SECTION 33 11 00 – WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included:

1. Water lines, valves, and appurtenances.

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. Section33 12 00– Water Service Connections.
4. Section 09 90 00 – Painting and Coating

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Pipe and Fittings:

1. Basis of Measurement: By linear foot.
2. Basis of Payment: Includes excavation, bedding, backfilling, thrusts, testing, cleanup, and pipe to indicated depth and connection to water distribution system. Separate line item on bid form for restrained joint pipe sections.

B. Valves:

1. Basis of Measurement: Price per valve.
2. Basis of Payment: Includes all required materials including but not limited to excavation, backfilling, collars, valve box, valve, installation, cleanup, and testing for a complete installation where indicated on Drawings. Additionally, Air release valves shall include cost of valve, tapping saddle, manhole, manhole frame/cover, markers, accessories, pipe, excavation, installation, clean up, and testing for a complete installation.

C. Additional items:

1. Basis of Measurement: Price per linear foot or per item as indicated on bid form.
2. Basis of Payment: Items in this category shall include all required materials, installation, and testing for a complete installation (fire hydrant assemblies, etc.).

1.3 REFERENCE STANDARDS

A. All products, installation, and testing of water lines shall meet the requirements of the State Primary Drinking Water Regulations (R61-58).

B. All materials and products that contact potable water must be third party certified as meeting the specifications of ANSI/NSF 61.

C. All chemicals and products added to the public water supply must be third party certified as meeting the specifications of ANSI/NSF 60.

D. 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.

E. American Water Works Association:
1. AWWA B300 - Hypochlorites
2. AWWA C104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings
3. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
4. AWWA C110 – Ductile-Iron and Gray-Iron Fittings
5. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
6. AWWA C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
7. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
8. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
9. AWWA C153 – Ductile-Iron Compact Fittings
10. AWWA C500 – Metal-Seated Gate Valves for Water Supply
11. AWWA C502 – Dry-Barrel Fire Hydrants
12. AWWA C504 – Rubber-Seated Butterfly Valves, 3 in. through 72 in.
13. AWWA C509 – Resilient Seated Gate Valves for Water Supply
14. AWWA C550 – Protective Interior Coatings for Valves and Hydrants
15. AWWA C600 – Installation of Ductile-Iron Mains and Their Appurtenances.
16. AWWA C606 – Grooved and Shoulder Joints
17. AWWA C651 – Disinfection Water Mains
18. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in through 60”
19. AWWA M41 – Manual of Water Supply Practices, latest version.
20. Additional applicable AWWA standards which are not specifically stated.

F. American Society for Testing Materials:
1. ASTM A48 – Standard Specification for Gray Iron Castings
2. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. ASTM A197 – Standard Specification for Cupola Malleable Iron
4. ASTM A240 - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
5. ASTM A242 – High-Strength Low-Alloy Structural Steel

6. ASTM A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
7. ASTM A377 – Standard Index of Specifications for Ductile Iron Pressure Pipe
8. ASTM A506 – Standards Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled
9. ASTM A575 – Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
10. ASTM A615 – Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
11. ASTM A536 - Standard Specification for Ductile Iron Castings.
12. ASTM A546 – Standard Specification for Steel Wire, Medium-High-Carbon, Cold-Heading Quality, for Hexagon-Headed Bolts
13. ASTM C33 – Standard Specification for Concrete Aggregates
14. ASTM C150 – Standard Specification for Portland Cement
15. ASTM C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
16. ASTM C497 – Standard Test Methods for Concrete Pipe, Concrete Box Sections, Manhole Sections or Tile
17. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforce Concrete Manhole Structures, Pipes, and Laterals
18. ASTM D2241 - Standard Specification for Type Poly(Vinyl Chloride) (PVC) Pressure Rated Pipe
19. ASTM D3139 – Standard Specification for Plastic Pressure Pipes Using Flexible Elastomeric Seals
20. ASTM F477- Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
21. Additional applicable ASTM standards which are not specifically stated.

G. National Sanitation Foundation:

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

H. American Welding Society

I. AWS D11.2 – Guide for Welding Iron Casting

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 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 all appropriate parties at least 72-hours prior to construction.

C. Notify the appropriate Commission representative of any recommencement of work should there be any suspension of work for more than 72-hours.

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 minimum ten (10) years of experience. 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. 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. Developers' 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. Remove any temporary features (erosion control, etc.) and the language consisting of the words new/proposed from any labels on Drawings.
11. Provide total lump sum cost for Work (include engineering, surveying, legal and contract cost as a lump sum).
12. All sheets shall be numbered consecutively in one set.
13. Easements to be dedicated to the Joint Municipal Water and Sewer Commission shall be clearly labeled on the Record Drawings.
14. The drawings shall be clearly labeled as Record Drawings with the date of the last revision.

B. Water Lines:
1. Where locations exceed four (4) feet deep, provide pipe elevation every 100'.
2. Provide location of all fittings and valves with two (2) pulled tape distances. Distances shall not be pulled from building structures. Distances shall be pulled from items such as drainage boxes, telephone poles/boxes, etc.
3. Provide location of all encasements and pipe material transitions.

C. Submittal Procedure:
1. Submit 2 copies of the Preliminary Record Drawings, Deeds, 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 DHEC final inspection:
   a. Three (3) Printed Copies including all information required herein and an electronic copy containing the record drawing files in PDF and AutoCAD formats.
   b. One (1) Copy of Filed Subdivision Plat showing property lines with bearings and distances.
   c. One (1) Recorded Deed to Easements (Developer Project) .
   d. Original copy of Affidavit and Agreement of Indemnity – General Contractor (Developer Project)

e. Original copy of Affidavit and Agreement of Indemnity – Developer (Private Project)

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 is 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. 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.

C. 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 water 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. Natural rubber gaskets are not acceptable.

D. All products related to potable water construction shall be NSF approved.

E. Provide products with no trace amounts of lead or copper for items listed within this section. Products shall comply with the latest edition of the EPA National Primary Drinking Water Regulations: Lead and Copper and SC DES guidelines for Lead and Drinking Water.

2.2 PIPE, FITTINGS, VALVES, AND APPURTENANCES

A. Use pipe material specified herein as indicated on the Contract Drawings.

B. Ductile-iron pipe (DIP) and Fittings:

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/A21.11as 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) Cement Mortar rated for handling pH levels ranging from 6-10.
2) Shall be in accordance with AWWA C104, standard thickness.
3) If flanged piping or fittings are used, no coating shall be used on the face of the flange.

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/A21.11as 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 series 1100, 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 C110 or 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. All fittings and valves should be restrained as specified in Part 2.2.B.2.2 above.
    f. Welded-on outlets may be used where appropriate in lieu of fittings. Welded-on outlets may be used in lieu of the tees shown on the plans. All welded-on outlets shall be rated for a working pressure of 250 psi and shall have a minimum safety factor of 2.0; except that 36" welded-on outlets for 54"-64" parent pipe diameters shall be rated at 200-psi. Welded-on outlets may be provided as a radial (tee) outlet, a tangential outlet, or a lateral outlet. Parent pipe and branch pipe shall meet hydrostatic test requirements in accordance with AWWA C151, section 51-9, prior to fabrication.
        1) All joints on welded-on branch outlets shall be provided in accordance with the latest revision of ANSI/AWWA C111/A21.11 and/or ANSI/AWWA C115/A21.15, as applicable. All outlets shall be fabricated from centrifugally cast ductile iron pipe designed in accordance with ANSI/AWWA C150/A21.50 and manufactured in accordance with ANSI/AWWA C151/A21.51.
        2) All welds must be produced using 55% nickel iron welding rod or wire. Carbon steel electrodes will not be acceptable. Both branch and parent outlet pipe shall be class 53. After fabrication each outlet pipe shall be air tested to 15 psi to ensure weld integrity. A soap and water solution shall be applied during the testing procedure to inspect the weld for leakage. Any welds that show air seepage shall be refabricated and retested.

C. Polyvinyl Chloride (PVC) Pipe and Fittings:

1. Polyvinyl Chloride (PVC) Pipe
    a. PVC Pipe 3" and less in diameter shall comply to ASTM D2241 for PVC 1120, SDR 21 with a pressure rating of 150 psi at a temperature of 73ºF.
    b. PVC Pipe 4" through 42" in diameter shall comply with ANSI/AWWA C900 with a pressure class of 150 (DR 18).
    c. All PVC pipe shall bear the NSF potable water logo marking.
    d. Use integral bell and spigot pipe.
    e. Provide watertight seal using elastomeric gasket joints complying with ASTM F477. Gaskets to be factory installed and shall be of material resistant to domestic sewer and industrial wastes, including oils.
    f. Furnish pipe in 12.5,20, or 22-foot lengths.
    g. All PVC water main pipe shall be blue colored.

h. Provide any required gaskets, adapters, etc. required to accommodate any differences in dimensions from pipe sizing (transition from DIP to PVC), fittings, and materials.
i. Install pipe in strict accordance with manufacturer's recommendations.

2. PVC Restrained Joints and Fittings
   a. Where indicated on Drawings, provide restraint for C-900 PVC separate from the mechanical joint gasket sealing gland. Restraint shall be designed to provide circumferential loading over the enter restrainer.
   b. Provide wedge type.
   c. Provide split gland where standard gland cannot be installed.
   d. Provide restraint device equal to or greater than the pressure rating of pipe to be installed upon. Restraint shall also be able to withstand a test pressure of a minimum of 2 times the pipe pressure rating.
   e. Provide tee-head bolts conforming to ANSI/AWWA C111/A21.11 latest revision.
   f. Restraints should be factory prepared and have two (2) liquid thermoset epoxy coats using a heat cure following each coat. Restraints shall use MEGA-BOND by Ebaa Iron, Inc.
   g. Provide MEGALUG, Series 2000PV by Ebaa Iron, Inc.

3. Fittings for PVC
   a. Use ductile iron fittings complying with Part 2.2.B.3 above.

D. Casing Pipe and Spacers

1. As specified in Section 33 05 23.16 – UTILITY PIPE JACKING.
2. Casing pipe shall be sized adequately to accommodate spacers, joints, and restraints.

E. Valves and Appurtenances
1. General
   a. Where indicated on the drawings, provide valves as specified below.
   b. All valves should be designed to open by turning counterclockwise.
   c. Below grade valves shall have a 2" nut operator with direction to open indication. Above grade valves shall have a handwheel operator with direction to open indication.
   d. All valves shall have end connections as required for the piping scenario in which they are to be installed. Valve end section connections must be indicated on shop drawings. Mechanical ends for buried applications and flanged for above ground unless otherwise stated.
   e. Provide stem extensions on all depths greater than 36 inches below valve box.
   f. Valve manufacturers should be ISO 9001 Certified and have a minimum of five (5) years of experience in manufacturing the valve type specified below.
   g. Provide certified copies of all valve performance and leakage test results to Engineer for approval prior to shipments of valves.

2. Gate Valves
   a. Sizes 2" through 12"

1) Valves shall be resilient-seated wedge, ductile iron body, conforming to AWWA C515, NSF 61, and rated for a maximum working pressure of 350 psi.
2) Gate shall not be wedged into a pocket nor slide across the seating surface to obtain tight closures.
3) Sealing mechanism shall provide zero leakage at the water working pressure against the line flow from either direction and be designed such that no metal seams, edges, screws, etc. are within the waterway in the closed position.
4) Iron wedge must be symmetrical and fully encapsulated with molded rubber and no exposed iron.
5) All interior and exterior ferrous surfaces of the valve, including the interior of the gate, shall be coated with a protective coating conforming to AWWA C550. Coating shall be applied to castings prior to assembly to ensure all exposed areas will be fully covered.
6) Stem shall be designed to have an external failure should stem ever fail under excessive torque. Design should allow for operation of valve by wrench or other readily available tool during time of failure without disassembly the valve.
7) Provide 316 stainless steel bolts and nuts.
8) Valve shall have a non-rising stem.
9) Provide Mueller NRS A2361 Resilient Wedge Gate Valve or approved equal.

b. Greater than 12”
1) Valves shall be resilient-seated wedge, ductile iron body, conforming to AWWA C515, NSF 61, and rated for a maximum working pressure of 250 psi.
2) Gate shall not be wedged into a pocket nor slide across the seating surface to obtain tight closures.
3) Sealing mechanism shall provide zero leakage at the water working pressure against the line flow from either direction and be designed such that no metal seams, edges, screws, etc. are within the waterway in the closed position.
4) Iron wedge must be symmetrical and fully encapsulated with molded rubber and no exposed iron.
5) All interior and exterior ferrous surfaces of the valve, including the interior of the gate, shall be coated with a protective coating conforming to AWWA C550. Coating shall be applied to castings prior to assembly to ensure all exposed areas will be fully covered.
6) Stem shall be designed to have an external failure should stem ever fail under excessive torque. Design should allow for operation of valve by wrench or other readily available tool during time of failure without disassembly the valve.
7) Provide 316 stainless steel bolts and nuts.
8) Valve shall have a non-rising stem.
9) Provide Mueller NRS A2361 Resilient Wedge Gate Valve or approved equal.
10) OR provide Butterfly valves per section 2.2.E.3.

3. Butterfly Valves
    a. Valves shall be of the synthetic rubber-seated tight closing type conforming to AWWA C504, NSF 61, and class 250B, short body design, unless otherwise stated.
    b. Valve body shall be high strength cast iron conforming to ASTM A126, Class B, ASTM A-48, Class 40, or Ductile Iron ASTM A546 A536, Grade 65-45-12. with 18-8 Type 304 Stainless steel body seat. Valve bodies shall meet the designed operating pressures.
    c. The synthetic rubber, resilient valve seat shall be designed to seat properly against a pressure differential on either side of the valve. Any seat attachment hardware shall be stainless steel and have the capability to service in the field without disc removal along the shaft axis or from the line. The seat surface shall be Monel or stainless steel.
    d. Butterfly valves shall be eccentric or concentric shaft types. Disk shall be the "offset" design, to provide full 360-degree seating surface with no external ribs transverse to flow.
    e. Furnish valve with stainless steel valve shafts in a one- or two-piece unit which is sized to accommodate torques required for operation of the valves under the design pressures and with a safety factor included.
    f. Valve shaft shall be securely attached to the valve disk with corrosion resistant pins, threaded at one end and secured with lock washers and nuts. Ensure no leakage of valve by providing O-rings where necessary. All associated materials shall be corrosion resistant.
    g. Valve shaft seal shall be pull down packing type, bronze cartridge type (Consisting of O-Rings), or monolithic V-type. If pull down packing type or monolithic V-Type is used, the seal shall be self-compensating and self-adjusting type. Provide packing as manufactured by Chevron.
    h. For valves with pull down packings, provide design capable of repacking without removal of the actuator. Provide packing gland cover with a heavy-duty rating against soil and water resistance.
    i. All stuffing box bolts and nuts shall be stainless steel.
    j. For valves with O Ring type shaft seal, provide design where seal can be contained in a removeable bronze cartridge. Provide with a nitrile, BUNA-N rubber O ring rated for use with potable water.
    k. Provide permanently self-lubricated shaft bearings in the integral hub of the valve body. Bearings shall be corrosion resistant with a sleeve type of Teflon or heavy-duty bronze. Valve assembly shall have factory set two-way thrust bearings which is designed to always center the valve disc in the seat. All required bolts shall be stainless steel.
    l. Provide mechanical joints on both ends of valve per AWWA C111 for below grade applications or flanged ends for above grade applications.
    m. Shop drawings shall include the end clearance dimensions when the disc is fully opened and indicate the proposed valve end connections.
    n. Valve seats shall be factored tested at a pressure equal to or exceeding the design pressures, per AWWA C504. Provide proof of factory test results.
    o. All ferrous components and surfaces of the valves shall be shop painted with two coats of epoxy at a minimum total dry film thickness of 10 mils.

p. Provide butterfly valves as manufactured by Pratt, Mueller, Dezurik, or approved equal.

4. Tapping Valves
   a. Valves shall have a ductile iron body, resilient wedge type, symmetrical and fully encapsulated with molded rubber. conforming to AWWA C500, NSF 61, and rated for a working pressure of not less than 250 psi.
   b. All interior and exterior ferrous surfaces of the valve, including the interior of the gate, shall be coated with a protective coating conforming to AWWA C550. Coating shall be applied to castings prior to assembly to ensure all exposed areas will be fully covered.
   c. Stem shall be designed to have an external failure should stem ever fail under excessive torque. Design should allow for operation of valve by wrench or other readily available tool during time of failure without disassembly the valve.
   d. Valve shall have one end flanged with alignment lip to attach to tapping sleeve.
   e. Valves shall have an O-ring sealed stuffing box.
   f. Provide 316 stainless steel bolts and nuts.
   g. Valves 16” and larger, for working pressures greater than 50 psi, shall be provided with a spur or bevel gear operator and bypass.
   h. Provide Mueller T-2361 Tapping Valve or approved equal.

5. Tapping Sleeves
   a. General
      1) Shall be the type designed for making connection to existing water lines (while “live” / “hot” / “wet”) without loss of water or interruptions in service and be NSF 61/372 Certified.
      2) Tapping sleeves for lines 12 inches and less shall have a minimum working pressure of 200 psi. Tapping sleeves greater than 12 inches shall have a minimum working pressure of 150 psi, unless indicated otherwise.
      3) All tapping sleeves shall be designed to accommodate the existing pipe for which they will be installed. This includes pipe material, pipe outside diameter, and existing condition of the pipe itself.
      4) All gaskets and seals associated with tapping sleeve shall be vulcanized EPDM or Buna-N (NBR). Material shall be designed to withstand shrinkage or swelling after installation and must be fully comprised of non-recycled material.
      5) Joints on sleeves shall be suitable for the intended use.
      6) Sleeve shall have all pertinent information clearly marked on the side, including but not limited to, manufacturer, part number, date of manufacture, rated working pressure, and certifications.
      7) For sizes 12” and below, gate valves (flange x MJ) shall be used with tapping sleeve. For sizes greater than 12”, tapping valves shall be used with tapping sleeves.

   b. Size for Size Tap Sleeves
      1) Shall be cast iron or ductile iron split repair type suitable for minimum working pressure of 200 psi.

2) The sleeve shall be made of two halves which can be assembled and bolted around the main.
3) Provide flange corresponding to specified gate valve bolt patterns.
4) Cast iron sleeves shall be factory coated on inside and outside.
5) Tapping sleeve shall have a 3/4" NPT threaded plug.
6) Sleeve shall include the mechanical end joint accessories and split glands necessary to assemble the sleeve to pipe.
7) Provide Mueller Mechanical Joint H-615 or approved equal.

c. Reduced Size Tap Sleeves
1) Shall be ASTM A36 steel with a fusion bonded epoxy coating in accordance with AWWA C213.
2) Tapping sleeve shall have a 3/4" NPT threaded plug.
3) Provide type 304 stainless steel hex head nuts and bolts. Coat nuts to prevent galling.
4) Must be certified NSF 61.
5) Provide gaskets rated for water service made of virgin SBR.
6) Tapping sleeve shall have a minimum working pressure of 250 psi for sizes 6" – 12" and 150 psi for 14"-42".
7) Tapping sleeve flange shall be compatible with specified gate valves.
8) Provide ROMAC Industries FTS 420 Model for ductile iron, cast iron, or steel piping and FTS 419 for PVC (plastic piping), FTS 423 for HDPE, or approved equal.

6. Valve Boxes
a. Valve boxes shall be provided for all buried valves.
b. Provide a cast iron adjustable slip-joint or screw type, three (3) piece valve box suitable for depths shown on construction drawings. Provide extensions as required to meet depths. Valve box assembly shall consist of lower/base piece to fit around the stuffing box gland and rest on valve bonnet, the upper part shall be flared on lower end to telescope on a socket to receive cap or cover.
c. The valve box cover shall have the word "WATER" cast within.
d. Provide cast iron valve boxes with a minimum inside diameter of 5" at the top on all valves located below grade.
e. All castings shall have a minimum thickness of 1.5 mil of bitumastic paint.
f. For valve boxes located within pavement, provide heavy duty valve box and cover rated for use in traffic areas and conforming to AASHTO standards.
g. As required, valve shall be fitted with an extension stem for use with the buried service non-rising stem valves. The stem shall be of corrosion resistant metal and be designed to bring the valve nut within 3' of finished grade.
h. Stem shall be fitted with a self-centering disk below the operating nut to keep the extension stem aligned and limit foreign debris inside of the box.
i. Provide 24" (O.D.) concrete collar with wire reinforcement at all valve boxes. Collar shall have a minimum height of 4" at valve box opening.
j. Provide Tyler Series 6860 valve boxes or approved equal.

7. Air Release Valves
a. Air valves shall be installed on significant highpoints throughout the system.

b. Valves shall be designed for use with potable water applications and have an NSF 61 certification.
c. Valve should be designed to discharge air (gases) from the system during the filling and release any built-up air during operation.
d. Valve shall be designed for a working pressure of 0 to 150 psi and capable of handling the required venting. The valve shall have a hydrostatic test pressure of 150% of maximum working pressure.
e. Valve to have cast iron body with an epoxy coating, and adjustable Buna-N rubber plunger.
f. Valve shall have bronze trim with a stainless-steel ball float system.
g. Provide 1" threaded discharge outlet for connection to vent hose.
h. Furnish valve with a 1" NPT male threaded connection.
i. Provide required appurtenances per detail – Air Release Valve Assembly
j. Provide Type N, PL-10 air valve by Crispin or approved equal.
k. For mains larger than 12" in diameter, provide analysis for air release/vacuum lines sizing.

8. Air Release Valve Manhole
   a. Provide reinforced precast manhole with flat top in accordance with the Drawings and Specification Section 33 39 13 – MANHOLES.
   b. Manhole shall be installed on gravel bed (8" minimum thickness) with sufficient clearance between the valve and gravel to remove or service the valve.

9. Pressure Reducing Valves
   a. All Pressure reducing stations shall consist of two pressure reducing valves piped in parallel and valved for isolation for times of maintenance where shown in the drawings.
   b. One valve shall be full line sized and the other valve shall be sized per the manufacturer's design to handle low flows.
   c. Valves shall be diaphragm style, fluid actuated, and automatic control valves piloted to function as water pressure reducing valves.
   d. Valves 4" and larger shall have flanged end connections. Valves 3" and smaller shall have threaded end connections.
   e. Provide valves with fusion bond epoxy coating and outfitted with the following extra options:
      1) Wye strainer blowdown (4" and larger).
      2) Wye Strainers with blowdown (3" and smaller).
      3) 2. Wye strainers with blowdown (3" and smaller).
      4) Isolation cocks 3" and smaller (standard 4" and larger).
      5) Pilot line blowdown.
      6) Cover air bleed/blowdown.
      7) #ARD pilot regulator (30-300# adjustable outlet range).
      8) All piloting shall be stainless steel.
      9) Adjustable Opening speed control (4" and larger, included as "standard" on 3" and smaller).
      10) Closing speed control.
      11) Extra repair parts/kits (one each) shall be furnished with EACH valve (two valves per station) per the following schedule:

a) Main valve elastomer repair kit.
b) Opening speed control.
c) Closing speed control.
d) #ARD pilot regulator.

f. Provide Watts Regulator Series 115A pressure reducing valves or approved equal.

10. Isolation Valves - For Pressure Reducing Stations
    a. For valves 4 inches and larger
        1) Provide resilient seated, wafer style butterfly valve with a ductile iron body conforming to ASTM A536 and a 200-psi rating (2”-12”) or 150 psi (14”-24”).
        2) Valve shall be controlled using a lever handle.
        3) Provide valve with a one piece, 316 stainless steel shaft and 316 stainless steel disc.
        4) Provide full 360 degrees EPDM seating.
        5) Provide coating on body with manufacturers recommendations.
        6) Provide Watts Regulator #BF04-121-15-M2 or approved equal.
    b. For valves 3 inches and smaller
        1) Provide full port, full flow brass body ball valve.
        2) Provide PTFE seats, thrust washer, adjustable stem packing gland, stem packing nut, chrome plated brass ball (or stainless steel) brass adapter and steel handle.
        3) Provide NPT threaded end connections.
        4) Provide Watts series FBV-3 or approved equal ball valve.
        5) OR provide Watts Regulator butterfly valve as specified in 2.2.F.1 above.

11. Altitude Valves
    a. Provide diaphragm style, fluid actuated, one-way flow altitude valve designed to open, allowing flow into tank or reservoir and close drop tight when highwater level is achieved.
    b. Valve body and cover shall be strong and durable ductile iron conforming to ASTM A536.
    c. Furnish valve with flanged end connections.
    d. Valve body shall be fusion bond epoxy coated.
    e. Valve shall consist of the following options:
        1) Wye strainer with blowdown
        2) Cover blowdown
        3) Isolation Cocks
    f. Include the following repair kits with each valve:
        1) Main valve elastomer repair kit
        2) Opening speed control
        3) Pilot accelerator valve repair kit
    g. Provide a field installed sensing line of manufacturers recommended size.
    h. Valve shall be suitable for operating pressure ranges required for project design.
    i. Provide Watts Regulator series 127-1A or approved equal.

12. Valve Markers

a. Approved plastic or fiberglass valve markers shall be furnished to the Owner. A marker shall be required for each air release valve and every main line valve or cluster.

13. Valve and Meter Housing:
    a. All meters, pressure reducing valves, or altitude valve assemblies larger than 4" shall be installed in housing as detailed on plans and the Commission's Standard Details.

F. Fire Hydrants
1. Fire hydrants shall be three-way type consisting of two (2), 2-1/2" hose connections and one (1) steamer connection and conform to AWWA C502. Each connection of the hydrant shall have a cast iron cap attached to hydrant by chains and consisting of leather gaskets.
2. Hydrant valve opening shall not be less than 5-1/4".
3. Hydrants shall be rated for a working pressure of 250 psi and a test pressure of 500 psi.
4. All hydrants are required to open in the counterclockwise direction, have standard 1-1/2" operating pentagon operating nut, and shall be marked on top of hydrant indicating the direction of open.
5. Hydrant shall be fitted with bell end to accommodate the spigot end of six (6) inch ductile iron pipe. Provide hydrant barrel with the proper length to accommodate 3-1/2 foot depth of bury.
6. The hydrant valve shall be designed to close against the pressure of the distribution system and remain closed in the event of the upper part of the barrel being broken.
7. A flange shall be provided above ground level to permit adjust the facing of the hydrant. The hydrant shall be designed and constructed as to permit replacement of the upper portion of the barrel without digging. Hydrant shall be the "Breakable" type in the event of an accident to prevent the avoid damage to the lower portion of the hydrant.
8. Hose nipples shall be of the removable type and shall conform to the existing hose nipples in use by the Owner. On a new system, they shall have National Standard Threads on the hose connection side.
9. All hydrants and hydrant valves shall be rodded or restrained (MEGALUGG by EBAA) to hydrant tees. Hydrant leads shall be ductile iron pipe.
10. Clamps, straps, and washers shall conform to ASTM A 506, Rods to ASTM 575, Rod Couplings to ASTM A 197, and bolts to ASTM A 307.
11. All bolts and nuts shall be stainless steel.
12. Fire Hydrant shall be factory painted with a high-quality epoxy prime and polyurethan top-coat system in the color of Sherwin Williams 15092 – Federal Safety Blue.
13. Provide American Darling B-84-B (5-1/4") fire hydrant.

G. Dedicated Fire Lines
1. Shall follow comply with all NFPC requirements (latest).
2. Dedicated fire lines shall have a minimum size of 6 inches.
3. Provide double check valve assembly near the connection point to the water system.
4. Valve assembly shall be housed above or below ground in appropriate concrete enclosure with an aluminum service hatch.

H. Post Hydrants
1. Post hydrants shall be utilized as blow-off valves for 4" mains.

2. Post Hydrants shall be factory painted with a high-quality epoxy prime and polyurethane top-coat system in the color of Sherwin Williams 15092 – Federal Safety Blue.
3. Provide M&H Hydrant Style 33 post hydrants.
4. Where post hydrants are used, the system shall be designed to attain a minimum velocity of 2.5 ft/sec (3.0 ft/sec for PVC), and maintain a residual pressure of twenty-five (25) psi.

I. Blow-Off/Flushing Point
1. For 2" water mains, blow off assembly shall be in a jumbo meter box and conform to detail WL002A.
2. Blow off should meet the following requirements by SCDHEC:
   a. Blow-off should not be directed towards roads or so water fill flows into creeks, etc. At stream crossings, direct away from streams, over ground.
   b. Orifices shall be sized as follows:

Pipe Diameter (in)	Minimum Flow Required (gpm)	Orifice Size (in)
2.0	25	0.75
2.5	40	1.00
3.0	60	1.25
4.0	100	1.50
6.0	220	2.00
8.0	400	2.50
10.0	612	Fire Hydrant
12.0	882	Fire Hydrant
14.0	1200	Sp. Blow-off
16.0	1570	Sp. Blow-off

J. Tracer Wire

1. Where PVC or polyethylene pipe is used, provide a continuous 12-gauge insulated copper tracer wire.
2. Insulation to be blue in color and must be approved for direct bury by the manufacturer.
3. Tracer wire should be located at a minimum of 6" above the top of the water line or wrapped around the pipe.
4. Tracer wire to terminate at each valve and allow for connection of equipment for tracing. Wire should be located at valve in a manner which prevents interference with the operation of the valve.

K. Thrust Blocks
1. Provide restrained joint on all plugs, caps, tees, and bends deflecting 22.5 degrees or more either vertically or horizontally unless indicated otherwise. Provide on all lines 2.5" and greater. Thrust blocking is not required where restrained joints are used unless stated otherwise on drawings.
2. Where applicable, provide concrete thrust blocking with a minimum 28-day compressive strength of 3,000 psi.
3. Blocking shall be sized by Engineer based on soil condition.
4. Provide anchoring for all valves or hydrants associated with thrust blocking.

5. Blocking shall be placed between.

L. Miscellaneous Parts and Accessories
   1. Where additional parts or accessories are required to complete any part of this specification, use standard commercial grade items suitable for the type of installation. Parts and accessories shall conform to any applicable standards and specifications of the AWWA.

M. Bedding Material
   1. Provide clean washed coarse gravel consisting of crushed stone or gravel of strong durable nature.
   2. Gravel shall conform to SCDOT No. 57 stone in section 800 of the lates “Standards specifications for Highway Construction”

N. Backflow Prevention Device
   1. Refer to Lexington County Joint Municipal Water and Sewer Commission Backflow Prevention Manual (latest edition).

2.3 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of pipe, valves, fittings, hydrants, etc.

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 water distribution piping 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

G. > 15’ depth: Shall be reviewed and determined by the commission on a case-by-case basis.All piping below 400 MSL elevation shall be ductile iron pipe regardless of depth below surface.

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 water location is not clearly shown by dimensions on the drawings, locate the water:

1. Not closer than 10' horizontally from a gravity sewer or force main. The distance shall be measured edge to edge.
2. Where it is not practical to maintain a 10' horizontal separation, the water line may be installed closer to a sewer, provided that the sewer is in a separate trench or on an undisturbed earth shelf located on one side of the water line and at an elevation, so the bottom of the water main is at least 18" above the top of the sewer.
3. Where water lines are crossing a sewer, 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 (if existing) for a minimum distance of 10' on each side of the crossing or use acceptable pressure pipe (if new sewer) 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.
8. Water lines shall not be laid within the same trench as sewer, gas, fuel, or electrical wires.
9. All water lines shall be located outside of any area that is considered to be contaminated or containing contaminant runoff (wastewater spray fields, etc.).
10. Where any non-ferrous metallic pipe (copper tubing, etc.) crosses any ferrous piping, a minimum vertical separation of 12” shall be maintained.

C. Provide adequate support for other utilities around water 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 water line.
3. Provide adequate distance for maintenance to allow repair of either line without damaging the other.

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 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, valves, and appurtenances shall be installed in accordance with Drawings and manufacturer's recommendations.

B. Trench, bed, backfill, and compact piping in strict accordance with pertinent provisions of Section 31 23 16.13 - Excavation, Trenching, and Backfilling for Utilities.

C. Maximum trench widths, depths, and bedding methods.

1. Install all water pipe complying with manufacturer's requirements for maximum depths of cover indicated on the Drawings.

D. Pipe Cutting:

1. Cutting of pipe shall be done in a neat workmanlike manner without causing damage to pipe.
2. Cutting shall only be completed with an approved type mechanical cutter or as recommended by the pipe manufacturer. Where practicable, wheel type cutters shall be used.

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. As soon as possible after the joint is made, sufficient backfill materials shall be placed along the pipe to prevent pipe movement off line or grade. PVC pipe shall be completely covered to prevent damage from ultraviolet light.
j. 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.
k. No caulking of joints is permitted.
l. Securely close open ends of pipe, fittings, and valves when work is not in progress. If a pipe end is left for a future phase or connection, pipe shall be valved, plugged, or capped and anchored per the drawings.
m. Record pipe elevation every 100' if water line pipe depths differ from drawings and submit elevations to Engineer weekly.
n. Use only NSF approved gasket lubricants recommended by the pipe manufacturer.
o. 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.
p. Pipe fittings shall be handled and lifted from outside only to avoid damage to the interior coating.
q. Remove defective pipe and replace at no additional cost to the Owner.
r. All pipe stub outs for future phases shall have a water service connection installed. This water service will only be utilized to relieve line pressure in the event of a capped pipe end being removed during future extension. All stub outs shall be restrained joint for 60 feet from the end.
s. A post hydrant or fire hydrant shall be installed at dead end lines (hydrant type determined by line size). Dead end lines shall be restrained joint for 60 feet from the end.

2. Ductile-iron pipe:

a. Install pipe, mechanical, push-on joints in accordance with ANSI/AWWA C600 and ASTM A-377.
b. Handle, lubricate where necessary, and install gaskets in strict accordance with manufacturer's recommendations.
c. The maximum allowable joint deflection will be as given in AWWA C600. If alignment requires deflection in excess of the above limitations, special bends or a

sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the specified limit at no additional cost to the Owner.

3. Polyvinyl chloride pipe (PVC):

    a. Lubricate and invert gaskets as recommended by manufacturer.
    b. The maximum offset in alignment between adjacent pipe joints shall not exceed 1% unless manufacturer supplies additional verification and approved is by the engineer, but in no case shall it exceed 3 degrees. Should an alignment exceed the allotted amount, pipe shall be adjusted at no additional cost to the Owner.

F. Connections to Existing Water Mains
1. Where connection of new water main to existing water main is required, the connection shall be completed as established on the plans or approved by the Owner.
2. Contractor shall provide all materials and labor required to successfully connect to existing water main.
3. Contractor shall provide a minimum of 72 hours notice to the assigned Commission Representative prior to making any tap.
4. Connections to water mains shall be completed in a manner to prevent disturbance, loss of pressure, or service to the Commissions system.
5. For tapping of water mains:
    a. Thoroughly inspect and clean pipe to be tapped prior to beginning process.
    b. Tapping sleeve and valve shall be installed per the manufacturer's recommendations.
    c. Tapping sleeves and valves shall be hydrostatically pressure tested at 150 psi for a minimum of 15 minutes.
    d. The tapping sleeve and valves shall yield no drop in pressure or visible leakage.

G. Pipe Through Wall:
1. Any pipe passing through walls of valve pits or structures shall be provided with ductile-iron or schedule 40 steel wall sleeves.
2. Annular space between walls and sleeves shall be filled with cement mortar. Mastic is not allowed.

H. Valve Setting:
1. All valves after delivery shall have interiors cleaned of all foreign matter prior to installation.
2. Where indicated on drawings, install gate valves on water main per manufacturer's recommendations.
3. Where feasible, valves shall be located outside of the area of roadways.
4. Valve boxes shall be placed over valves setting plumb and be centered upon valve.
5. Tamp fill material a minimum of 4', or to the undisturbed trench face, on all sides of valve box to ensure no loose soil shifts valve box.
6. Test each valve by opening and closing to ensure the valve is fully operable.
7. Place valve box protection ring around top of valve box around box. Top of ring shall be level no more than 1" above valve box. Top of ring shall not be higher than 1" above finished grade.
8. Check valves shall be installed within valve pits as shown on drawings.

I. Fire Hydrant Setting:

1. Fire Hydrants shall be located and installed where shown on drawings.
2. After delivery, thoroughly clean the inside of all hydrants to move any foreign debris prior to installation.
3. All hydrants shall be installed plumb with the pumper nozzle facing the roadway and the centerline of the nozzle not less than 18" above finished grade.
4. Operating nut of hydrant shall not exceed 48" above grade.
5. Fire hydrants shall only be connected to water lines 6 inches or greater.
6. Each hydrant shall be connected to the main with a 6" ductile iron lead and a gate valve.
7. Hydrant shall be set upon a slab of concrete not less than 4" thick and 15" square.
8. Provide a minimum of 1 cubic yard of No. 57 or No. 67 stone around and beneath the waste opening of dry barrel hydrants to ensure drainage.
9. Fully open and close all parts of the hydrant and valve assembly to ensure that all is working properly.
10. Install fire hydrant assembly as described in the Commission's standard Fire Hydrant Assembly Details for the hydrant scenario to which it pertains.

3.6 INSPECTIONS AND TESTING

A. General:

1. All water lines will be visually inspected and tested for leaks and pressure. Testing must be conducted in accordance with AWWA C600.
2. Any visible leaks shall be repaired.
3. All pipe must be cleaned and flushed of any air or foreign debris.
4. Broken or cracked pipe, mislaid pipe and other defects shall be corrected.
5. All required testing and materials will be performed and supplied at the expense of the contractor.
6. Failure to meet specified test requirements will result in removal, replacement, and retesting of pipe until water line is brought to the specified standards at no additional cost to the Owner.
7. All inspections and tests must be completed in the presence of a 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.
8. No tests shall be performed on any pipe sections containing concrete (thrust blocks, encasement, etc.) for a minimum of 5 days after completion of concrete work.

B. Pressure Tests:

1. Perform pressure test on all fully installed pipe sections after backfilled upon.
2. Test shall be performed on each section of water line or valved section. Perform tests using a pressure of 150 psi or 1.5 times the maximum working pressure, whichever is greater. Test should be based upon the elevation at the lowest point of the section being tested and shall be corrected to the test gauge elevation.
3. Valves at the section being tested should be opened and closed multiple times during testing period.

4. Repair or replace any section not passing pressure test or visual test at no additional cost to the Owner.

C. Leakage Test:

1. Perform leakage test after the pressure test results obtained are satisfactory.
2. Test shall be performed on each section of water line or valved section. Perform tests using a pressure of 150 psi or 1.5 times the maximum working pressure, whichever is greater. Test should be based upon the elevation at the lowest point of the section being tested and shall be corrected to the test gauge elevation.
3. Perform leakage test for a minimum of two hours.
4. Leakage is defined as the quantity of water to be supplied into the newly laid pipe or any valved section thereof, necessary to maintain the leakage pressure.
5. No pipe installed will be accepted until the leakage is less than the number of gallons per hour as determined by the formula:

   a. $\frac{SxDx(P)^{1/2}}{133{,}200}$ For DIP pipe

   b. $0.000135xNxDx(P^{0.5})$, For PVC Pipe

   Where: L equals the allowable leakage in gallons per hour; N is the number of joints in the length of pipeline tested; D is the nominal diameter of the pipe in inches: S is the length of the pipeline tested in feet; and P is the average test pressure during the leakage test, in psi gauge. Should any test of pipe disclose leakage greater than that specified in the foregoing formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Owner.

D. Tracer Wire Testing:
1. Provide an approved magnetic locating device to test all locations where tracer wire is installed.
2. Connect to ground rod and to tracer wire located at valves. Using manufacturers equipment instructions, located the newly installed line.
3. Perform tracing wire locating and testing in the presence of the Owners representative.
4. Where there is a break in the tracer wire, repair wire by splicing and using gel nuts or an approved equal repair at no additional cost to the Owner.

E. Disinfection:
1. General:
   a. Before acceptance of a potable water line for operation, each completed water line section shall be disinfected as prescribed by AWWA C651 and SCDHEC.
   b. Valves and other appurtenances shall be operated several times when line is full of water and chlorination agent.
   c. Should disinfection treatment yield a failed test result, contractor shall repeat procedures until satisfactory results are obtained at no additional cost to the owner.
   d. Contractor is responsible for suppling all required materials, including taps, for the sterilization process.

e. Submit to Engineer and Owner a copy of the disinfection plan 30 days prior to disinfection.

2. Flushing:
   a. Upon completion of pressure tests and leakage test, thoroughly flush all lines until all foreign debris is removed before beginning the chlorination process. Provide flow required to produce a minimum flushing velocity of 2.5 feet per second.
   b. All valves and connections to the existing water distribution system shall be closed. Provide any backflow preventor or other approved devices at the source during flushing operation to prevent contamination of the existing water distribution system.
   c. Provide protection of any existing surrounding condition during flushing operations.
3. Disinfection Process:
   a. Provide water supplied from a temporary, backflow protected connection to the existing water distribution system.
   b. Provide sodium hypochlorite or calcium hypochlorite complying with AWWA B300.
   c. The chlorination agent shall not be introduced into the line in a dry solid state. Disinfection with pure chlorine gas is not permitted.
   d. Chlorine solution shall be injected into the new main at a constant rate. Chlorine solution feed rate to maintain a free chlorine concentration of 50 mg/L during the filling until the main has reached water capacity.
   e. Point of injection shall be no further than 10 feet downstream from the beginning of the new water main.
   f. Ensure the minimum chlorine concentration requirement is met by measured at regular intervals with a high range chlorine test kit.
   g. The chlorinated water shall remain within the water main for a minimum of 24 hours. All valves and hydrants shall be operated during this time to ensure disinfection of these appurtenances.
4. Sampling, Testing, and Acceptance:
   a. After 24 hours, all sample locations shall yield test results of not less than 10 mg/L of free chlorine.
   b. Complete a final flushing of the water lines, including valves and hydrants, until the chlorine residual is between the water systems residual of 1.5 to 0.5 ppm.
   c. After final flushing, Contractor to provide two separate samples for each sample location. Samples are to be taken in 24-hour intervals.
   d. All samples shall be tested by an SCDHEC approved laboratory and shall be free from coliform bacteria. No test results shall be older than 14 days.
   e. Satisfactory results are obtained when two consecutive tests taken 24 hours apart yield bacteria free results at all locations.
   f. Samples shall be clearly labeled with location of sample, date, time, and sampler information prior to having lab tested. Sample point locations shall be labeled as “NON-POTABLE WATER, DO NOT DRINK”.
   g. Provide all testing results to Engineer and Owner.
   h. Samples shall be taken at the following locations:
      1) End of all dead-end lines.
      2) At intervals no more than 1,200 feet for all new lines
      3) Each tie-in location of new and existing water lines.

i. If samples fail to produce the minimum chlorine concentration or bacterial free results, contractor shall repeat flushing and disinfection steps until satisfactory results are obtained.

F. Final Acceptance and Certification:
1. Upon completion of the project and before final acceptance, the Contractor shall deliver to the Owner a statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in complete accordance with the contract plans and specifications. Certification shall also indicate that the manufacturer's prescribed procedures and techniques were used and met.
2. Contractor shall supply the Owner with record drawings and any closeout documentation.

G. Cleanup:
1. Upon completion of all water line work, all debris and surplus materials shall be removed from the project site.
2. Any damaged or disturbed areas shall be repaired prior to final cleanup.

END OF SECTION 33 11 00