SECTION 02561
GRAVITY SANITARY SEWER AND HOUSE CONNECTIONS

1.0 GENERAL

A. Description

Sanitary sewer installation shall include, but not necessarily be limited to furnishing all labor, materials, and services necessary to install pipe, fittings, miscellaneous structures of concrete or brick masonry, and appurtenances for gravity sewer and house connections, of the size and type shown, in accordance with the Contract Documents.

B. Related Work Specified Elsewhere

1. Trench Excavation, Backfill and Compaction: Section 02250
2. Sanitary Sewer Manholes: Section 02562
3. Precast Concrete Utility Structures: Section 03400
4. Mortar: Section 04100
5. Brick Masonry: Section 04200
6. Miscellaneous Metals: Section 05500

C. Quality Assurance

The Commission will inspect all materials before, during and after installation to ensure compliance with the Contract Documents.

2.0 MATERIALS

A. General

1. Materials shall be furnished in accordance with the Contract Documents.
2. To minimize the number of joints, only standard manufacturer's length of pipe shall be furnished and installed for all sanitary sewer mains and house connections unless otherwise indicated on the Plans, or as approved by the Commission.

B. Pipe Symbols

For convenience and standardization, the various types of pipe are designated on the plans by the following symbols:

DIP - Ductile iron pipe

PVC - Polyvinyl chloride pipe

RCSP - Reinforced concrete sewer pipe

C. Materials Furnished by the Commission

1. The Commission will not furnish any materials for gravity sanitary sewer and house connections.

2. Unless otherwise noted in the “Special Provisions,” the Contractor shall pay for all potable water used for testing. The Contractor shall contact the Commission to coordinate its use.

D. Contractor’s Options

1. The Contractor may furnish polyvinyl chloride (PVC), or ductile iron pipe (DIP) for sewers equal to or smaller than 24-inch diameter unless specified otherwise in writing by the Commission.

2. The Contractor may furnish reinforced concrete sewer pipe (RCSP), or ductile iron pipe (DIP) for sewers greater than 24-inch diameter unless specified otherwise in writing by the Commission.

3. The Contractor may furnish precast, cast-in-place, or masonry construction for miscellaneous sanitary sewer structures unless specified otherwise in writing by the Commission.

E. Detailed Material Requirements

1. Polyvinyl Chloride Sewer Pipe (PVC) and Fittings

a. Polyvinyl chloride (PVC) pipe and fittings 6-inch through 15-inch in diameter shall comply with ASTM D 3034 and F1336 and have a minimum wall thickness of SDR 35. Pipe and fittings 18-inch through 24-inch diameter shall meet the material requirements of ASTM F679 and F1336 and have a minimum wall thickness of T-1. All PVC compounds for all sizes shall comply with ASTM D 1784 and have a minimum cell classification of 12454B.

b. All pipe and fittings shall be manufactured with a locked-in gasket.

c. The PVC wye and fitting supporting the house service riser shall be as per the Standard Details.

2. Ductile Iron Pipe (DIP) and Fittings and Cast Iron Fittings

a. Ductile iron pipe (DIP) and fittings shall conform to ANSI/AWWA C150/A21.50 in matters of design and ANSI/AWWA C151/A21.51 for materials. Pipe thickness shall conform to the Special Thickness Class 52 minimum. Pipe class shall be as shown on the Plans.

b. Ductile iron pipe, ductile iron fittings and cast iron fittings shall be ceramic epoxy-lined. The outside surfaces shall be bituminous coated.

3. Reinforced Concrete Sewer Pipe (RCSP) and Fittings

Circular reinforced concrete pipe and fittings shall meet the material requirements of ASTM C 76 as modified herein. Bedding shall be Class “D” bedding as defined by the American Concrete Pipe Association. Maximum trench widths shall be as indicated in the Standard Details. The pipe class, when

designated on the Plans, is in accordance with ASTM C 76 and indicates the external load crushing strength.

a. Portland cement shall be Type II in accordance with ASTM C 150.

b. Coarse aggregate for concrete shall consist of hard, durable particles of crushed limestone which shall conform to the requirements and tests specified in ASTM C 76.

c. No elliptical reinforcement will be permitted.

d. Longitudinal reinforcing steel shall extend to within 3/4 inch of the terminal faces of the pipe, whether barrel, bell or spigot. Longitudinal bars shall be bent or crimped to provide full cover at the bell.

e. Minimum concrete cover over all reinforcement shall be 3/4 inch, except where the groove intrudes into the spigot.

f. The circumferential steel shall terminate in at least one full circular ring of the same size as is in the barrel of the pipe at both ends of pipe; i.e. in both bell and spigot. This hoop shall be no more than 1 inch from the terminal face of the pipe unit. Spacing of circumferential steel in bell and spigot ends shall not be more than 1 inch.

g. Pipe shall have bell and spigot ends with rubber gasket joints meeting material requirements of ASTM C 361. Joints may be either steel and rubber or concrete and rubber. For pipe 24-inch and larger with steel and rubber joints, the outside of the joint shall be protected by use of a diaper filled with cement grout or other protective methods approved by the Engineer and the inside of the joint filled with mortar or other approved material.

h. Rubber gaskets, whether used in conjunction with steel joint rings or concrete ends, shall be the sole element depended upon to make the joint watertight under all conditions, including movement due to expansion, contraction, and normal settlement. Joints shall be made according to the manufacturer's recommendations.

i. Concrete Y-branches or tee fittings and bends shall be fabricated and assembled in the manufacturing plant. The fabrication of Y-branches or tees and bends shall be to the angle and radius shown and the interior shall permit the smooth and even flow of liquid.

j. Pipe and fittings shall be furnished with an exterior coating(s) of a flexible two part coal tar epoxy waterproofing coating having a finished thickness of at least 26 mils and suitable for field repair if damaged. Coating shall be applied in accordance with the manufacturer's recommendations.

k. Concrete pipe manufactured by a dry cast process is not acceptable.

4. Pipeline Plugs for Testing

Pipeline plugs shall be rubber gasketed or ribbed, watertight and airtight to the extent required by air testing requirements of this Section, not able to be dislodged by testing pressure (internal or external), and of an approved design.

5. Detector Tape

   Detector Tape shall be 3 inches wide (minimum) nonmetallic green plastic tape lettered “sewer” in black graphics.

3.0 EXECUTION

A. Preparation

1. Trench excavation, backfill, and compaction, and pipe bedding and haunching shall be as specified in Section 02250.

2. Prior to start of utility installation, all rights-of-way shall be graded to within ±0.2 feet of the proposed subgrade in paved areas and finished grade in unpaved areas.

3. Trench Water: The pipeline trench excavation shall be dewatered sufficiently to allow pipe joints to be made under dry conditions. No joint shall be made under water. In the event significant groundwater is encountered during construction, the Chief Engineer may require the Contractor to prepare a corrective plan of action for review and approval by the Commission.

4. Laying Pipe in Freezing Weather: No pipe shall be laid upon a foundation into which frost has penetrated, or at any time when there is danger of ice formation or frost penetration at the bottom of the excavation. In freezing weather, open trench length shall be kept to a minimum and the excavation promptly backfilled after the pipe had been installed.

5. Pipe Bedding: Each pipe shall be bedded on a solid foundation acceptable to the Commission and in accordance with the Standard Details. Bedding shall be installed to ensure that joints are properly made and the pipe is firmly supported the full length of the barrel. All sewer mains and services shall be installed with a minimum of six inches of aggregate bedding below the pipe invert, meeting the gradation requirements of AASHTO M43, size number 57. Aggregate bedding shall be installed to grade prior to laying pipe sections.

B. Pipe Installation

1. All pipe shall be installed in accordance with the approved manufacturer’s written instructions, Commission Standards, and as specified herein. These recommendations, if more restrictive than that shown in the Standard Details shall include maximum trench width, bedding requirements, backfill material, and compaction, where applicable. In addition, the following shall apply unless otherwise noted:

   a. Polyvinyl chloride sewer pipe (PVC) shall be installed in accordance with the Standard Details and the recommendations of Uni-Bell.

   b. Reinforced concrete sewer pipe (RCSP) shall be installed in accordance with the manufacturer’s recommendations and the recommendations of the Concrete Pipe Association.

   c. Ductile iron pipe (DIP) and cast iron soil pipe shall be installed in accordance with the manufacturer’s recommendations and the recommendations of the Ductile Iron Pipe Research Association.

2. Equipment for Handling Pipe: Proper and suitable tools and appliances as approved for safe and convenient handling and joining of pipes shall be used.

3. Pipe Installation: Pipe shall be carefully handled and lowered into the trench. Pipe shall be installed with special care to ensure that each joint is watertight, has met the required manufacturer's insertion depth, and has no shoulder or unevenness of any kind along the inside of the pipeline. No wedging or blocking will be permitted in installing any pipe unless directed by written order or permission in writing is obtained from the Commission.

4. Pipe Setting and Protection: No pipe shall be brought into position until the preceding length has been thoroughly bedded and secured in place. Care shall be used to assure water tightness and prevent damage to, or disturbing of, the joints during the refilling process. After pipes have been installed and joints have been made, there shall be no walking on or working over the pipe, except as may be necessary in tamping the backfill material, until the backfill is at least 2 feet over the top of the pipe.
8/9/10 For gravity sewer, place a minimum of 1 foot of gravel over the top of the pipe prior to placement of suitable compactable backfill to maintain laser alignment integrity during construction.

5. Cleaning Pipe: The pipes shall be thoroughly cleaned before being installed and shall be kept clean until acceptance of the completed work. Open ends of all pipelines shall be provided with a stopper carefully fitted to keep dirt and other substances from
8/9/10 entering. To protect downstream systems that are in service, the contractor shall plug unused section of pipe at a downstream manhole. The manhole shall be plugged at incoming lines. This stopper shall remain in place at all times when installation is not in progress.

6. Cutting Pipe: Whenever a pipe requires cutting, to fit into the line or bring it to the required location, the work shall be performed by an approved method that leaves a smooth, square end. Cut PVC pipe ends shall have burrs removed and the end beveled to match factory bevel. Field spigots shall be stop-marked with a felt tip marker or wax crayon for the proper length of assembly insertion.

8/9/10 7. Alignment of Pipe: A laser beam shall be used to align the pipe to the proper grade. The Contractor is responsible to monitor the line and grade in each pipe run between structures at pipe station 0+50, and at each 100-foot interval thereafter as a minimum quality control, or as directed by the Commission. It is the Contractor's responsibility to maintain proper calibration of the equipment throughout the duration of the project.

8. Jointing Pipe

a. General

Before any joints are made in the trench, the Contractor shall demonstrate to the Commission by making a sample joint that methods he will employ to conform to the Specifications, will secure a watertight joint, and that the workmen whom he intends to use for this work are familiar with the requirements for making proper joints.

b. Push-On Gasketed Joints

Prior to making gasketed joints, both mating pipe ends and the gasket shall be cleaned of all foreign material. The gasket shall then be inserted in or stretched over the cleaned gasket seat and lubricant applied as recommended by the manufacturer and approved by the Commission. The pipe ends shall be carefully aligned and pushed together to meet the required manufacturer's insertion depth. There shall be no shoulder or

unevenness of any kind along the inside of the pipeline. The method of inserting the spigot into the bell shall be as recommended by the manufacturer and approved by the Commission.

c. Other methods of jointing pipe will be given consideration by the Commission, provided the Contractor furnishes evidence that the proposed method is equal to or better than the specified methods, and further, provided that the proposed method has been successfully used and that the joint has previously been manufactured by the company from whom the Contractor proposes to purchase pipe.

d. All jointing and workmanship shall be in accordance with the manufacturer's recommendations as approved by the Commission.

9. Detector Tape: Install visual detection tape 12 inches below the surface at final grade on all mains.

10. Connections to existing work shall be made by the Contractor in the presence of the Commission at such a time and in such manner as directed and approved by the Commission. Shut-off operations will not be allowed. The Contractor shall complete the connections with the greatest possible speed and all work will proceed without interruption until the connection operation is complete.

C. Sanitary House Connections

1. Sanitary house connection branch fittings shall be located where designated by the Contract Documents and/or the Commission. Short pieces of sewer pipe shall be field-cut to meet this condition as approved. The Contractor shall have available at the construction site factory approved equipment to machine and adapt the field-cut end to standard couplings and jointing materials.

2. Sanitary Sewer Taps: Connections to active gravity sewer mains shall be made using a "Sewer-Tap" or a similar mechanical device in accordance with the manufacturer's recommendations. The appropriate saddle shall then be placed over the tapped hole in accordance with the Standard Details. Under no circumstances will concrete collar joints be permitted. Saddles shall not be used during construction of new sewer systems.

3. Backfill for the support of Y-branches and bends shall be placed as shown in the Standard Details, or as directed.

D. Field Tests

1. General

a. All portions of the sewers and appurtenances shall be tested. The Commission shall have the final decision as to the method or methods
8/9/10 used, i.e. water infiltration, water exfiltration, air, closed circuit video inspection, or combination of these.

b. After installation, sanitary sewers and sanitary house connections will be inspected by the Commission with the assistance of the Contractor for compliance with these specifications. Inspections and tests will not be conducted until the section of pipeline being inspected and tested has been backfilled, dewatering pumps have been removed from the area, and the ground water has stabilized.

c. The Contractor shall schedule all tests with the Commission at least 48 hours in advance of the test, and shall conduct all tests in the presence of the Commission. On Commission Capital Projects, the Commission will witness one test at no cost the Contractor. Should the pipeline fail the first Commission witnessed test, the Contractor shall reimburse the Commission for all costs resulting from such additional tests so required until the pipeline passes the test(s). The Contractor shall also reimburse the Commission for the cost of inspection if the Contractor is not prepared for any test, or for additional tests required.

d. The pipeline shall not contain any debris, silt, earth, gravel, rock, or other foreign material. If deemed necessary by the Commission, the pipeline shall be flushed with water. It shall be done in a manner that prevents debris or water from entering the existing sewer and before the Commission witnessed test.

e. Control and/or treatment of the discharge of chlorinated water used for flushing, cleaning, or testing operations shall comply with all current applicable local, state, and federal regulations. Costs associated with the control or treatment procedures shall be the Contractor's responsibility.

f. Any defective work which shows up while conducting tests shall be replaced or repaired as approved by the Commission by the Contractor at his expense.

2. Materials

a. When specific test of materials are called for in the referenced standards and specifications, the Commission has the option of requiring that any or all of these tests be performed.

b. Polyvinyl chloride (PVC) pipe and couplings shall be homogeneous throughout and free from visible cracks, bubbles, blisters, holes, foreign inclusions, cuts or scrapes on inside or outside surfaces or other imperfections which may impair the performance or life of the pipe. Each pipe shall be straight-to-within 1-1/4 inch per 20-foot length of pipe when uniformly supported along its entire length, and shall have a true circular cross-section to within ±1/64 inch.

c. Reinforced concrete sewer pipe and fittings shall be free from fractures or cracks that extend through the wall of the pipe or fitting, surface defects indicating honeycombed or open texture, damaged or cracked ends where such damage would prevent making a satisfactory joint, or any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more.

d. Ductile iron pipe (DIP), and ductile iron fittings shall be sound and without defects that might impair its service.

3. Visual Inspection

a. All equipment necessary for the inspection will be furnished by the Contractor. The Contractor shall provide assistance as may be required to enable the Commission to perform the inspection.

b. The Commission will inspect all sanitary sewers for alignment, grade, leakage, and condition. The inspection may be conducted by crawling or walking through the pipeline, using mirrors to reflect light through the pipeline, or closed circuit television equipment.

1) If a mirror test is used, the pipe alignment will be acceptable if it is sufficiently true and straight to allow passage of the reflected light with an image of a “full moon.”

2) The pipeline shall be installed on a continuous grade so it does not pond or trap water anywhere along the line.

3) No visible infiltration will be allowed. Any water leakage into the system sufficient to constitute any noticeable trickle or dribble shall be corrected.

4. Acceptance Testing

a. General

1) The Contractor shall furnish all labor, tools, materials, and equipment necessary to perform the specified tests. Testing shall be conducted only after the section of sewer has passed the visual inspection.

2) Generally sewers will be tested from manhole to manhole or from manhole to terminus of the pipeline if there is no manhole at the other extremity. Sewers shall only be tested after the brick channel and bench have been installed. Testing shall be by low pressure air and/or infiltration/exfiltration as specified herein and/or as determined by the Commission.

3) If the sanitary sewer or sanitary house connection fails any test specified herein, the Contractor shall, at his own expense, repair or replace any defective component and retest the failed section or component until all requirements are met. Defective material shall be replaced.

4) All equipment used for testing shall be approved by the Commission.

b. Low Pressure Air Test

Low pressure air testing shall not be completed until sewer main lines are backfilled and compacted to final grade; manholes, frames and covers are in place to final grade with backfill in place and compacted; channels and benches are complete and to the satisfaction of the Commission; and sewer service connections are complete and to the satisfaction of the Commission. Failure to comply with these provisions shall be cause for the Commission to require rescheduling of the tests at the Contractor’s expense. Sanitary sewers 27-inch diameter and smaller and attached sanitary house connections shall be tested with low pressure air in accordance with the following procedures:

1) Test plugs shall be supplied and installed by the Contractor within the pipeline at each manhole. Each plug shall be securely braced.

2) If the pipeline to be tested is expected to be below the ground water table, the Commission may visually inspect the trench prior to backfilling to determine the elevation of the groundwater table. All gauge pressures for the test shall be increased by an amount to provide 4 psig above the back pressure due to ground water submergence over the end of the probe to a maximum of 6 psi in the pipe system to be tested.

3) If the air pressure required for the test is greater than 6 psig, the pipeline shall not be air tested, but shall be tested for infiltration in accordance with method indicated in Paragraph C, which follows.

4) The Contractor shall add air slowly to the portion of the pipeline under test until the internal pressure is raised to 4.0 psig greater than the average back pressure of any groundwater above the pipe's invert.

5) The Contractor shall not allow personnel in manholes after the air pressure is increased in the sewer. If the test plug is suspected of leaking, the Contractor shall first relieve the pressure before any adjustments are made to eliminate air leakage at the plug. The Contractor may precoat the plug with a soap solution to check for leakage.

6) The Contractor shall allow the air temperature to stabilize for at least 2 minutes by adding only the amount of air required to maintain 4.0 psig above groundwater back pressure. After this 2 minute period, the Contractor shall completely disconnect the hose and compressor from the section being tested to assure no additional air is added to the pipeline.

7) The time required for the pressure to drop 1 psig will be observed and recorded. Pipelines which fail to maintain the stipulated pressure for a period equal to or greater than the holding time shown in the table at the end of this Section shall be deemed to have failed the low pressure air test and will not be accepted by the Commission.

8) The portion of the line being tested will be acceptable if the time required in minutes for the pressure to decrease from 4.0 to 3.0 psig above groundwater back pressure shall not be less than the time shown for the given diameters in the following table:

Pipe Diameter in Inches	**Minutes**
6	5.0
8	5.0
10	5.0
12	5.0
15	5.0
18	10.0

21	10.0
24	10.0

9) Air testing may be required for pipe diameters greater than 24 inch when specified by the Engineer and approved by the Commission.

c. Infiltration/Exfiltration Tests

1) Sanitary sewers 24-inch in diameter and larger and sewers in which air testing is not specified or required shall be subjected to either infiltration or exfiltration tests as determined by the Commission. Testing may be conducted from manhole to manhole, or between more than two manholes, however, the length to be tested shall not exceed 700 feet. Minimum test duration shall be 24 hours unless otherwise directed by the Commission. Testing shall be conducted in accordance with ASTM C 969 as modified herein.

a) Infiltration test shall be made by measuring the amount of water infiltrating into the pipeline section at the lower end of the section being tested by means of a weir installed in the pipe or by other measurement method approved by the Commission.

b) Exfiltration test shall be made by plugging the lower manhole, filling the pipeline section with water to a level of at least 2 feet above the crown of the pipe at the upstream end of the section being tested or 2 feet above groundwater level whichever is greater and measuring the water level drop in the manhole at the end of the specified test period. Pipelines shall be filled with water for at least 24 hours immediately before the test.

c) Test Criteria

The maximum leakage allowance in the completed sewer lines shall not be greater than 25 gallons per inch diameter per mile per twenty-four hours. Note that this is a rate and does not in any way prescribe or infer the length of the line to be included in each test section.

d. Deflection Testing

In addition to other tests detailed in this Section, PVC sanitary sewers may be tested for deflection (reduction in vertical inside diameter). Testing shall be performed by passing a 5% undersized GO/NO-GO mandrel or sewer ball through the pipeline or measuring deflection continuously by using a deflectometer. Maximum allowable deflection shall be 5%.

e. Manhole Testing

Manhole leak tests shall be made using a partial air vacuum as the testing method. Place airtight plugs in those pipes entering and leaving the structure, (plugs must be braced against expulsion) after which the

manhole top is sealed. Draw a vacuum to 10" of Hg. Close the outlet port valve and start the test for the period of time in the following table.

Vacuum Test Table

Manhole Diameter	Test Period
48"	60 Seconds
60"	75 Seconds
72"	90 Seconds

If the drop in vacuum is more than 1.0" of Hg., the manhole shall be repaired and retested. Any vacuum drop of less than 1.0" of Hg. is satisfactory and the manhole will be accepted.

4.0 METHOD OF MEASUREMENT

A. Sanitary Sewers

Measurement for furnishing and installing sanitary sewers will be made horizontally along the center line of the pipe for each size and type of pipe without deduction for wye or drop connections. The inside lengths of manholes and junction chambers will be deducted.

B. Sanitary House Connections

Measurements for furnishing and installing sanitary house connections will be made horizontally along the center line of pipe for each size and type of pipe from the center line of the sewer to the end of the house connection without deduction for wyes, bends, cleanouts, plugs, or other fittings.

5.0 BASIS OF PAYMENT

A. General

1. Payment will be made at the unit and/or lump sum prices bid. The prices bid shall include furnishing all labor, tools, equipment, and materials necessary to complete the work as shown and specified, in strict accordance with the Contract Documents.

2. The price(s) bid for furnishing and installing sanitary sewers and sanitary house connections shall include trench excavation, backfill, compaction, and incidental items as specified in Section 02250.

3. Payment will be made for contingent items when approved by the Commission.

B. Sanitary Sewers

Payment for furnishing and installing sanitary sewers, complete and in place, will be made per linear foot of the size and type of pipe installed. The price(s) bid shall include traffic control, furnishing and installing of all pipe, fittings, plugs, stoppers, and jointing materials; connection to existing pipelines, structures, or manholes; testing; providing an approved spoil site, and disposing of all spoil or excess materials, aggregate bedding, and backfill; all environmental and erosion or sediment control; restoration of all disturbed areas; and incidental items to complete the sanitary sewers.

C. Sanitary House Connections

Payment for furnishing and installing sanitary house connections complete and in place will be made per linear foot of the size and type of pipe installed. The price(s) bid shall include traffic control, furnishing and installing all pipe, fittings, vertical riser, cleanout, cap, plugs, precast concrete blocks where required, jointing materials; connection to sewer branch fittings; testing; providing an approved spoil site, and disposing of all spoil or excess materials; aggregate bedding, and backfill; all environmental and erosion or sediment control work including off-site requirements at spoil storage or borrow sites; restoration of all disturbed areas; and incidental items to complete the sanitary house connection.

****END OF SECTION 02561****