

SECTION 33 31 00 - GRAVITY SEWER

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:

1. GRAVITY SEWER.

B. Related Sections:

1. Section 31 23 16.13 - Excavation, Trenching, and Backfilling for Utilities.
2. Section 33 05 23.16 – Utility Pipe Jacking.
3. Section 33 39 13 - Manholes.
4. Section 33 32 00 - Sanitary Sewer Lateral Connections.

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:

1. Basis of Measurement: By linear foot measured from center to center of manholes and depth of cut from invert to original ground at centerline
2. Basis of Payment: Includes excavation, bedding, backfilling, testing, cleanup, video inspection and pipe to indicated depth and connection to sewer system.

1.3 REFERENCE STANDARDS

- A. All products, installation and testing of force mains and GRAVITY SEWER shall meet the requirements of Regulation 61-67, Standards for Wastewater Facility Construction or State Primary Drinking Water Regulations (R61-58).
- B. All products, installation and testing of force mains and GRAVITY SEWER shall meet the requirements of "Recommended Standards for Wastewater Facilities" (Ten State Standards), latest edition.
- C. Any reference to SCDOT standard specifications was obtained from "Standard Specifications for Highway Construction" published by the South Carolina Department of Transportation. Unless otherwise noted, the most current date published applies.
- D. American Water Works Association:
1. AWWA C104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings
 2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 3. AWWA C110 – Ductile-Iron and Gray-Iron Fittings
 4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
 6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.

7. AWWA C153 – Ductile-Iron Compact Fittings
8. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
9. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in through 60”
10. AWWA M41 – Manual of Water Supply Practices.
11. Additional applicable AWWA standards which are not specifically stated.

E. American Society for Testing Materials:

1. ASTM A536 - Standard Specification for Ductile Iron Castings.
2. ASTM A746 – Ductile Iron Gravity Sewer Pipe
3. ASTM C828 – Standard Test Method for Low-Pressure Air.
4. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
5. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
6. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
7. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
8. ASTM F1417 - Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air.
9. Additional applicable ASTM standards which are not specifically stated.

F. National Sanitation Foundation:

1. NSF 61 – Drinking Water System Components – Health Effects.

1.4 SUBMITTALS

- A. Product Data: Upon receiving Owner’s Notice To Proceed, Submit manufacturer information indicating proposed materials, accessories, details, and construction information, including storage requirements.
- B. Provide Shop Drawings for all products in this section.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions:
 1. Indicate special procedures required to install specified products.
 2. Submit detailed description of procedures for connecting new sewer mains to existing system.
- E. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Submit qualifications for manufacturer and installer.

1.5 COORDINATION

- A. Coordinate Work of this Section with utility owners and local authorities.
- B. Notify affected utilities at least 72 hours prior to construction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Stored Materials:
 - 1. Store materials according to manufacturer instructions.
 - 2. Store materials to the best of ability to prevent damage, theft, or vandalism.
 - 3. For materials in a storage facility, the products must be classified and marked in accordance with the NFPA 704, NFPA 49, and NFPA 325M.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Block individual and stockpiled pipe lengths to prevent moving.
 - 3. Provide additional protection according to manufacturer instructions.

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with a minimum five years of experience.
- B. Installer: Company specializing in performing Work of this Section shall have appropriate licensure through South Carolina LLR.

1.8 CLOSEOUT DOCUMENTS

- A. RECORD DRAWINGS - Provide the following information on all record drawings:
 - 1. Project Name and Address
 - 2. Subdivision Name, Lot, Block, Section, Tax Map Number, Phase and Total Number of Lots. (If applicable)
 - 3. Scale: Prefer 1" = 50', No Less than 1" = 100'.
 - 4. North Arrow and Location Map.
 - 5. Developer's Name, Address and Telephone Number.
 - 6. Street Names.
 - 7. Title Block with Engineers Name, Address, Telephone Number, and Date of Record Drawings. (Show revision dates).
 - 8. Signature, Seal and Certification of SC Design Engineer.

9. Locate all pipe and utility system crossings (electric, cable, telephone, gas, etc.). Include vertical and horizontal separation distances, depth of cover, and pipe materials.
10. All bends, valves, manholes, etc. shall have two (2) pulled tape measured distances from permanent structures or points (fire hydrants, property corners, buildings, poles, etc.)
11. Remove any temporary features (erosion control, etc.) and the language consisting of the words new/proposed from any labels on Drawings.
12. Provide total lump sum cost for Work (include engineering, surveying, legal and contract cost as a lump sum).
13. All sheets shall be numbered consecutively in one set.
14. Easements to be dedicated to the Joint Municipal Water and Sewer Commission shall be clearly labeled on the Record Drawings.
15. The drawings shall be clearly labeled as Record Drawings with the date of the last revision.

B. Gravity Sewer:

1. Provide manhole rim and inverts (in and out, as applicable) elevations, and actual line grades. Show size, length (center to center), and material of pipe used. Lines with grades less than the minimum for any particular pipe size, based on Ten State Standards, will not be accepted. Manholes shall be tied down to building corners (not private residential structures), fire hydrants, property corners, or other suitable permanent locations.
2. Manholes shall be stationed from the downstream manhole going upstream, with all manholes reverting to 0+00 for the next line segment. Station all service laterals from downstream manhole, show distance in feet from the main line to the end of the service, and locate services from property corners.
3. Provide a chart on the drawing giving total number of manholes, linear feet of sewer pipe, size and material, number of service laterals. Also, include the name, address, and telephone number of the Contractor who installed the system, and the date of installation.
4. All inverts shall be tied to NAVD 88 datum.
5. Refer to specification section 33 39 13 MANHOLES for full manhole specification requirements.

C. Submittal Procedure:

1. Submit two (2) copies of the Preliminary Record Drawings, Deeds (recorded), Affidavits, and required inspection documentation to the Commission a minimum of 5 working days prior to the Commission's final inspection. The Commission will field verify the record drawings. If incorrect they will be returned to the Engineer. This step will be repeated until the record drawings are approved by the Commission.
2. Submit the following items 5 working days prior to the SC DES final inspection:
 - a. Three (3) Sealed Bond Copies (Five (5) if also used as Easement Map).
 - b. Three (3) Printed Copies including all information required herein and an electronic copy containing the record drawing files in PDF and AutoCAD formats.
 - c. Three (3) Copies of Easement Map (if Easement Map is not combined with Record Drawings).

1.9 WARRANTY

- A. Provide a two-year materials and workmanship warranty. The contractor shall be responsible for correcting defects in the Work during the warranty period, including defective material and workmanship.

- B. Provide any required documentation or certifications for items with a manufacturer's warranty.

1.10 EXISTING CONDITIONS

- A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

- B. Protection of other utilities:

1. Approximate location of certain known underground lines are shown.
2. Existing small lines not shown.
3. Locate small and other possible utility lines using electronic pipe finder, or other approved method.
4. Excavate and expose existing underground utilities ahead of trenching operations.
5. Repair or replace any damaged utility line or structure at no additional cost to Owner.

1.11 JOB CONDITIONS

- A. Work under this Section may require construction or work in a confined space, defined as any space having one or more of the following characteristics:

1. Limited openings for entry and exit.
2. Unfavorable natural ventilation.
3. Not designed for continuous worker occupancy.

- B. The Contractor shall have on the job site at all times the following minimum safety equipment:

1. Gas monitor capable of testing and detecting for combustible gas, oxygen deficiency and hydrogen sulfide.
2. Confined space access and retrieval winch system.
3. Ventilating fan with large diameter ventilating hose.
4. Supplied air respirator, MISHA/NIOSH approved type.
5. Safety harness and lifelines.

This equipment to be available for use by the Contractor, Engineer and Owner for the duration of the project.

- C. All entries into or work within confined spaces to be conducted in accordance with the U.S. Department of Health and Human Services/National Institute for Occupational Safety and Health [DHHS (NIOSH)] Publication No. 87-113, A Guide to Safety in Confined Spaces.

- D. It is the responsibility of the Contractor to maintain all necessary safety procedures in accordance with all local, state, and federal regulations.

1.12 GENERAL REQUIREMENTS

- A. All sewer lines shall have a minimum of three (3) feet of cover or as indicated on the Drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe shall be subject to observation prior to installation for culling or rejecting pipe, independent of laboratory tests, not conforming to this Section.
- B. Rejected pipe will be marked and shall be promptly removed from the project site at no additional cost to the owner.
- C. Fittings (horizontal bends) may not be used in lieu of manholes at horizontal orientation changes in the gravity sewer. Manholes shall be installed at location as indicated on plans.

2.2 PIPE AND FITTINGS

- A. Use pipe material specified herein as indicated on the Contract Drawings.
- B. Ductile-iron pipe and fittings (DIP):
 - 1. Ductile iron pipe (DIP):
 - a. All ductile iron pipe shall be domestically manufactured in the United States. Pipe shall be cast, cleaned, lined, coated, fabricated, tested, and certified at a United States of America manufacturing facility.
 - b. Pipe shall be in accordance with ANSI/AWWA C150/21.50 and conform to the requirements of ANSI/AWWA C151/21.51, latest revision. The raw material for ductile iron shall have an average minimum content of 90% recycled iron and steel.
 - c. The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "Ductile" shall be cast or stamped on the pipe.
 - d. Wall thickness in accordance with ANSI/AWWA C150/A21.50 for depth of cover indicated.
 - e. Push-on and restrained joint pipe shall have a minimum rated pressure class of 150 PSI.
 - f. All buried pipe shall have a minimum of 2 to 1 safety factor and shall be pressure class as follows:
 - 1) 4" – 12" Pressure Class 350
 - 2) 14" – 20" Pressure Class 250
 - 3) 24" Pressure Class 200
 - 4) 30" – 64" Pressure Class 150
 - g. Push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI A21.51/AWWA C151 such as Fastite, Tyton, or Bell-tite, or approved equal.
 - h. Use rubber gaskets and lubricant complying with ANSI/AWWA C111/A21.11 Unless otherwise specified gasket material shall be standard styrene butadiene copolymer (SBR.)
 - i. Ductile iron pipe and fittings should be delivered to the application facility free of other linings and containing a compatible the manufacturers recommendations.

- j. Interior Linings shall meet the following:
- 1) Lining Materials
 - a) Material must have a permeability rating of 0.0 when tested according to Method A of ASTM E-96-66, Procedure A with a test duration of 30 Days.
 - b) Material shall be amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Provide Protecto 401 or approved equal. Any substitution submission shall be accompanied by a successful history of lining pipe and fittings for service as well as a test report verifying the properties and a certification of the test results.
 - 2) Lined DIP Tests: The following test must be run on coupons from factory lined ductile iron pipe.
 - a) ASTM B-117: Salt Spray (scribed panel) – Results equal to 0.0 undercutting after 2 years.
 - b) ASTM G-95: Cathodic Disbondment – 1.5 volts @ 77 degrees F. Results to equal no more than 0.5 mm undercutting after 30 days.
 - c) ASTM D-714-87: Immersion Testing – 20% Sulfuric Acid with no effect after 2 years, 140 degrees F 25% sodium hydroxide with no effect after 2 years, 160 degrees F distilled water with no effect after 2 years, 120 degrees F tap water with no effect after 2 years.
 - d) Abrasion resistance of no more than 3 mils (0.075 mm) loss after one million cycles using European Standard EN 598: 1994 Section 7.8 Abrasion Resistance.
 - 3) Application:
 - a) The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
 - b) Surface Prep: Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas with oil, grease, or any substance which can be removed by solvent, shall be cleaned to remove those substances. After the surface has been made free of grease, oil, or other substances, all areas to receive the protective compounds shall be abrasive blasted using sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering oxide may be left on the surface. Any area where rust reappears before lining must be reblasted.
 - c) Lining: After the surface preparation and within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils nominal dry film thickness of Protecto 401. No lining shall take place when the substrate or ambient temperature is below 40 degrees Fahrenheit. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.
 - d) Coating of Bell Sockets and Spigot Ends: Due to the tolerances involved, the gasket area and spigot end up to 6 inches back from the end of the spigot end must be coated with 6 mils nominal, 10 mils maximum using Protecto Joint Compound. The Joint Compound shall be applied by brush to ensure coverage. Care should be taken that the

Joint Compound is smooth without excess buildup in the gasket seat or on the spigot ends. Coating of the gasket seat and spigot ends shall be done after the application of the lining. If flanged piping or fittings are used, no coating shall be used on the face of the flange.

- e) Number of coats: The number of linings material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining manufacturer. To prevent delamination between coats, no material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.
- f) Touch-up & repair: Protecto Joint Compound shall be used for touch-up or repair in accordance with manufacturer's recommendations.
- 4) Inspection
 - a) All ductile iron pipe and fittings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPC-PA-2 Film Thickness Rating.
 - b) The interior lining of all pipe barrels and fittings shall be tested for pinholes with a nondestructive 2,500 volt test. Any defects found shall be repaired prior to shipment.
 - c) Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.
- 5) Certification
 - a) The pipe or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified.
- 6) Handling
 - a) Protecto 401 lined pipe and fittings must be handled from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.
- k. Exterior Coating for buried ductile iron pipe and fittings shall meet the following:
 - 1) Asphaltic (bituminous) with minimum thickness of 1 mil., comply with AWWA C151.
 - 2) For exposed service, all ductile iron pipe and fittings unless otherwise noted, shall be primed with Tnemec N140 or approved equal. All primed material to receive a field coating as specified by the design engineer. Contact ductile iron manufacturer for additional recommended primers. Refer to Specification Section 09 90 00 – Painting and Coating.
- l. Piping or fitting manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification and that the material used was as specified.
- 2. Polyethylene encasement:
 - 1) Provide polyethylene encasement of pipe where indicated on the Drawings.
 - 2) Minimum nominal thickness of 8 mils.
 - 3) Comply with all requirements of ANSI/AWWA C105/A21.5 Polyethylene Encasement for Ductile Iron Pipe Systems.

- 4) Ductile iron pipe and the polyethylene encasement used to protect it shall be installed in accordance with AWWA C600 and ANSI/AWWA C105/A21.5 and in accordance with all recommendations and practices of the AWWA M41, Manual of Water Supply Practices.

3. Ductile Iron Joints:

- a. Use mechanical or push-on joints complying with ANSI/AWWA C111/A21.11 as modified by ANSI/AWWA C151/A21.51.
- b. Restrained Joints shall be Amarillo Fast-Grip gasket, Flex-Ring, Field Flex-Ring, Lok-Ring, Barracuda orange gasket, US Pipe Red Field Lok gaskets, US Pipe HDSS (4"-54"), TR Flex, Ebaa Megalug, or approved equal. Restrained joint gaskets shall be colored, non-black. The color shall be consistent throughout the entire cross section of the gasket and not be attained by surface coating; the color shall be inherent within the rubber. Gaskets shall meet applicable requirements of AWWA/ANSI C111/A21.11 and shall be ANSI/NSF Standard 61 certified. Restrained gaskets shall be manufactured in the United States.

4. Ductile Iron Fittings:

- a. Provide ductile iron fittings complying with ANSI/AWWA C153/A21.53 and in accordance with ANSI/AWWA C111/A21.11.
- b. All fittings shall have a minimum pressure rating of 250 psi.
- c. Supply fittings consisting of a lining as specified in section 2.2.B.1.J-K above.
- d. The nominal diameter (each leg as required), country of origin, fitting material, manufacturer, pressure rating, degree of bend, casting period, and AWWA C-153 or C-110 conformance, shall be clearly marked on each fitting.
- e. Provide any required gaskets, adapters, etc. required to accommodate any differences in dimensions from pipe fittings sizing and materials (transition from DIP to PVC).

C. Polyvinyl chloride (PVC) Pipe and Fittings:

1. Polyvinyl Chloride (PVC) Pipe

- a. Use integral wall bell and spigot, minimum of SDR35, complying with ASTM 3034.
- b. For pipe cover depths 10 feet or greater, provide minimum of SDR26.
- c. Provide watertight seal using elastomeric gasket joints complying with ASTM F477.
- d. Install in strict accordance with manufacturer's recommendations.
- e. Gaskets shall be of material resistant to domestic sewer and industrial wastes, including oils.
- f. Joints shall conform to ASTM D3212.
- g. Furnish pipe in 12.5 or 20-foot lengths. Provide any required gaskets, adapters, etc. required to accommodate any differences in dimensions from pipe sizing (transition from DIP to PVC), fittings, and materials.

2. Fittings for PVC

- a. Comply with ASTM F1336 utilizing SDR 26 PVC fittings at service taps on gravity sewer main and SDR 35 PVC fittings at service connections (near cleanout) as described in specification for Sewer Service Laterals.

- b. Fittings shall be Molded in one piece with elastomeric joints and minimum socket depths as specified in sections 6.2 and 7.3.2 of ASTM D3034.
- c. Molded fittings shall be grey in color where specified herein and as indicated on the Drawings.
- d. Gaskets shall have a minimum cross-sectional area of 0.20 sq. in. and conform to ASTM F477 specification.
- e. PVC material shall have a cell classification of 12454 or 13343 as defined in ASTM D1784.
- f. Where possible, use sweep (long) radius bends.
- g. Fittings are to be manufactured by The Harrington Corporation in Lynchburg, VA or approved equal.

2.3 MANHOLES

- A. As specified in Section 33 39 13 - Manholes.

2.4 SANITARY SEWER LATERAL CONNECTIONS

- A. As specified in Section 33 32 00 – Sanitary Sewer Lateral Connections.

2.5 CASING PIPE

- A. As specified in Section 33 05 23.16– Utility Pipe Jacking.
- B. Casing pipe shall be sized adequately to accommodate spacers, joints, and restraints.

2.6 MISCELLANEOUS MATERIALS

- A. As required, provide all other materials for a complete and proper installation for products and installation as described here within.

2.7 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of pipe.
- B. Make completed pipe sections available for inspection at least 7 days prior to installation.

PART 3 - WORK EXECUTION

3.1 LAY OUT OF WORK

- A. Provide all required materials, labor, instruments, etc. required to properly lay out work.
- B. Prepare "cut sheets" for approval by Engineer and Owner.

- C. Exercise proper precaution to verify requirements on the Drawings prior to laying out Work. Any errors that otherwise might have been avoided shall be corrected at no additional cost to the owner.
- D. Provide proper notification of errors or discrepancies found to Engineer in a timely manner to ensure corrective actions are made.
- E. All gravity sewer shall be located within SCDOT Rights-of-Way, on Joint Municipal Water & Sewer Commissions personal private property, or in deeded easements.
- F. Easements shall meet the following requirements based upon depth of pipe:
 - 1. 0'-7' depth: 15' easement width
 - 2. 7'-12' depth: 25' easement width
 - 3. 12'-15' depth: 30' easement width
 - 4. > 15' depth: Shall be reviewed and determined by the commission on a case-by-case basis.

3.2 LOCATING

- A. Sewer lines in proximity to water lines must conform to the South Carolina Standards for Wastewater Facility Construction R.61-67 section 67-300 paragraph A.14.
- B. Where the sewer location is not clearly shown by dimensions on the drawings, locate the sewer:
 - 1. Not closer than 10' horizontally from a water supply main or service line. The distance shall be measured edge to edge.
 - 2. Where it is not practical to maintain a 10' horizontal separation, the sewer pipe may be installed closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18" above the top of the sewer.
 - 3. Where sewers are crossing a water main, either above or below, provide a minimum vertical distance of 18" between the outside of the water main and the outside of the sewer.
 - 4. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints.
 - 5. Where a water main crosses below a sewer, fully encase the sewer pipe for a minimum distance of 10' on each side of the crossing or use acceptable pressure pipe with no joint closer horizontally than 3' feet on either side of the crossing. This pipe will be pressure tested to assure watertightness prior to backfilling.
 - 6. Provide not less than 4" thickness, including that on pipe joints, when using concrete encasement on sewer at crossings.
 - 7. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a sewer manhole.
- C. Provide adequate support for other utilities around gravity sewer line to prevent damage during construction or maintenance activities.

- D. Special Conditions: When it is impossible to locate piping as specified herein, ensure that the following conditions are met and approved by Engineer and Owner prior to proceeding:
 - 1. Maximize the distances between the water main and sewer line and do not locate joints of either pipe near the crossing.
 - 2. Use materials which meet the requirements AWWA Section C and NSF 61 for the sewer line.
 - 3. When metallic piping is used for sewer line, provide lead free pipe and fittings.
 - 4. Provide adequate distance for maintenance to allow repair of either line without damaging the other.
- E. If work being completed in associated with existing gravity sewer (rehabilitation or upgrades), prior to beginning work, Contractor shall perform CCTV on all existing gravity sewer lines (PVC and DIP) associated with project area. The Contractor shall provide the owner with a digital video copy in an accessible format. Video intent is to ensure any existing service connections are fully documented and reinstalled before completion of project.

3.3 EXAMINATION

- A. Verify that trench is ready to receive Work of this Section.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.4 PREPARATION

- A. Correct over-excavation with crushed stone.
- B. Protect and support existing sewer lines, utilities, and appurtenances.
- C. Utilities:
 - 1. Maintain profiles of utilities.
 - 2. Coordinate with other utilities to avoid conflict.
 - 3. Notify Engineer of any conflicting utilities encountered. Relay conflicting utilities when approved and directed by the Engineer and Owner.

3.5 INSTALLATION

- A. All pipe shall be installed in accordance with Drawings and manufacturer's recommendations.
- B. Manholes shall not be placed further than 400 linear feet apart. Piping shall be installed accordingly.
- C. Trench, bed, backfill, and compact piping in strict accordance with pertinent provisions of Section 31 23 16.13 - Excavation, Trenching, and Backfilling for Utilities.
- D. Maximum trench widths, depths, and bedding methods.

1. Install all sewer pipe complying with manufacturer's and Engineer's requirements for maximum depths of cover indicated on the Drawings.
2. Unless otherwise noted, all gravity sewer pipe with a depth greater than 10 feet shall be SDR 26 PVC.

E. Pipe laying:

1. General:
 - a. Follow pipe manufacturer's recommendations for proper installation.
 - b. Lower individual sections of pipe into trench by means of crane, slings, or other suitable means to prevent damage to pipe, coatings, or liners. Where any part of coating or lining is damaged, repair in accordance with manufacturer's recommendation at no additional cost to the Owner.
 - c. Protect pipe during handling against shocks and free fall. Do not dump or drop pipe into trench.
 - d. Keep debris from entering the pipe interior. Continually clear and clean interior of the pipe free from any debris.
 - e. Lay pipe to slope gradients as indicated on the Drawings. Begin at the downstream end and proceed upstream with the spigot ends of bell-and-spigot pipe pointing in direction of flow when possible.
 - f. Rest the full length of each section of pipe solidly on the pipe bed, with recesses excavated to accommodate bells, couplings, and joints.
 - g. Before making pipe joints, clean and dry all surfaces of the pipe to be joined. Place, fit, join, and adjust the joints to obtain the degree of water tightness required.
 - h. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress. Remove and relay any pipe that has the grade or joint disturbed after initial laying.
 - i. Do not lay pipe in water or when trench conditions are unsuitable for the work; keep water out of the trench until jointing is completed.
 - j. Securely close open ends of pipe, fittings, and valves when work is not in progress.
 - k. Use only gasket lubricants recommended by the pipe manufacturer.
 - l. Protect all existing utilities, curbs, pavement, etc. in the vicinity of the work and promptly repair any damages at no additional cost to the Owner.
 - m. Remove defective pipe and replace at no additional cost to the Owner.
2. Ductile-iron pipe:
 - a. Mechanical, push on and flanged joints, install in accordance with ANSI/AWWA C600.
 - b. Gaskets: Handle, lubricate where necessary, and install in strict accordance with manufacturer's recommendations.
3. Polyvinyl chloride pipe (PVC):
 - a. Comply with ASTM D2321, except as otherwise specified herein.

3.6 INSPECTIONS AND TESTING

A. General:

1. All sewers will be visually inspected, tested, and gauged for infiltration and/or exfiltration.
2. Any visible leaks shall be repaired even if infiltration is within allowable limits.
3. Any debris remaining in pipe upon inspection will be removed and cleaned.
4. Broken or cracked pipe, mislaid pipe and other defects shall be corrected.
5. All required testing will be at the expense of the Contractor.
6. Failure to meet specified test requirements will result in removal, replacement, and retesting of pipe until sewers are brought to the specified standards at no additional cost to the Owner.
7. All inspections must be completed in the presence of representative of the Owner. Should inspections be performed by an unapproved inspector of the contractor, the contractor will be required to retest and/or make the required repairs at no additional cost to the Owner.

B. Construction observation:

1. Clean and prepare for observation each block or section of sewer upon completion, or as directed.
2. Each section between manholes shall show a full circle of light when viewed from either end.

C. CCTV Inspection

1. All sewer mains and service laterals require television inspections for final acceptance.
2. CCTV shall not be completed until all other tests are completed, punch lists corrected, and acceptable results are achieved.
3. The Contractor shall provide the owner with a digital video copy in an accessible format.
4. All lines shall be clean and free of debris prior to beginning CCTV work.
5. All work performed by contractor shall be completed in NASSCO PACP format by PACP certified professionals. Provide PACP numbers for individuals working on inspection data and reports.
6. Prior to beginning work, contractor shall place water in the pipe system to be able to identify standing water at sags and dips of the new sewer sections.
7. Provide all required materials and equipment that are designed for the type of inspection being performed. This includes lighting, pan, and tilt capabilities. Cameras shall have the capability to move through the pipe via a self-powered tractor assembly. The sizing of assembly shall correspond to the pipe size to be inspected.
8. Provide a sample photograph to Engineer and Owner to confirm the final products will have a clean acceptable video.
9. Begin video with a look down from above ground into the manhole. Ensure manhole and flow are visible in shot. Inspection will begin at center of manhole and end at the center of the end manhole. Prior to starting inspection of pipe, a tape measure shall be used to show the diameter of the pipe to be inspected.
10. If the pipe is found to be clogged during inspection preventing the equipment from continuing the inspection, the contractor shall remove the blockage as authorized by the Engineer at no additional cost to the owner. Upon removal, inspection shall continue and location shall be thoroughly documented.

11. There shall be no reverse setups unless approved otherwise by the Engineer. Reverse setups shall only be allowed and accepted for payment if a blockage or defect preventing the CCTV inspection in the initial direction does not need to be repaired as determined by the Engineer.
12. Contractor shall perform daily calibrations on equipment to verify the accuracy of measurements. Pipe lengths shown and reported on the CCTV inspection logs and video shall be within (\pm) 3 feet of the actual pipe length as measured above ground from center of manhole to center of manhole. Any CCTV not meeting this requirement shall be reperformed at no additional cost to the Owner.
13. All flow levels shall be controlled to a maximum of 20% of the pipe diameter of any existing sewers. There shall be no flow within new sewers during inspection.
14. Contractor shall use caution on all sewer lines when inspection or cleaning. No process shall cause any damage to any parts of new or old sewer lines.
15. Should a contractor's equipment become lodged within a pipe, the contractor shall take all necessary actions to retrieve the equipment at no additional cost to the owner. This includes any flushing, cleaning, excavation, materials, damage caused, etc. Cost exceptions may be made by the Engineer and Owner if the cause of the equipment lodge is a result of severely existing damaged infrastructure.
16. Upon completion of all CCTV, the contractor shall submit the final inspection via an acceptable digital format. All inspections must be in the correct order or the Engineer reserves the right to return to contractor for corrective action at no additional cost to the owner.
17. The final inspection shall yield results indicating that the pipe and manholes have been completely cleaned of all debris. The final inspection shall include all segments from manhole to manhole.
18. Should the Owner's representative be in question about the construction of an interconnecting sewer service, the owner reserves the right to request camera inspection of the service laterals in question. This can be completed by using a push camera installed at the cleanout or other camera suggestions from the CCTV performer. Any service laterals found to be out of compliance shall also be repaired or reset at no additional cost to the owner.
19. There shall be no protruding cuts of pipe from service connections within the gravity main. If there are any point repairs, service lateral repairs, protruding sections, or manhole repairs identified during or after inspection, contractor shall fully execute the repairs at no additional cost to the owner.
20. CCTV Visuals
 - a. At a minimum, each CCTV video shall include overlay of text display containing the following items for each inspection:
 - 1) Owner's Name
 - 2) Project
 - 3) Contractor for whom the work is being performed (if performed by a Subcontractor)
 - 4) Street name (if applicable) (constant display)
 - 5) Time and Date of inspection (constant display)
 - 6) MH #s from the start to the finish and shall be consistent with the manhole numbering system on approved construction drawings. (constant display)
 - 7) Distance of travel (constant display)
 - 8) Pipe Material and size
 - 9) Direction of travel
 - 10) Weather

21. For items not required to be on constant display, the items shall be shown on screen for a min of 5 seconds at the beginning of the video.
22. No display of text shall impair the view of inspection review and shall be adjusted accordingly.
23. The distance display option is highly critical for the inspection process. The contractor shall ensure that the equipment is calibrated and tested daily.
24. Display of video shall have a file resolution of 640 x 480.

D. Infiltration Tests:

1. Conduct tests using V-notch weir, or by direct measurement prior to allowing sewage flows in the line.
2. Close the end of the sewer at upstream structure sufficiently to prevent the entrance of water.
3. Discontinue use of well points or other groundwater pumping operations at least three days prior to testing.
4. Infiltration into the entire system of new sewers or any one trunk, interceptor or outfall sewer, including connecting laterals, or any stretch of sewer shall not exceed:
5. 200 gallons per inch of diameter per mile per day.
6. Make tests in presence of the Engineer, giving the Engineer at least three days advance notice.

E. Air testing:

1. Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing procedures for PVC pipe shall use the pressures and testing times prescribed by the pipe manufacturer. Pipe shall be tested at five (5) psi for a duration of five (5) minutes.

END OF SECTION 33 31 00