

SECTION 331116 - SITE WATER DISTRIBUTION & FIRE PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Front End Specification Sections, apply to this section.

1.2 SCOPE

- A. This section of the Specifications describes products to be incorporated into the water lines buried 5 feet beyond the building and requirements for the installation and use of these items. The Contractor shall furnish all products and perform all labor necessary to fulfill the requirements of these Specifications. The Contractor shall be responsible for paying all costs for this work. All materials and installation shall conform to City of McDonough Standards and Details and the Drawings and Specifications. Contractor shall furnish and install all other water and fire main lines, valves, post indicators, fittings, tamper switches, etc. shown on the Drawings and included in the Specifications.
- B. Contractor shall coordinate all connections to water main with local governing authority.
- C. The piping serving the fire protection system shall be installed by a fire protection contractor with a certificate of competency issued by the Georgia State Fire Marshall's Office.

1.3 APPLICABLE STANDARDS

- A. Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), National Fire Protection Association (NFPA), National Sanitation Foundation (NSF), or other recognized standards. Latest revisions of all standards are applicable. If requested by the Owner, submit evidence that manufacturers have consistently produced products of satisfactory quality and performance for a period of at least two years.
- B. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

1.4 MANUFACTURERS

- A. Whenever a product is identified in the Specifications by reference to manufacturers' or vendors' names, trade names, catalog numbers, etc., the Contractor may freely choose from those referenced products which ones he wishes to provide. Otherwise products shall meet the criteria set forth in the specifications for each item.

1.5 WARRANTY

- A. Water distribution systems installed by Contractors which are accepted by the Owner for ownership, operation and maintenance shall be warranted and guaranteed for a period of one year from the date of final acceptance that the completed system is free from all defects due to faulty products or workmanship, and that the Contractor shall make such corrections as may be necessary by reason of such defects upon notice by the Owner.

1.6 CONSTRUCTION DRAWINGS

- A. The term construction drawings shall mean drawings, prints, descriptive literature, test reports, samples, calculations, schedules, material lists and information and items of similar meaning.

1.7 SUBMITTALS REQUIRED

- A. The Contractor shall furnish to the Engineer, Owner and local water purveyor for review in accordance with the procedure outlined below, drawings and descriptive literature for all manufactured or fabricated products. Additional information such as special drawings, schedules, calculations and curves, shall be provided as specifically requested by the Engineer and/or Owner.
- B. The Contractor shall furnish to the Architect and local governing authority As-Built Drawings of the installed water system in accordance with Local Governing Authority Standards for As-Built Drawings.

1.8 DRAWINGS FOR CONSTRUCTION

- A. Drawings or other submittals not bearing the Engineer's review notation shall not be issued to subcontractors or utilized for construction purposes. The Contractor shall maintain at the job site a complete set of construction drawings bearing the Engineer's review.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish all pipe, fittings, valves, tapping sleeves and valves, hydrants, and all other materials required for completion of the work. Furnish materials in accordance with the following:

2.2 PIPE

- A. Water Distribution Pipe Smaller Than 4": High-Density Polyethylene Pressure Pipe
 - 1. High-Density Polyethylene: PE 4710 Resin, meeting AWWA C901/906, with butt-fused joints. Pipe shall be DR 11 with working pressure of 200 PSI. Pipe shall be approved for potable use by National Sanitation Foundation (NSF)
- B. 4 Inch - 12 Inch – Ductile Iron Pipe (DIP): Ductile iron pipe shall conform to AWWA C151 and shall be a minimum of Pressure Class 350. Sizes will be as shown on the Drawings. Pipe and fittings shall be cement lined in accordance with AWWA C104. Pipe and fittings shall be furnished with a bituminous outside coating.
 - 1. Joints shall be push-on type for pipe and standard mechanical or flanged restrained joints for fittings unless otherwise noted. Push-on and mechanical joints shall conform to AWWA C153 with gasket conforming to AWWA C111.
 - 2. Provide the appropriate gaskets for mechanical or flange joints. Gaskets for flange joints shall be made of 1/8-inch thick cloth reinforced rubber; gaskets may be ring type or full face type, and must comply with the indicated water pressures in this specification.
 - 3. Provide the necessary bolts for mechanical or flange connections. Bolts for flange connections shall be steel with American Regular unfinished square or hexagon heads. Nuts shall be steel with American Standard Regular hexagonal dimensions, all as specified in ANSI B 17.2. All bolts and all nuts shall be threaded in accordance with ANSI B.1.1. Coarse Thread Series, Class 2A and 2B fit.
 - 4. All pipe shall be furnished in lengths of at least 18 feet.

- C. Warning Tape and locator wire for all pipe shall be per Specification Section "Earthwork".
- D. Acceptance of all pipe will be on the basis of the Engineer's review and the manufacturer's written certification that the pipe was manufactured and tested in accordance with the applicable standards.

2.3 DUCTILE IRON FITTINGS AND ACCESSORIES

- A. Fittings shall be restrained joint ductile iron furnished in accordance with ANSI Specifications A21.10 (AWWA C110), latest revision, and shall be a minimum of 250 psi pressure class rating. Joints shall be mechanical joint with retainer glands with set screws. Cement mortar lining shall be furnished for all pipe.
 - 1. Mechanical joints shall be ductile iron compact pattern in accordance with AWWA C153.
 - 2. Glands, gaskets and bolts shall conform to AWWA C111.
- B. 3 INCH AND SMALLER GATE VALVES (GV): Gate valves 3 inches and smaller shall have bronze body, bronze rising stem, solid wedge and threaded bronze bonnet in accordance with UL 262 and FMG Approved with 175 psi working pressure.
- C. 4 - 12 INCH GATE VALVES (GV): Gate valves shall be mechanical joint end fitted with retainer glands, resilient seat, iron body, bronze mounted, non-rising stem with O-ring stem seals, open left with 2" square operating nut. Gate valves 3" through 12" shall be designed for a water working pressure of 250 psi and a test pressure of 400 psi. Valves 14" and larger shall be designed for a water working pressure of 150 psi and a test pressure of 300 psi. Valves 4" through 12" will be designed for installing in a vertical position. Valves larger than 12" will be designed for a horizontal installation and equipped with bevel gearing, gear case, tracks, rollers, scrapers and by-pass valves. All valves shall be furnished with valve marker and concrete collars.
- D. Gate valves shall be UL listed and FMG Approved and conform to AWWA standard specification C-509, latest revision for "Ordinary Water Works Service," with interior coating of epoxy complying with AWWA C550.
- E. Valve Boxes (VB): All gate valves shall be equipped with valve boxes. Valve boxes shall comply with AWWA M44 for cast iron valve boxes. Valve boxes shall be heavy roadway type and have a minimum shaft diameter of 5-1/4". The valve boxes shall be cast iron two-piece slip or screw type with drop covers marked "WATER." The valve boxes shall be adjustable to 6 inches up or down from the nominal required cover over the pipe. Typical valve box details are shown on the plans.
 - 1. All valve boxes shall be equipped with concrete collar as detailed on the plans.
 - 2. Provide one operating wrench with stem of length to operate the deepest buried valve, and socket matching valve operating nut.
- F. Tapping Sleeves and Valves (TS&V): Tapping sleeves shall be American Flow Control Series 2800 for lines 12" and smaller or American Flow Control Series 1004 for lines larger than 12", or an alternate acceptable to Water Authority. Valves shall be gate valves furnished in accordance with the specifications shown above, with flanged connection to the tapping sleeve and mechanical joint connection to the branch pipe. The necessary bolts, glands, and gaskets shall be furnished.
- G. OS&Y, Rising Stem, Resilient Seated Gate Valves: Shall conform to AWWA C500 and shall be allowed for use in the backflow preventers, only.
- H. Fire Hydrants (FH): All fire hydrants shall conform to the requirements of AWWA C 502 UL 246 and FMG Approved for 250 psi working pressure. Hydrants shall be the compression type, closing with

line pressure. The valve opening shall be 5-1/4 inches. Hydrants shall match City of McDonough Standards.

1. In the event of a traffic accident, the hydrant barrel shall break away from the standpipe at a point above grade and in a manner which will prevent damage to the barrel and stem, preclude opening of the valve, and permit rapid and inexpensive restoration without digging or cutting off the water.
 2. The means for attaching the barrel to the standpipe shall permit facing the hydrant a minimum of eight different directions.
 3. Hydrants shall be fully bronze mounted with all working parts of bronze. Valve seat ring shall be bronze and shall screw into a bronze retainer.
 4. All working parts, including the seat ring shall be removable through the top without disturbing the barrel of the hydrant.
 5. The operating nut shall match those on the existing hydrants. The operating threads shall be totally enclosed in an operating chamber separated from the hydrant barrel by a rubber O-ring stem seal and lubricated by a grease or oil reservoir. A stop nut shall be positioned in the top operating mechanism so that the valve cannot contact the bottom of the shoe when fully open.
 6. Hydrant shall be a non-freezing design and provided with a simple, positive, and automatic drain which shall be fully closed whenever the main valve is opened.
 7. Hose and pumper connections shall be breech-locked, pinned, and then caulked with lead; or threaded and pinned, to seal them permanently into the hydrant barrel. Each hydrant shall have two 2-1/2 inch hose connections, and one 4-1/2" diameter pumper connection. Equip each connection with cap and chain. Threads shall match the latest requirements of the State Fire Insurance Commission.
 8. Hydrants shall be furnished with a mechanical joint shoe connection to the spigot of the 6-inch hydrant lead. The lead shall be 6" ductile iron with rods or retainer glands connecting the fire hydrant to a 6" gate valve. Gate valve shall connect to main line using a locked hydrant tee equal to American Pipe Model A-10180. When the hydrant is close enough to the valve to allow its use, the hydrant shall be connected to the valve by using a locked hydrant adapter, equal to American Pipe Model A-10895.
 9. Minimum depth of bury shall be 4.0 feet to top of pipe. Provide extension section where necessary for vertical installation and in accordance with manufacturer's recommendations. The minimum height from the ground surface to the bottom of the hose nozzle shall be no less than 24".
 10. All outside surfaces of the barrel above grade shall be painted with two coats red, reflective enamel paint to match water company standards.
- I. Water Meters and Backflow Preventers: Refer to Drawings for requirements.
- J. Concrete Vaults: Refer to Drawings for requirements.
- K. Post Indicators: Indicator post for underground gate valves in the firemain shall be U.L. listed, FM approved, cast iron body with steel operating rod with locking lug, operating handle and indicator target protected by plexiglass cover. Body and operating rod length shall be field adjustable to the required depth of bury. Indicator posts shall be Stockham G-951, Nibco NIP-1A or American/Darling 1P71.
- L. Fire Protection Components Security: Post Indicator Valves and Backflow Preventer to be secured in the open position. Post Indicator Valves to be padlocked at hasp. Backflow Preventer to utilize 3/8" chain through O.S. & Y Hand Wheels. Each to be secured by padlocks provided by Contractor. Keys shall be given to Owner.
- M. Fire Department Connections (Siamese Connections): Fire Department connections shall be freestanding with cast-bronze body, thread inlets according to NFPA 1963 and matching City of McDonough Fire Department hose threads and threaded bottom outlet. Include lugged caps,

gaskets, and chains; lugged swivel connection and drop clapper for each hose connection inlet; brass sleeve meeting City of McDonough Fire Department's height requirements; and round escutcheon plate with marking "AUTO SPKR" and/or "STANDPIPE." Fire department connections shall comply with UL 405.

- N. Tamper Switches: Furnish and install tamper switches on post indicator valves and fire line backflow preventers in accordance with the following: Tamper switches for post indicators shall be designed for installation on indicator valves with cased aluminum housing with red finish; U.L. Listed, F.M. approved. The switch shall operate when the valve is intentionally or accidentally closed. Tamper switches for backflow preventer valves shall be designed for installation on operating stem and yoke valves and shall be U.S. Listed, F.M. approved. The switch shall open when the valve is intentionally or accidentally closed. Connect to alarm devices to building fire alarm as specified in Specification Section "Fire Alarm".

PART 3 – EXECUTION

3.1 GENERAL

- A. Unloading: Furnish equipment and facilities for unloading, handling, distributing and storing pipe, fittings, valves and accessories. Make equipment available at all times for use in unloading. Do not drop or dump materials. All materials dropped or dumped will be subject to rejection without additional justification.
- B. Handling: Handle pipe, fittings, valves and accessories carefully to prevent shock or damage. Handle pipe by rolling on skids, forklift, or front loader. Do not use material damaged in handling.
- C. Distribution: Distribute and place pipe and materials to not interfere with traffic. Do not string pipe more than 300 feet beyond the area where pipe is being laid. Do not obstruct drainage ditches.
- D. Storage: Store all pipe which cannot be distributed along the route. Make arrangements for the use of suitable storage areas. Do not interfere with other contractors right to access.
- E. Construction Along Highways, Streets and Roadways: Install pipe lines and accessories along highways, streets and roadways in accordance with the applicable regulations of the County, and/or the Department of Transportation with reference to construction operations, safety, traffic control, road maintenance and repair.
- F. Protection of Traffic: Provide and maintain suitable signs, barricades and lights for protection of traffic.
1. Replace all highway signs removed for construction as soon as possible. Do not close or block any highway, street, or roadway without first obtaining permission from the proper authorities.
 2. Provide flagmen to direct and expedite the flow of traffic.
- G. Construction Operations: Perform all work along highways, streets and roadways to least interfere with traffic.
- H. Stripping: Where the pipe line is laid along road shoulders, strip and stockpile all sod, topsoil and other material suitable for shoulder restoration.
- I. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

- J. Shaping: Reshape damaged slopes, side ditches, and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.
- K. Excavated Materials: Do not place excavated material along highways, streets and roadways in a manner which obstructs traffic. Sweep all scattered excavated material off of the pavement.
- L. Drainage Structures: Keep all side ditches, culverts, cross drains, and other drainage structures clear of excavated material and free to drain at all times.
- M. Maintaining Highways, Streets, Roadways and Driveways: Maintain streets, highways, and roadways in suitable condition for movement of traffic until completion and final acceptance of the work. Use steel running plate to maintain traffic until pavement replacement is completed.
 - 1. NOTE: Traffic must be maintained at all times. When one lane is closed, flagmen must be utilized to maintain traffic flow.
 - 2. Repair all driveways that are cut or damaged immediately. Maintain them in a suitable condition for use until completion and final acceptance of the work.
- N. Existing Underground Utilities and Obstructions: It is the responsibility of the Contractor to locate all existing utilities along the path of his construction. The drawings shall indicate underground utilities or obstructions that are known to exist. Where these or unforeseen underground utilities are encountered, the location and alignment of the water main may be changed, upon written approval of the Engineer and Owner, to avoid interference.
- O. Connections to Existing Pipe Lines: Before laying pipe, the Contractor shall locate the points of connection to existing pipe lines and uncover as necessary for the Engineer and Owner to confirm the nature of the connection to be made. The Contractor shall furnish materials and make the connection to all existing pipe lines. The Contractor will be observed during construction of tie-ins by the Utility Owner and the Engineer. The Contractor shall use all available practices and resources to minimize the time the customers are without water. The Contractor shall notify Water Purveyor's Customers of Water outages at least 24 hours in advance.
- P. Laying Pipe:
 - 1. General: Unless specifically indicated on the plans or called for in the specifications, water lines shall be constructed with restrained joint fittings and mechanical joint valves.
 - 2. Field Inspection: All pipe and accessories shall be laid, jointed, tested for defects and for leakage with pressure and chlorinated in the manner herein specified in the presence of the Engineer or his authorized representative and subject to their approval.
- Q. Handling Pipe and Accessories
 - 1. Care: Pipe, fittings, valves and other accessories shall be unloaded at the point of delivery, hauled to and distributed at the site of the project by the contractor; they shall at all times be handled with care to avoid damage. In loading and unloading they shall be lifted by hoists or slid or towed on skid-ways in such a manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on skidways must not be skidded or rolled against pipe already on the ground.
 - 2. At Site of Work: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench and shall be laid on high ground so that it will not be in a drainage way.
 - 3. Bell Ends, How Faced: Pipe shall be placed on the site of the work parallel with the trench alignment and with the bell ends facing the direction in which the work will proceed, unless otherwise directed by the Engineer.

4. Pipe Kept Clean: The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.
5. Alignment and Grade: General - All pipe shall be laid and maintained in the required lines and grades, with fittings and valves at the required locations, with joints centered and spigots home, and with all valve stems plumb.

R. Depth of Pipe:

1. The top of the barrel of the pipe shall have a minimum cover of forty-eight inches. A greater depth of cover is required in certain sections of the main, such as railroad crossings, valve locations and other sections of special construction, and within State and Federal highway rights-of-way.

S. Excavation and Preparation of Trench:

1. See Specification Section "Earthwork" for additional requirements.
2. Pipe Foundation: The pipe shall be laid upon a sound earthen foundation cut true and even so that the barrel of the pipe will have a bearing for its full length.
3. Care of Surface Materials for Re-Use: If local conditions permit their re-use, all surface materials suitable for re-use in restoring the surface shall be kept separate from the general excavation material.
4. Trenching by Machine or by Hand: The use of trench digging machinery will be permitted except in places where operation of same will cause damage to existing structures above or below ground; in which case hand methods shall be employed. Excavation shall be made by ladder type machine or backhoe.

T. Pipe Installation:

1. All copper pipe shall be installed according to CDA's "Copper Tube Handbook". All pipe shall be wrapped and coated in accordance with this manual.
2. Manner of Hauling Pipe and Accessories: Proper implements, tools and facilities shall be provided and used by the contractor for the safe and convenient execution of the work. All pipe, fittings and valves shall be carefully lowered into the trench piece by piece by means of derrick ropes or other suitable tools or equipment, in such manner as to prevent damage to pipe to pipe or accessories be dropped or dumped into the trench.
3. Pipe Kept Clean: All foreign matter or dirt shall be removed from the pipe, and it shall be kept clean by approved means during and after laying.
4. Laying of the Pipe: The spigot shall be centered in the bell, the pipe forced "home" and brought into true alignment; it shall be secured there by earth carefully tamped under and on each side of it, excepting at the bell holes. Care shall be taken to prevent dirt from entering the joint space. No "blocking up" of pipe or joints will be permitted. The joint shall be made as hereinafter described.
4. Install continuous underground warning tape and locator wire during backfilling of trench for underground water distribution piping. Locate tape 18 inches below finished grade, directly over piping. Underground warning tapes and locator wire is specified in Specification Section "Earthwork." Locator wire shall be wrapped around pipe and shall be looped up inside all valve boxes and extended to surface at all hydrants, PIVs and other water main accessories.
5. Trench Water Entering Pipe: At times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means and no trench water shall be permitted to enter the pipe.
6. Cutting Pipe: Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe.

7. Bell Ends Face Direction of Laying: Unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying; and for lines on an appreciable slope, bells shall, at the discretion of the engineer face up-grade.
8. Permissible Deflections at Joints: Wherever necessary to deflect pipe from a straight line, either in the vertical or horizontal plane to avoid obstructions, the degree of deflection shall be according to manufacturer's recommendations.
9. Unsuitable Conditions for Laying Pipe: No pipe shall be laid in water.
10. Jointing Pipe-Mechanical Joints: The following steps shall be taken in making mechanical joints:
 - a. All lumps, blisters and excess coal-tar enamel shall be removed from socket and spigot of the pipe.
 - b. Wash socket and plain end with soapy water containing chloride solution; then slip gland and gasket over plain end. The small side of gasket and lip gland shall face bell.
 - c. Paint gasket with soapy solution containing chlorine.
 - d. Push gasket into position, being sure it is evenly seated in socket.
 - e. Slide gland into position; insert bolts and run nuts up finger tight.
 - f. Tighten bolts to uniform tightness with correct ratchet wrench. The first bolt tightened shall be the bottom bolt, then top. All other bolts shall be tightened in sequence at 180 degrees apart.
11. Setting Valves, Valve Boxes and Fittings:
 - a. General: Gate valves and pipe fittings shall be set and jointed to new pipe in the manner heretofore specified for cleaning, laying and jointing pipe.
12. Valve Boxes: Cast iron valve boxes shall be firmly supported, and maintained centered and plumb over the wrench nut of the gate valve, with box cover.
13. Plugging Dead Ends: Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. Plugs or caps shall be jointed to the pipe or fittings in the manner specified above.
14. Thrust Blocking: Concrete having compressive strength of not less than 1500 psi shall be used as a cradle or thrust blocking where shown on the plans or where directed by the Engineer. Bends exceeding 22-1/4 degrees, crosses with one opening plugged, and all tees shall be backed with concrete as a thrust block. Blocking shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on ground in each instance shall be that shown on the plans. The blocking shall be so placed that the pipe fitting joints will be accessible for repair. No extra payment will be made for the thrust blocks. Contractor shall notify the Fire Marshal's office for inspection of all Thrust Block locations. Fire Marshal's sign off sheet shall be turned over to the Architect.

U. Pressure and Leakage Tests (See Subsection 'X' for additional testing):

1. All fire hydrants are to be flow tested in the presence of the Architect and Civil Engineer. Once tested they shall be tagged with date and time of test. Do not shut off valve after flow test is completed.
2. Pressure During Test: Immediately after the pipe and fire hydrants have been laid and backfilled, but prior to the placement of pavement, each valved section of newly laid pipe shall be subjected to a leakage and pressure test. For any section being tested the pressure applied shall be such that at the highest point in the section, the pressure shall be 200 pounds per square inch. Test shall be conducted as per NFPA-13. Test on fire protection supply shall be witnessed by Fire Marshall, Owner and Architect/Engineer.
3. Procedures: Each valved section of pipe shall be slowly filled with water and the specified test pressure, measured at the point of highest elevation shall be supplied by means of a pump connected to the pipe in a satisfactory manner. The pump, pipe connection, and all necessary apparatus, gauges, and meters shall be furnished by the contractor. The contractor shall furnish all necessary labor and assistance in conducting the tests. The

- owner will furnish, through connections made by the contractor to existing mains, water for filling the lines for making the test.
4. Expelling Air Before Tests: Before applying the specified test pressure, all air shall be expelled from the pipe. To accomplish this, taps shall be made, if necessary, at points of highest elevation and afterward tightly plugged.
 5. Examination Under Pressure: At intervals during the test, the route of the pipe line shall be inspected to locate any leaks or breaks. Any cracked or defective joints, cracked or defective pipe, fittings or valves discovered in consequence of this pressure test shall be removed and replaced with sound material in the manner provided and the test shall be repeated until satisfactory results are obtained.
 6. Leakage: No detectable leakage will be allowed during the pressure testing.
- V. Other Testing: All water mains and fire hydrants and their appurtenances shall be subject to all testing required by County Fire Department.
- W. Backfilling:
1. Time of Backfilling: As soon as practicable after the completion of laying and jointing of the pipe, the trench shall be backfilled, and at not time shall the completed backfilling of the trench be more than 300 feet behind the pipe laying.
 2. Backfill Procedure at Pipe Zone: Select backfill material free from rock fragments shall be deposited in the trench simultaneously on both sides of the pipe for the full width of the trench and to an elevation of twelve inches above the top of the barrel of the pipe. The backfill material shall be moistened if necessary, tamped in thin (about 4-inch) layers and thoroughly compacted under and on each side of the pipe to provide solid backing against the external surface of the pipe.
 3. Backfill Procedure Above the Pipe Zone: Succeeding layers of backfill may contain coarser materials and shall be compacted thoroughly to the natural ground surface. Refer to Specification Section "Earthwork" for requirements of trench compaction.
 4. Restoration of Surfaces: The contractor shall replace all curbing, sidewalks, gutters, shrubbery, fences, sod, and other surfaces disturbed to a condition equal to that before the work began, furnishing all labor and materials incidental thereto.
- X. Disinfection of Mains:
1. The contractor shall disinfect all new mains, furnishing all labor, equipment and material necessary for the complete disinfection of the mains as hereinafter provided. Mains shall be disinfected by the application of a chlorinating agent into the water used for the initial filling of the mains. The chlorinating agent may be chlorine gas-water mixture, calcium hypo-chlorite in water, or chlorinated lime of known chlorine content in water and shall be fed through a suitable solution feed device. The chlorinating agent shall be applied at or near the beginning point from which the main is being filled and shall be injected into the main through a corporation cock tapped into the horizontal exit of the newly laid main. The water being used to fill the line shall be controlled to flow into the section to be sterilized very slowly and the rate of application of the chlorinating agent shall be in such proportion to the rate of the water entering the pipe that the chlorine dose applied to the water shall be at least 50 ppm. The chlorine treated water shall be retained in the new main at least 24 hours and a 10 ppm of residual chlorine shall remain after the 24 hour period. Following chlorination all treated water shall be flushed from the mains until replacement water shall have a chlorine content of not more than 0.1 ppm in excess of the residual in water from the supplying main and in any event not less than 0.2 ppm. Samples of the water shall be taken from several points in the new lines and submitted to a State Approved lab for bacteriological analysis. Should the analysis show

- contamination, the system shall be re-chlorinated and further samples taken and submitted for analysis until no contamination is indicated.
2. Provide copies of satisfactory test results to Architect/Engineer for review prior to placing Water System in service.

END OF SECTION 331116