maximum 6" lifts.

Pipe bedding shall conform to Class "C" bedding with 3/4" maximum diameter granular material as described in the American Concrete Pipe Association Handbook.

2. Pipe Depth 14-18 Feet: In trenches between 14' and 18' in depth, the pipe shall be installed on Class "B" bedding having a minimum thickness of 1/2 the outside diameter of the pipe, but not less than 4" thick below the pipe barrel and back-filled with crushed stone to at least one-half the pipe diameter. The backfill for a minimum of 24" over the top of the pipe shall be carefully compacted material brought up in maximum 6" lifts.

B. PVC Piping: Pipe installation shall be in accordance with ASTM D 2321. Installation shall consist of Class I bedding material (Gravel 1/4" to 3/4" particle size) having a

minimum thickness of 1/2 the outside diameter of the pipe, but no less than 4" thick below the pipe barrel and continue as backfill to the top of the pipe. Based on the existing soil conditions, the District may adjust the depth of Bedding Material required. Any adjustment in the depth will be authorized in writing by the District. Initial backfill from the top of the pipe to 6" above the top of the pipe shall be of Class I, II or III materials (sand or gravel). The Class I, II and III backfill shall extend over the full width of the trench. Class IV material (silt or clay) may be used above the initial backfill. PVC piping shall only be used for depths of 3' – 14'. From 0' – 3' in cover and over 14' in depth shall require interior coated ductile iron piping.

6. GRADE:

A. Laser Beam: If laser beam equipment is used, the Contractor will check the pipe grade and alignment every 50' , by on line and grade instruments, to insure that the pipe is being laid according to plans and/or cut sheets. Any deviations in grade or alignment will be corrected by the Contractor at no charge to the District.

7. INSPECTION AND TESTING: Visual inspection of individual legs of the gravity sewer main between manholes shall be performed by the SCDHEC inspector, Engineer, and/or District inspector prior to the line being placed into service. The sewer main shall exhibit a full circle pattern when viewed. It shall also be free of any obstructions, rocks, pieces of wood, dirt, etc. and shall be true to line and grade.

A. Flushing: Any obstructions or debris revealed during visual inspection of the line shall be removed by flushing with water at a minimum velocity of 2.5' per second until the line is clean. The Contractor shall be responsible for any cost any water used from the District's water distribution system at the District's current rate.

B. Infiltration: Leakage into the sewer shall not exceed 100 gallons per day per inch of pipe diameter per mile of sewer for any section between manholes. If leakage into the sewer appears excessive, a testing program determined by the Engineer shall be initiated by the Contractor.

1. Method A: Each leg of sewer shall be tested by plugging the high side opening of both the upper and lower manholes. The pipe will then be filled with water with approximately 6' of head above the crown of the pipe maintained in the upper manhole. Leakage will be determined by measured additions of water required to maintain the specified head. If ground water is present to a point at least 4' above the crown of the sewer, the leakage test may be made by measuring the amount of infiltration. The duration of the test shall be six hours or to the satisfaction of the Engineer.

2. Method B: If unable to locate leakage using Method A, a low pressure compressed air test may be used. A section of sewer main shall be considered acceptable when tested at an average of 3.0 psi above any back pressure applied by groundwater above the pipe, when that section does not lose air at a rate greater than 0.0030 cfm per square feet

of internal pipe surface. If this method is used, separate infiltration/exfiltration tests will be performed on each manhole.

C. Deflection Testing: This test may be required on some PVC composite pipes as determined by the Engineer. If required, the test shall be performed using a nine prong mandrel pulled through the pipe. The maximum allowable deflection will be five percent. Mandrel size will be in accordance with the following table:

<u>Main Size</u>	<u>Mandrel Dimensions</u>
8"	7.40"
10"	9.31"
12"	11.22"
15"	14.09"

8. CONCRETE CRADLE AND ENCASEMENT: When indicated on the plans or directed by the Engineer and/or District, the pipe shall be supported on a concrete cradle or encased in concrete. The concrete shall have just enough water to make it workable. Total compensation to the Contractor shall be one and one-half times the cost of the concrete delivered by truck.

9. PIPELINE CONSTRUCTION (Sewer Force Main): Pipe under pressure shall be laid in accordance with ANSI/AWWA Specification C-600.

All pipe, special castings, valves, fittings, and the bells, and/or spigots, shall be thoroughly cleaned of all earth or other foreign matter before being fitted together. The spigot end shall be adjusted in the bell of the pipe, special castings, and valves, to allow for uniform gasket space; and the pipe shall be completely forced home and held there.

Only PVC force main piping shall be accepted by the District.

A. Blocking: All turns, fittings, etc., that induce pressure which would cause separation of the pipe, breakage, etc., shall be blocked with 3,000 lb. concrete. Blocking shall be formed and placed in such a manner that the pressure to be exerted at the point of blocking shall be transferred to firm, undisturbed earth at a maximum load of 2,000 lbs. per square foot. The Contractor shall insure that blocking at all tees, bends, plugs, etc., shall be sufficient to contain all pressure exerted by the pipe up to a pressure of 150 lbs. per square inch hydraulic pressure within the pipe, i.e., pressure at plug = 150# x (area of pipe in inches). The Contractor shall also be responsible for any damage or repairs caused by blowouts of any insufficiently blocked pipe.

B. Testing: The Contractor will be required to set up a pump and test out each section of water line or sewage force main to a hydrostatic pressure of one hundred fifty (150) pounds per square inch or the rated pressure of the pipe whichever is less.

This test shall be sustained for not less than two hours, and as much longer as the Engineer may require to determine the tightness of the joints, or to detect any broken or otherwise defective material in the pipe lines. Leakage shall not exceed the amount determined by $L = [(N)(D)(T)^{1/2}] / 1850$ where L is leakage in gal/hr., N is number of joints, D is Inside Diameter of pipe in inches, and T is the Test Pressure in PSI. The Contractor shall remove and replace any defective material that shows evidence of leakage.

C. Basis of Payment: Payment shall be made at the contract unit price on the measured length of the force main. Unit price in bid shall include tying in to the manhole, as well as connection to lift station outlet pipe.

10. MANHOLE CONSTRUCTION: Excavation shall be made to the required depth and the foundation of the manhole shall be constructed as shown on the plans.

Where existing manholes are to be reused, the Contractor shall make all connections thereto, as directed by the Engineer and/or the District, at no additional cost. If however, it is necessary to modify the bottom of the manholes or make other major adjustments, such work shall not be classified as extra work and additional compensation is not allowed.

Manholes shall be left clean and in good order and so kept until final acceptance of the work by the District.

Manhole tops shall be set at an elevation to be determined by the Engineer for each individual manhole. Any manhole that is built without securing this information from the Engineer, or not as ordered by the Engineer, that is found to be at an elevation too high or too low, shall be lowered or raised as ordered by the Engineer. If necessary to comply with the detail drawing, the manhole shall be required to be torn down to the beginning point of the draw-in and rebuilt from that point.

A. Pre-cast Concrete Manholes: Pre-cast concrete manholes shall be furnished and installed as specified herein:

Excavation will be made to the required depth and the foundation on which the pre-cast manhole is to be set shall be approved by the Engineer. The excavation shall include the removal of obstructions and the removal of unstable materials unsuitable for a good foundation. The excavation shall allow for a minimum 6" thick bedding of crushed stone under the manhole base 7' square.

Pre-cast manholes shall consist of a monolithic pre-cast base section with built up 1:2 concrete mortar inverts. Pre-cast base sections shall be set at the proper invert elevations on a 6" thick base of crushed stone which is 7' square.

The barrel of the manhole shall be constructed from pre-cast, reinforced sections, stacked to form the manhole and manufactured according to the latest revision of ASTM C-476. The tapered section of the manhole shall be manufactured under the same specification and designed in a

manner to suit the Engineer' s requirements. Top slabs of manholes shall be designed to support street traffic and H-20 loadings. Pre-cast manhole sections shall be joined with mastic material to show both inside and outside. Inlet and outlet pipes are to be connected to the manholes by means of flexible connectors cast into the manhole section. Flexible connectors are to be manufactured of high quality rubber or synthetic rubber and all strap clamps or draw bolts are to be manufactured from stainless steel.

Pre-cast inverts are required in all pre-cast manholes.

11. CONNECTION TO EXISTING WORK: Connections to existing manholes and sewers shall be made in such a manner that the work will conform to the requirements of new work. All OSHA Standards shall be taken into consideration by the Contractor for all connections to District's existing sanitary sewer system. District is to charge contractors it's current hot tapping fee charge to hot tap any District owned existing sewer force main line. Any existing manhole that will be receiving a proposed sewer force main into it shall be coated with interior coating which shall withstand hydrogen sulfide bacterially corrosive environments down to pH 2. Lining shall be Sewpercoat, Strong Seal, Quadex, or approved equal.

12. BORINGS:

A. Borings under Paved Roads and Highways: The minimum depth from the roadway surface to the top of the casing pipe at its closest point shall be 3' . When the casing pipe ends are below ground, they shall be protected from the entrance of foreign material.

Contractors shall be required to provide shoring of boring pits and trenches more than 5' deep in accordance with the South Carolina Department of Transportation and Federal Occupation Health and Safety Administration.

B. Borings under Railroads: The depth from the base of the railway rail to the top of the casing at the closest point shall not be less than 5' . Also, there should not be less than 3' from the bottom of the side ditches to the top of the casing pipe. Where ends of casing pipe are below grade, provisions shall be taken to protect the ends against foreign material.

Contractors shall be required to shore all pits used for boring if it is over 5' deep in accordance with the local Railroad owner, the South Carolina Department of Transportation and Federal Occupation Health and Safety Administration.

13. METHOD OF MEASUREMENT: The quantities to be paid for under this section shall be the actual number of feet of sanitary sewer pipe installed at varying depths and classes of pipe. The length shall be measured from the beginning of the pipe to the end of the line, including distances through intermediate manholes, except where cross lines are constructed, and in such cases, the distance through the manhole will be measured only.

Manholes shall be measured by unit of the varying classifications of depth. The depth shall be measured from the invert of the effluent line to the top of the brick or block work. Where special drop manholes are constructed, payment shall be made on the basis of the unit price for drop manholes in various depth classifications.