SECTION 02722

SANITARY SEWERS AND FORCE MAIN

PART 1 - GENERAL

1.01 RELATED WORK

A. Section 02221 - Trenching, Backfilling, and Compacting.

1.02 QUALITY ASSURANCE

A. Install sewers to meet requirements of the Tennessee Department of Environment and Conservation.

1.03 SUBMITTALS

A. Submit product data for pipe, valves, manholes and manhole castings and steps.

B. Submit manufacturer's certification that pipe, fittings, and manhole sections meet specification requirements.

1.04 REFERENCES

A. ASTM A48 - Gray Iron Castings.

B. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

C. AWWA C104 - Cement - Mortar Lining for Cast-Iron and Ductile - Iron Pipe and Fittings.

D. AWWA C150 - Thickness Design of Ductile Iron Pipe.

E. ASTM C478 - Precast Reinforced Concrete Manhole Sections.

F. AWWA C110 - Gray-Iron and Ductile-Iron Fittings, 3 inch through 48 inch, for water and other liquids.

G. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

H. ASTM D3212 - Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

I. AWWA C111 - Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings.

J. AWWA C151 - Ductile-Iron Pipe Centrifugally Cast, in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Store PVC pipe under cover to protect from ultraviolet light.

B. Protect ductile iron pipe from damage to coating and lining.

C. Carefully examine each pipe and fitting for cracks and other defects while suspended above the trench immediately before installation.

1.06 JOB CONDITIONS

A. Whenever pipe laying is not actively in progress, open ends of all installed pipe and fittings shall be fitted with a watertight plug.

B. Separation of Sewers and Water Mains

1. Parallel Installation of Sewers and Water Mains

a. Whenever possible the sewer shall be installed at least 10 ft. horizontally from water mains, the distance measured from edge to edge.

b. If local conditions prevent a horizontal separation of 10 ft., the sewer shall be installed in a separate trench so that the top of the sewer pipe is at least 18 inches below the bottom of the water main.

c. If neither of these conditions can be met, the sewer shall be constructed of mechanical joint ductile-iron pipe, and the pipe pressure tested to assure water tightness prior to backfilling.

2. Crossing of Sewers and Water Mains

a. The sewer shall be installed so the minimum distance between the outside of the water pipe is at least 18 inches above the top of the sewer line. The crossing shall be arranged so that the sewer joints will

be equidistant and as far as possible from the water main joints.

b. If local conditions prevent this separation, the sewer shall be constructed of mechanical joint ductile-iron pipe, and the pipe pressure tested to assure water tightness prior to backfilling.

PART 2 - PRODUCTS

A. Polyvinyl chloride pipe and fittings for force main: ASTM D2241, SDR 21, Elastomatic gasketed joints, 20 foot laying length. Integral thickened bell at annular recess designed, sized and shaped so that the gasket is locked in place against displacement.

B. Lateral branches: Lateral sewer service branches shall be wyes of the same material as the main sewer, with each service out and plugged at the property line. Branches shall be 6" in diameter.

C. Ductile iron pipe: AWWA C151, thickness class 50. Joints: AWWA C111; mechanical joint with gray or ductile iron glands, or push on joint; plain gaskets of natural rubber or neoprene. Pipe shall have coal tar epoxy lining.

D. Polyvinyl chloride pipe and fittings for gravity sewer: ASTM D3034, SDR 35. Elastomeric gasketed joints, ASTM D3212.

2.02 MANHOLES

A. Manholes shall be cast-in-place or precast concrete type with a precast concrete base, riser, and flat top or cone sections adhering to ASTM C478, with 0-ring joints in accordance with ASTM C443 or ASTM C361. Use type II cement. See the attached detail for construction installation.

B. Frame and Cover: Cast iron, capable of supporting a 16,000 pound wheel load, combined weight of 230 lb. complete with polyvinyl gasket set. See **Standard Drawing** for cover. Horizontal and vertical mating surfaces shall be machined. Rings and covers shall be either vented or watertight as determined by the **HALLSDALE-POWELL UTILITY DISTRICT**. Vented manhole rings and covers shall be East Jordan Iron Works 2450-A. Watertight rings and covers shall be East Jordan Iron Works 2450-B or equal; with anchor bolt holes. All frames and covers shall match the existing standard of the **HALLSDALE-POWELL UTILITY DISTRICT**. All manholes, frames and covers shall have a minimum 24 inch clear opening.

C. Steps: Cast iron, ASTM A48, Class 30B; or polypropylene plastic molded around a steel rod. Tread shall be 16 inches wide on 16" vertical centers and be designed that a foot cannot slide off the end. Installed tread shall resist a concentrated load of 250 lb.

D. Connection between pipes and manholes shall be watertight, made with flexible gaskets meeting quality standards of ASTM C443.

E. Manhole coating: Tnemec 47-461 Foundation Coating, Sonneborn Hydrocide 648, or approved equal.

F. Resilient Manhole/Pipe/Connectors: "Kor-N-Seal", A-Lock "Manhole Pipe Seal" or Dura-Tech "Dura-Seal.

G. Precast concrete manhole sections shall be waterproofed by the manufacturer using NPCA approved admixtures and additives for waterproofing.

H. Gasket material for precast section joints: Kent-Seal No. 2 as manufactured by Hamilton Kent Manufacturing Company, Stone Mountain, GA; or Ram-Nek as manufactured by KT Snyder Company, Inc., Houston, TX.

2.03 STRUCTURAL PROTECTION

A. For structural protection of the sewer pipe where less than 2.5 ft. of cover is provided (4.0 ft. under roads); where less than 18 inches separates top of the sewer and culverts or other conduits; and at other locations shown on the drawings or requested by the Engineer, ductile iron pipe, concrete encasement or special bedding and backfilling shall be required.

2.04 AIR RELEASE ASSEMBLIES

A. Furnish in 2" nominal diameter for 8" force main and smaller and in 3" nominal diameter for 10" mains and larger, unless otherwise specified or shown on the plans.

B. Air release assemblies shall consist of:

1. Double strap, bronze service clamp with neoprene gasket (for PVC lines.

2. Stainless steel pipe of the nominal diameter required by the main size.

3. Red Brass Corporation stop.

4. Stainless steel elbow.

5. Gate or globe valve.

6. Combination air release valve by Apco, or equal.

C. Combination air release valves consisting of:

1. An air and vacuum valve coupled with an air release valve.

2. Cast iron body, stainless steel float, stainless steel linkage, stainless steel trim, suitable for use in mains having a working pressure of 200 psi.

D. Install in a concrete pipe or vault as shown on the detail in **Standard Drawings**.

E. Place crushed stone from the top of the main to 12" below the bottom of the main.

2.05 THRUST BLOCKS

A. Concrete for thrust blocks shall meet the requirements of Section 03300. Concrete for thrust blocks shall be mechanically mixed unless specific approval is obtained from the **HALLSDALE-POWELL UTILITY DISTRICT**.

B. Thrust blocking shall be provided at all bends of 11-1/4 degrees or greater, and at all tees, wyes, plugs, and dead end valves. Blocking shall be poured against undisturbed earth, be a minimum of 12 inches thick, and constructed so that the pipe and fitting joints will be accessible for repairs. If adequate support against undisturbed ground cannot be obtained, metal harness anchorages consisting of joint clamps or tie rod and clamp systems shall be installed to provide the necessary thrust resistance.

2.06 CASING PIPE

A. For major roadway and all railroad crossings, force main pipe shall be installed in a casing pipe. Casing pipe shall be black steel pipe with minimum wall thickness as shown in Section 02235.

2.07 TRACER WIRE

A. A No. 12 AWG (insulated) copper wire shall be installed over all force mains. Wire may be required on gravity sewers. Check with **HALLSDALE POWELL UTILITY DISTRICT** personnel before proceeding.

2.08 WYES, TEES, AND HOUSE CONNECTIONS

A. General: The General locations of wyes and house service pipes shall be as specified below, but the Contractor shall establish their exact locations, grades, and elevations.

1. Before laying each main sewer section, the Contractor shall examine the property on each side of the sewer section, run all necessary levels, and install each wye and each house service pipe 10 feet from the internal property line to serve the property involved, by gravity flow. In each case where it is found that property can not be served as described above, immediately notify the Engineer for decision before proceeding further with the work on the sewer section involved.

B. Wyes: Provide wyes at the following General locations in gravity flow service, unless otherwise approved:

1. For each house, and for each other building requiring a sewer connection, including those existing and those under construction.

2. For each vacant lot, on each side of the sewer, if authorized by the Engineer.

3. At each other location authorized.

C. House Service Pipe: House service pipe and fittings shall be of the same materials and with the same type joints as those of the main sewers. Lay house services with minimum uniform grade of one percent (1%), depth at property line as required to serve the property, but in no case less than 4'-6" deep at property line, and with 1'-6" minimum cover over top of pipe. In all cases where service pipe must cross a side ditch exposed, install cast iron pipe across ditch, extending at least 1'-0" into ditch banks on each side. Terminate each house service pipe at the property line with a plugged bell end. See **Sanitary Sewer Service Connection** drawing included in these specifications.

1. Unless otherwise authorized, install house service pipe only for existing houses and other existing buildings requiring sewer connections.

D. Indicate the location of each service pipe by an approved mark on the curb or a metal stake at the property line end of the service pipe, and maintain these marks or stakes clearly visible until final project acceptance. Before final acceptance, at Contractor's expense locate and mark or stake each service pipe which is not so indicated, including replacing all marks or stakes which have been obliterated or removed.

2.09 WYE AND HOUSE SERVICE PIPE RECORD

A. Keep an accurate record of the locations of all wyes, and the locations and lengths of all service pipes. Do not cover any wyes or service pipes until they have been recorded by both the Contractor and the Engineer. Upon project completion and before final payment will be made, submit an acceptable copy of the wye and service pipe record, showing the following:

1. Distance in feet from each wye to the centerline of the first manhole downstream from the wye, and the direction in which each branch inlet is turned.

2. Length in feet and routing of each service line.

3. Distance in feet from property line end of each service pipe to the centerline of the first manhole downstream from the service pipe, measured parallel to main sewer line.

2.10 CLEANING UP SEWER SYSTEM

A. Clean up the sewer system as the work progresses. Negligence in proper cleaning up which causes undue inconvenience to the public or private citizens, presents an unsightly or dangerous condition, or causes embarrassment to civic officials shall be sufficient reason for rejection of construction estimates until the unsatisfactory condition have been remedied.

B. After all work is complete, make a final cleanup of all areas where work has been done and leave them in broom clean condition.

2.11 PIPE ENCASED IN CONCRETE

A. All pipe indicated to be encased in concrete shall be as indicated.

B. Concrete encasement shall provide a minimum of six inches of concrete around the circumference of the pipe. (Concrete is specified hereinbefore.)

PART 3 - EXECUTION

3.01 PREPARATION

A. Establish line and grade for pipe and appurtenances. Verify location and elevation of existing manholes for collector sewer which are to be connected to new interceptors.

B. Examine trench foundation for stability. Do not install material until defects have been corrected.

C. Clean pipe and fittings of foreign matter and inspect for damage immediately prior to lowering into trench. Do not install damaged or defective pieces.

3.02 INSTALLATION

A. Install pipe in trench prepared as specified in Section 02221.

B. Excavation, backfill, and compaction for manholes shall meet applicable requirements of Section 02221.

C. Begin pipe installation at furthest point downstream and proceed upstream, with bell end of pipe facing direction of laying.

D. Make pipe joint in accordance with manufacturer's instructions.

E. Install pipe to the line and grade shown on the Drawings. Pipe shall form a sewer with a smooth, uniform invert.

F. Manhole sections shall be placed and aligned to provide vertical sides, with vertical alignment of steps. Completed manholes shall be watertight. Fill all lift holes. Interior of all manholes shall be coated with two (2) coats of a two component coal tar epoxy.

G. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

H. Foreign material shall be prevented from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.

I. Piping shall be laid to the lines and grades indicated on the drawings. Batter boards, laser beam equipment, or surveying instruments shall be used to maintain alignment and grade.

J. Batter boards, if used, shall be erected at intervals of not more than 25 feet. Batter boards shall be used to determine and check pipe sub-grades. Not less than three batter boards shall be maintained in proper position at all times when trench grading is in progress.

K. If laser beam equipment is used, reference points for both line and grade shall be set at each manhole and periodic elevation measurements shall be made with surveying instruments to verify accuracy of grades. If such measurements indicate thermal deflection of the laser beam due to differences between ground temperature and the air temperature within the pipe, precautions shall be taken to prevent or minimize further thermal deflections.

L. When dissimilar pipe materials or joints are joined, use compression couplings that are resistant to the corrosive action of soils and sewage and that will provide a permanent watertight joint. The compression couplings shall be of natural or synthetic rubber or rubber-like material and shall comply with the requirements and test methods specified in Table 2 of ASTM C425. The coupling shall meet the leak requirements specified in ASTM C425, and the bands for attaching the couplings to the dissimilar pipes shall be of stainless steel meeting ASTM A167 or A240. Each coupling shall bear the manufacturer's identifying mark and an indication of its size. Couplings shall be Fernco "Flexible Couplings" or Mission "Eastern Standard Band Seal Couplings".

M. Two inch wide, metallic foil sandwiched between two layers of plastic, blue color, or a No. 12 AWG copper wire shall be installed over all gravity sewer and force main lines.

N. Make connections between pipes and manholes in accordance with gasket manufacturer's instructions.

O. Adjust top of manhole covers to proper grade using cast iron adjusting rings. Cover shall be a finished grade of surrounding surface, or to the elevation shown on the Drawings. Manholes shall be placed at finished grade of final pavement and curb.

P. Complete manhole inverts in manner acceptable to the **HALLSDALE-POWELL UTILITY DISTRICT** as work proceeds upstream. Sewer lines shall be connected to the manhole at the locations shown on the Drawings. Cut-ins to the existing manholes where required shall be repaired neatly and left watertight. Fillet in the manhole shall be reworked as required to provide smooth flow.

Q. Concrete encasement shall be installed where indicated on the Drawings. Concrete and reinforcing steel shall be as specified in the concrete section. All pipe which is to be encased shall be suitable supported and blocked in proper position and shall be anchored against flotation.

3.03 FIELD QUALITY CONTROL

A. Prior acceptance of completed sewer lines, the lines shall be inspected and tested to ensure compliance with the following provisions. After the sewer lines have been brought to completion and prior to final inspection, the Contractor shall clean out the downstream segments by pushing through each individual line in the system, from manhole to manhole, appropriate tools for the removal from the lines of any and all debris and obstructions or may, if possible, flush clean with water or remove by hand. If necessary during the process of cleaning the system, water shall be turned into the system in such quantities to carry off the debris and trash. During the final inspection, the Engineer will inspect each individual line, from manhole to manhole, either by use of mirrors, visual inspection, or other means at his disposal, to determine whether the completed lines are true to line
and grade as laid out or as shown on the drawings. All lines or sections of lines that are found to be laid improperly with respect to line or grade, that are found to contain broken sections of pipe, are obstructed in such a manner that they cannot be satisfactorily corrected otherwise, or are deflected in excess of the allowable, shall be removed and replaced at the Contractor's expense.

B. An exfiltration test shall be conducted on each reach of sewer between manholes. The first line between manholes shall be tested before backfilling and before any sewer pipe is installed in the remainder of the work. Thereafter, exfiltration testing shall be done after backfilling, and individual or multiple reaches may be tested at the option of the Contractor.

C. Exfiltration tests shall be conducted by blocking off all manhole openings except those connecting with the reach being tested, filling the line, and measuring the water required to maintain a constant level in the manholes. Each manhole shall be subjected to at least one exfiltration test.

D. During the exfiltration test, the water depth above the pipe invert at the lower end shall be at least to the elevation of the ground surface, unless otherwise
specified. The maximum depth at the lower end shall not exceed 25 feet and the minimum depth at the upper end shall be at least 5 feet above the crown of the pipe or 5 feet above groundwater elevation, whichever is higher.

E. The total exfiltration shall not exceed 25 gallons per inch of nominal diameter per mile of pipe per day for each reach tested. For purposes of determining maximum allowable leakage, nominal diameter and depth of manholes shall be included. The exfiltration tests shall be maintained on each reach for at least 2 hours and as much longer as necessary, in the opinion of the Engineer, to locate all leaks.

F. The Contractor shall provide, at his own expense, all necessary piping between the reach to be tested and the source of water supply, and all labor, equipment, and materials required for the tests. The methods used and the time of conducting exfiltration tests shall be acceptable to the Engineer.

G. Low pressure air testing may be used in lieu of exfiltration testing for 24 inch diameter and smaller PVC sewer pipe. Air testing shall not be used for manholes or pipe larger than 24 inches in diameter.

H. Low pressure air testing shall comply with ASTM C828 for PVC pipe. The schedule of testing shall be submitted to the HALLSDALE-POWELL UTILITY DISTRICT prior to starting the tests. The time of conducting the tests shall be acceptable to the Engineer.

I. The requirements of this specification shall be considered satisfied if the time required in seconds for the pressure to be maintained at 5 psi is not less than that shown on the following table, or a minimum period of at least five minutes.

ALLOWABLE AIR LOSS VALUES PER 100 LF

Pipe Size	Time In Seconds
6"	42
8"	72
10"	90

J. If the length of sewer to be tested is submerged or partially submerged in groundwater, the test pressure shall be increased as required to overcome the actual static pressure exerted by the groundwater. If a test pressure greater than 8 psi results, air testing shall not be used, and exfiltration testing will be required.

K. Leaks shall be located by testing short sections of pipe. Leaks shall be repaired and the reach of sewer retested.

L. If, at any time prior to expiration of a one year warranty/guarantee period after acceptance of initial construction by the **HALLSDALE-POWELL UTILITY DISTRICT**, infiltration exceeds 25 gallons per inch of nominal diameter per mile of sewer per day, the Contractor shall locate the leaks and make repairs as necessary to

control the infiltration.

3.04 CLEAN-UP PROCEDURES AND REQUIREMENTS

A. The Contractor shall not, without the permission of the **HALLSDALE-POWELL UTILITY DISTRICT** remove from the line of work any earth until the excavation has been refilled and surfaced.

B. As soon as the backfilling of any excavation is completed and when in areas of existing development, the Contractor must at once begin the removal of all surplus dirt except that actually necessary to provide for the settlement of the filling unless otherwise provided in the special specifications. He shall also remove all the pipe and other material placed or left on the street by him except material needed for the replacement of paving, and the street shall be opened up and made passable for traffic. Following the above work, the repairing and complete restoration of the street surfaces, bridges, crossings, and all places affected by the work shall be done as promptly as possible.

C. All excavated material shall be cleared from adjacent street surfaces, gutters, sidewalks, parkways, railroads, grass plots, yards, etc., and the whole work shall be left in tidy and acceptable conditions. Contractor will be required to regrass lawns or neutral grounds where trenches are excavated in these locations or where Contractor has damaged lawns or neutral grounds by his operations.

D. The **HALLSDALE-POWELL UTILITY DISTRICT** shall be sole authority in determining the time in which rough and final clean-up shall be prosecuted. Rough clean-up shall consist of removal of rocks larger than 1 foot in any dimension, grading of excess backfill material over pipeline or removal of said material, opening of any drainage device, restoration of any street or roadway to a condition so that traffic may safely and conveniently use the street or roadway, restoration of pedestrian ways to a condition where the pedestrians may safely and conveniently use same. Rough clean-up shall, in general, be prosecuted no later than 1 day after pipe laying and backfilling or no farther behind pipe laying operations than 1000 feet; whichever time limit is shortest shall govern. Final clean-up consisting of pavement replacement, sidewalk replacement, removal of rocks, hand raking with seeding, strawing, etc., of lawns and neutral grounds, adjusting grade of ground over pipeline, property repairs, and other items, shall, in general, be prosecuted no later than 2 weeks after pipe has been laid and backfilled.

3.05 VACUUM TESTING OF MANHOLES

A. The same method is applicable to all manholes.

B. All lifting holes and exterior joints shall be filled and pointed with non-shrink grout for concrete manholes or sealed with compatible sealant for other materials. The exterior of the manhole must be painted as the vacuum is being applied to seal the pores of the concrete.

C. Manholes are to be tested immediately after assembly or construction and before backfilling. No standing water shall be allowed in the manhole excavation which may affect the accuracy of the test.

D. All pipes and other openings into the manhole shall be suitably plugged in such a manner as to prevent displacement of the plugs while the vacuum is pulled.

E. Installation and operation of the vacuum equipment and indicating devices shall be in accordance with equipment specifications and instructions provided by the manufacturer.

F. The test head may be placed in the cone section of the manhole.

G. A vacuum of 10.0 inches of mercury shall be drawn. The time for the vacuum to drop to 9.0 inches of mercury shall be recorded.

H. Acceptance for 4 foot diameter manholes shall be defined as when the time to drop to 9 inches of mercury meets or exceeds the following:

MANHOLE DEPTH	DIAMETER	TIME TO DROP 1" HG
4' TO 10'	4'	75 Seconds
10' to 15'	4'	90 Seconds
15' to 25'	4'	105 Seconds

I. For manholes 5 feet in diameter, add an additional 15 seconds and for manholes 6 feet in diameter, add an additional 30 seconds to the time requirements for four foot diameter manholes.

J. If the manhole fails to test, necessary repairs shall be made and the vacuum test repeated until the manhole passes the test.

K. If the manhole joint mastic or gasket is displaced during the vacuum test, the manhole shall be disassembled and the seal replaced.

3.06 DEFLECTION TESTING

A. Deflection testing of all flexible pipe shall be required. The test shall be conducted after the backfill has been in place at least 24 hours.

B. No pipe shall exceed a deflection of 5%.

C. The test shall be run with a rigid ball or an engineer-approved 9-arm mandrel having a diameter equal to 95% of the inside diameter of the pipe. The test must be performed by manually pulling the test device through the line.

END OF SECTION