CONSOLIDATED UTILITY DISTRICT

Rutherford County, Tennessee

STANDARD TECHNICAL SPECIFICATIONS

for

WATER SYSTEM ADDITIONS

APRIL 2025

Alan Stuemke 04-30-2025

Approved By: Date

DIRECTOR OF ENGINEERING CONSOLIDATED
UTILITY DISTRICT OF RUTHERFORD COUNTY

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STANDARD TECHNICAL SPECIFICATIONS

For Construction of

WATER SYSTEM ADDITIONS

For

CONSOLIDATED UTILITY DISTRICT

in

RUTHERFORD COUNTY, TENNESSEE

APRIL 2025

DW20250266
APPROVED WATER SPECIFICATIONS
THE DOCUMENT BEARING THIS STAMP HAS BEEN RECEIVED AND REVIEWED BY THE
TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER RESOURCES
AND IS HEREBY APPROVED FOR USE IN CONSTRUCTION BY THE COMMISSIONER
05/16/2025
THIS APPROVAL SHALL NOT BE CONSTRUED AS CREATING A PRESUMPTION OF CORRECT OPERATION OR AS WARRANTING BY THE COMMISSIONER THAT THE APPROVED FACILITIES WILL REACH THE DESIGNED GOALS.
APPROVAL EXPIRES FIVE YEARS FROM ABOVE DATE

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CONSOLIDATED UTILITY DISTRICT
STANDARD TECHNICAL SPECIFICATIONS

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STANDARD TECHNICAL SPECIFICATIONS

WATER LINE ADDITIONS

1 SCOPE OF PROJECT

1.1 GENERAL - The work to be accomplished under these Specifications consists of the furnishing of all materials, machinery, labor, equipment and services necessary for the construction of water line additions more particularly described elsewhere in the Specifications and shown on the Plans.

The **CONTRACTOR** shall perform all necessary clearing, staking, excavating, backfilling, grading, clean-up, restoration of damage to property, testing, etc., for the proper and complete installation of the system and restoration of the surface to its original condition.

Approved Manufacturers with associated specification designations are listed in **Appendix 'A'** of these specifications and are intended as District Standards. Any materials not listed shall be approved by the Engineer and the District

1.2 LOCATION OF FACILITIES - All proposed water lines shall be installed outside road rights-of-way on private property unless approved by the District.

2 PRELIMINARY WORK

2.1 GENERAL - No construction shall commence until plans are approved by the Tennessee Department of Environment and Conservation and said approved plans are on site.

Shop drawings shall also be submitted for review and approval by the **DISTRICT** prior to any work being done. It also shall be noted that all part numbers listed in the specifications are subject to change based on manufacturer product updates.

All subdivision road construction and drainage structures and ditches shall be constructed to subgrade prior to installation of water facilities.

In addition, no construction shall commence until a Construction Start Notification letter has been issued from the **DISTRICT** to the contractor performing the work.

The **CONTRACTOR** should be aware of and conform to any time restrictions as designated by State, City, and/or County governments. For bid projects: No separate Measurement and Payment will be made for complying with any such time restrictions. It will be considered a subsidiary obligation of the **CONTRACTOR** under other bid items to which it relates.

2.2 LOCATION AND PROTECTION OF UNDERGROUND UTILITIES - Prior to trenching, the **CONTRACTOR** shall determine, insofar as possible, the actual location of all underground utilities in the vicinity of his operations and shall have the respective utilities clearly mark their location so that they may be avoided by equipment operators. As per Tennessee State Law, a minimum of 72 hours before excavation is to begin, the **CONTRACTOR** shall call the Tennessee One Call System at 8-1-1 to have member utilities mark their utilities. Please note that non-member utilities will have to be contacted individually. Where such utility lines or services appear to lie in the path of construction, they shall be uncovered in advance to determine the exact location and depth and to avoid damage due to trenching operations. Existing facilities shall be protected during construction or removed and replaced in equal condition, as necessary.

Should any existing utility line or service be damaged during or as a result of the **CONTRACTOR** operations, the **CONTRACTOR** shall take such emergency measures as may be necessary to minimize damage and shall immediately notify the utility involved. The **CONTRACTOR** shall then repair the damage to the satisfaction of the utility or shall pay the utility for making the repairs. In all cases, the restoration and/or repair shall be such that the damaged structure will be in as good or better condition as before the damage occurred.

2.3 **SURVEYING AND STAKING -** The plans show the desired location of the water mains and it shall be the responsibility of the **CONTRACTOR** to provide the necessary stakes and lines to ensure that the water mains will be installed in the location shown. Graphic symbols are used to indicate valve and hydrant general locations but **ARE NOT** drawn to scale. Minor changes in pipeline location to avoid obstructions or provide better coordination with topographic conditions may be worked out in the field between representatives of the **CONTRACTOR** and the **ENGINEER**. In general, such field changes shall be limited to occasional deflections to avoid side drains, culverts, ditches, or other obstructions or lateral shifts which would result in an improved laying condition or a decrease in inconvenience to property owners or motorists.

It is intended that the water main be held a reasonable uniform distance from rights-of-way, edge of pavement, or other boundary and indiscriminate wandering over the available area solely for the purpose of selecting the easiest trenching conditions will not be tolerated.

Once the proposed location of the pipeline has been established the **CONTRACTOR** shall provide sufficient stakes and lines to guide the equipment operators and ensure that the trenching will be done to proper alignment.

2.4 **REMOVAL OF OBSTRUCTIONS -** The **CONTRACTOR** shall be responsible for the removal, safeguarding and replacement of fences, walls, structures, culverts, street signs, billboards, shrubs, mailboxes, or other obstruction which must be moved to facilitate construction. Such obstructions must be restored to at least their original condition.

2.5 **CLEARING AND GRUBBING -** The **CONTRACTOR** shall be responsible for cutting, removing and disposing of all trees, brush, stumps, roots and weeds within the construction area. Disposal shall be by means of chippers, landfills, or other approved method not in conflict with State or local ordinances.

Care shall be taken to avoid unnecessary cutting or damage to trees not in the construction area. The **CONTRACTOR** will be responsible for loss or damage to trees outside the permanent easement or rights-of-ways.

2.6 **VIDEO –** Prior to construction, the **CONTRACTOR** shall (color) videotape the entire project including the route of the line construction, all easement areas, the full width of all rights-of-way, and all service line areas. The **CONTRACTOR** shall identify the line designation and station number, all-natural landmarks, the street address of the area in view and all potential areas, structures, fences, trees, etc., subject to potential disturbance. The **CONTRACTOR** shall provide the **OWNER** with two (2) copies of the video with audio comments.

3 MATERIALS

3.1 **GENERAL -** All materials to be incorporated in the project shall be first quality, new and undamaged material conforming to all applicable portions of these specifications.

All materials must be furnished by the **CONTRACTOR** and with all applicable taxes paid by the **CONTRACTOR** and must conform to applicable portions of these specifications.

Approved Manufacturers with associated specification designations are listed in **Appendix 'A'** of these specifications and are intended as District Standards. Any materials not listed shall be approved by the Engineer and the District.

3.2 **CEMENT -** Cement shall be Portland cement of a brand approved by the **ENGINEERS** and shall conform to "Standard Specifications for Portland Cement", Type 1, ASTM Designation C150, latest revision. Cement shall be furnished in undamaged 94 pound, one (1) cubic foot sacks, and shall show no evidence of lumping.

3.3 **CONCRETE FINE AGGREGATE -** Fine aggregate shall be clean, hard uncoated natural sand conforming to ASTM Designation C33, latest revision, "**Standard Specifications for Concrete Aggregate**."

3.4 **CONCRETE COARSE AGGREGATE -** Coarse aggregate shall consist of clean, hard, dense particles of stone or gravel conforming to ASTM Designation C33, latest revision, "**Standard Specifications for Concrete Aggregate**." Aggregate shall be well graded between 1- 1/2" and #4 sieve sizes.

3.5 **WATER -** Water used in mixing concrete shall be clean and free from organic matter, pollutants and other foreign materials.

3.6 **READY MIX CONCRETE -** Ready-mix concrete shall be secured only from a source approved by the **ENGINEERS**, and shall conform to ASTM Designation C94, latest revision, "**Specifications for Ready-Mix Concrete**." Before any concrete is delivered on the job site, the supplier must furnish a statement of the proportions of cement, fine aggregate and coarse aggregate to be used for each mix ordered and must receive the **ENGINEERS** approval of such proportions.

3.7 **CLASS "A" CONCRETE -** Class A concrete shall have a minimum compressive strength of 3500 pounds per square inch in 28 days and shall contain not less than 6 sacks of cement per cubic yard.

3.8 **CLASS "B" CONCRETE -** Class B concrete shall have a minimum compressive strength of 2000 pounds per square inch in 28 days and shall contain not less than 4 1/2 sacks of cement per cubic yard.

3.9 **METAL REINFORCING -** Reinforcing bars shall be Grade 60 steel conforming to ASTM Designation A615, latest revision, "**Standard Specifications for Billet Steel Bars for Concrete Reinforcement**." Bars shall be deformed with a cross sectional area at all points equal to that of plain bars of equal nominal size.

3.10 **CRUSHED STONE -** Crushed stone for bedding or backfill shall be Tennessee Department of Transportation Standard Size No. 67 (Type "A") and No. 10 (Type "B") and shall meet State Highway Department Standards for road surfacing.

3.11 **PEA GRAVEL -** Pea gravel for shaping cradle bedding shall be #4 to 1/2" size Ohio River, or approved local gravel of similar character.

3.12 **DUCTILE IRON PIPE -** Ductile iron pipe for water shall be manufactured in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, latest revisions. All pipe must be new. Pipe shall be minimum pressure class or thickness class specified. All Ductile Iron Pipe shall be **Pressure Class 350** unless otherwise noted. Ductile iron pipe and fittings are to have rubber gasket joints in accordance with the latest revision of ANSI/AWWA C111/A21.11.

Where restrained joints are required to resist thrust due to internal pressure, an approved joint system shall be utilized at the specified locations. Restrained joints shall be rated for a working pressure of 250-psi minimum. All pipe installed in casing pipe shall be restrained joint.

Pipe and fittings shall be asphaltic coated outside per ANSI/AWWA C151/A21.51, latest revision, and cement lined inside in accordance with ANSI/AWWA C104/A21.4, latest revision.

All flanged pipe shall comply with ANSI/AWWA C115/A21.15, latest revision. Pipe barrel shall be manufactured in accordance with ANSI/AWWA C151/A21.51, latest revision. All flanges shall be ductile iron and rated for a working pressure of 250 psi. To ensure accountability, all flanged pipe shall be fabricated at the factory by the barrel manufacturer.

All 42" through 64" ductile iron pipe shall be the product of one manufacturer experienced in manufacturing pipe of the size, class, and quantity specified herein. The pipe manufacturer shall have manufactured this size pipe for a minimum of five years and have a successful performance record in the U.S.A. on projects of comparable magnitude.

The exterior of the pipe shall be clearly marked to indicate the manufacturer, date of manufacture, the pipe class and weight. Exterior markings shall also positively identify the pipe as being Ductile Iron.

All pipe must be new and shall be manufactured in the United States of America (USA); all ductile iron pipe shall be cast, cleaned, lined, coated, tested, and certified at a single manufacturing facility in the USA.

3.13 CROSS-LINKED POLYETHYLENE (PEX) WATER PIPE & FITTINGS – All PEX water pipe up to two inches (2") in diameter shall be:

- Service pipe to be cross-linked polyethylene (PEXa) piping manufactured using the high-pressure peroxide (Engel) method of cross-linking, with an approved cell classification of 354400 in accordance with ASTM D 3350, and a minimum degree of cross-linking of 70% in accordance with ASTM D 2765, Method B.
- Pipe to be certified to standards ASTM F 876, ASTM F 870, CSA B137.5, NSF 14, NSF 61, and PPI TR-4, by approved testing agencies.
- Pipe to have a minimum chlorine resistance as tested in accordance with ASTM F 2023 and specified in ASTM 876.
- Pipe to have a standard materials designation code of 1006, as certified by the PPI.
- Pipe to be certified to AWWA C 904 "Cross-linked Polyethylene (PEX) Pressure Pipe", ½ in. through 3 in., for Water Service" by approved testing agencies.
- Pipe to be manufactured in an ISO 9001 certified production facility.
- Approved temperature and pressure ratings to be from Table 3.1 and 3.2 below based on PPI Hydrostatic Design Basis as certified by CSA and NSF.

Table 3.1

Pressure (psi/kPa)	Temperature (˚F/˚C)
475/3310	73.4/23
210/1450	180/82.2
180/1240	200/93.3

Table 3.2

Pressure (psi/kPa)	Temperature (˚F/˚C)
160/1105	73.4/23
100/690	180/82.2
80/550	200/93.3

Provision must be made for proper transporting, handling, and storage of pipe. Pipe and fittings are to be as recommended by manufacturer and

approved by **ENGINEER**. (Pipe shall be as manufactured by Wirsbo Aquapex or Endot Endopure or approved equal.)

Piping shall carry the following markings every three (3) feet: manufacturer's name or trademark, nominal size, 1006 (materials designation code), ASTM F 876, F 877, F 2023, CSA B137.5, NSF-PW, PEXa (material designation), SDR9 (standard dimension ratio), 160 psi @ 73.4˚F, 100 psi @ 180˚F, POTABLE TUBING, manufacturing date and machine number, and footage mark.

For 1-inch and 1 1/2- inch pipe use plastic insert on all compression fittings and for 2-inch use stainless steel insert on all compression fittings.

Pipe to be shipped in protective cardboard boxes or containers clearly marked with size and product name.

3.13.1 Installation and Warranty – Pipe shall be installed according to manufacturer's instructions and engineer's specifications in accordance with AWWA C-904 and local codes. Pipe shall be connected with approved AWWA C-800 compression joint valves and fittings, suitable for buried applications, using stainless steel support liners inside pipe at each joint. The pipe shall be completely buried or protected by opaque conduit unless installed indoors out of sunlight.

Pipe manufacturer shall warrant the cross-linked polyethylene service pipe to be free from defects in material and workmanship for a period of twenty-five (25) years.

3.14 MULTILAYER COMPOSITE SERVICE PIPE All composite service pipe shall be multilayer composite NSF 14 and NSF 61 approved and meeting all requirements of ASTM F2855. Dimensions shall be as follows:

Dimensions						
Nominal Tube Size (NTS)	Average Outside Diameter, in (mm)	Average Inside Diameter, in (mm)	Wall Thickness, in (mm)			Weight, lbs./ft
			Aluminum (Average)	Inner CPVC (Minimum)	Outer CPVC (Minimum)	
3/4"	0.875 (22.23)	0.691 (17.55)	0.017 (0.43)	0.028 (0.71)	0.028 (0.71)	0.167
1"	1.125 (28.58)	0.932 (23.67)	0.017 (0.43)	0.034 (0.86)	0.034 (0.86)	0.227

3.15 HIGH-DENSITY POLYETHYLENE – High Density Polyethylene (HDPE). Water pipe meeting the most recent AWWA approval criteria is acceptable. See the latest version of AWWA C906 for more information.

3.16 DUCTILE IRON FITTINGS - All fittings shall be ductile iron and shall be cement lined, bituminous coated and manufactured in accordance with ANSI/AWWA C153/A21.53, latest revisions.

3.17 GATE & TAPPING VALVES - All gate valves shall be resilient seated, manufactured to meet or exceed the requirement of AWWA C509 for 2" thru 12" and AWWA C515 for 2" thru 48", latest revisions. All internal and external exposed surfaces shall be fusion- bonded epoxy coated with an approved epoxy coating to a minimum thickness of 6 mils, complying fully with AWWA 550 and certified to NSF61. Valves shall be furnished with mechanical joint ends in accordance with ANSI A21.11 unless otherwise shown or directed.

Valves shall be suitable for installation in an approximate vertical position in buried pipelines. Stem seal shall consist of three (3) O-ring seals. All valves shall open to the left (counterclockwise) with non-rising stems and shall be provided with a 2-inch square operating nut.

Valves shall be complete when shipped and the manufacturer shall use due and customary care in preparing them for shipment to avoid damage in handling or in transit. Care shall be taken to see that all valves are completely closed before shipment.

All valves shall have restrained joint systems on each side of the valve.
All gate valves 14-inch and larger shall be horizontal with Mechanical Joint Ends - Bevel Gear Actuator.

3.18 BUTTERFLY VALVES (with underground operator) - All butterfly valves 24-inch and larger shall be of the tight closing, rubber-seat type that fully comply with the latest revision of AWWA Standard C504 where applicable. All butterfly valves shall be manufactured with a 250-psi rating. The valves shall be rated to operate at a sustained pressure of 250 psi. The manufacturer furnishing valves under the specification shall be prepared to show proof that the valves proposed meet the design requirements of the latest revision of AWWA Standard C504.

Valve Bodies shall be constructed of ductile iron ASTM A-536 Grade 64-45-12. End connections shall be as specified on plans. Flange drilling shall be in accordance with ANSI B16.1 Class 125 standard for cast iron flanges. Mechanical joint ends shall be per AWWA C110/A21.10. Body wall thickness shall be in strict accordance with the latest revision of AWWA C504 where applicable.

Valve Discs shall be made from ductile iron ASTM A-536, Grade 65-45-12. Discs shall be furnished with 316 stainless steel seating edge to mate with the rubber seat. The disc shall not have any hollow chambers that can entrap water. All surfaces shall be visually inspected and measurable to assure all structural members are at full design strength. Disc and shaft

connection shall be made with stainless steel pins. Valve discs shall rotate 90° from the fully open position to the tight shut position. Regardless of valve size, angular misposition of disc can be 1° off center without leakage. The manufacturer shall have manufactured tight-closing, rubber-seat butterfly valves for a period of at least five (5) years.

Valve Seat shall be Buna-N rubber located on the valve body. Seats shall be a full 360° without interruption and have a plurality of grooves mating with a spherical disc edge seating surface. Valve seats shall be field adjustable around the full 360° circumference and replaceable without dismantling operator, disc or shaft and without removing the valve from the line. Manufacturer shall certify that rubber seat is field replaceable.

Valve Shafts shall be stainless steel ASTM A-564 Type 630 Condition H-1150. Through shafts are not acceptable.

All Bearings shall be sleeve-type bearings, corrosion resistant and self-lubricating. Bearing load shall not exceed 1/5 of the compressible strength of the bearing or shaft material.

Shaft Seals shall be standard self-adjusting split V packing. Shaft seals shall be of a design allowing replacement without removing the valve shaft.

Valve operator shall conform to the latest revision of AWWA Standard C504 and shall be designed to hold the valve in any intermediate position between full open and fully closed without creeping and fluttering.

The **Valve Interior** and **Exterior Surfaces** except for the seating shall be coated with 8-10 mils of NSF certified liquid epoxy in accordance with AWWA C550 and AWWA C504, latest revisions.

All Valves shall be hydrostatic shell, and seal leak tested. The leak test shall be performed at a differential pressure of 250 psig with the disc in a closed position. Duration of seal leak test shall be ten minutes, where no indication of leakage shall be observed. In a slightly open position, internal hydrostatic pressure equal to 500 psi shall be applied to the inside of the valve body for ten minutes. During this time there shall be no indication of leakage through the metal, shaft seal, nor shall any part exhibit visible deformation.

All Valves shall have restrained joints systems on each side of the valve.

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3.19 TAPPING SLEEVES AND VALVES - For all pipes eight inches (8”) or less in diameter, a stainless-steel tapping sleeve shall be used and shall consist of a stainless-steel tapping sleeve and a valve with a flange outlet. For all pipes 10-inch (10”) thru 24-inch (24”) in diameter, tapping sleeves shall consist of a full body mechanical joint tapping sleeve and a valve with a flange outlet. For all pipes greater than 30-inches (30”) in diameter the tapping sleeve shall be rated at 200 psi working pressure. All valves shall conform to all applicable specifications for gate valves. In addition, all tapping sleeves shall be hydrostatically tested per manufacturer’s instruction for warranty purposes.

3.20 VALVE BOXES - Heavy roadway type concrete valve boxes shall be used as shown in standard water detail on project plans. Base section shall be enlarged to enclose and protect valve operating nut without being in contact with pipe or valve. Top section shall be adjustable for elevation. Cover shall be heavy cast iron with the word WATER cast in raised letters**.** The maximum number of concrete valve box sections (risers) stacked for any valve installation shall be six (6). Contractor shall use deeper risers as directed.

3.21 VALVE OPERATING NUT EXTENSIONS – Operating nut extensions shall be constructed of 2-inch-thick wall pipe with a 2-inch square female end attached to the valve operating nut and a 2-inch square male on the valve wrench end. Extensions shall have centering rings on the valve wrench end. Extensions shall be required when the valve nut exceeds 30-inched in depth from the top of the valve box lid.

3.22 FIRE HYDRANTS - Fire hydrants shall be iron bodied fully bronze mounted, hydrants manufactured to equal or exceed AWWA Standard C502, UL246 and FM1510 specifications latest revision. Hydrants shall be suitable for 150 psi working pressure and shall be subjected to a test pressure of 300 psi. Inlet connection shall be 6" mechanical joint. Main hydrant valve shall be reversible compression type, closing with the pressure, with 5 1/4" valve opening.

All hydrants shall be equipped with two 2 1/2" hose nozzles, one pumper nozzle, breakable safety flange and stainless-steel safety stem coupling. Bronze nozzles shall be securely locked to prevent them from blowing off. Hose threads shall be National Standard. Nozzle caps shall be equipped with non-kink chains. All fire hydrants shall be equipped with 5” forged 6061 T-6 aluminum STORZ on the pumper nozzle and a 5” aluminum STORZ pumper cap secured by Stainless Steel STORZ cap cable. The STORZ connection shall be painted yellow as described herein to match fire hydrant.

Hydrants shall be of the "dry barrel" type with an oil reservoir and provision for automatic lubrication of stem threads and bearing surfaces each time the hydrant is operated. Double O-ring seals shall be provided to keep water out of the hydrant top. Operating nut style, size and direction of opening shall be in accordance with **OWNER'S** standard or as noted on the drawings, and shall be equipped with a weather cap.

Hydrants shall be provided with automatic multi-port drain ports arranged to momentarily flush under pressure each time hydrant is operated. A positive stop shall be provided on the operating stem to prevent over travel when operating valve.

All fire hydrants shall include a 6-inch non-slam type check valve having a 100% unobstructed flow path and only one moving component. The check valve shall have a ductile iron body and bonnet with epoxy coated interior and exterior certified to NSF 61. The bonnet must be removeable (for easy inspection) with stainless steel bolts. The check valve shall have a minimum 250 psi pressure rating with a resilient disc/flapper with zero leakage at a backpressure above 5 psi. The check valve shall have a restrained joint that connects directly to the fire hydrant shoe.

Fire hydrants shall be supplied with a bituminous coating for buried portion of hydrant and a high visibility yellow enamel finish for above ground portions of the hydrant (including all three nozzle caps) except for the bonnet which shall be ordered in factory primmer gray. Inside of hydrant shoe shall be covered with thermoset epoxy coating.

3.23 **CASING PIPE -** Where called for on the drawings, water pipe shall be installed in casing pipe. Casing pipe shall be black steel pipe with minimum wall thickness as follows (unless otherwise noted on plans)**:**

Pipe Diameter	Casing Diameter	Wall Thickness
6"	12"	0.250”
8"	16"	0.250”
10"	18"	0.250”
12"	20"	0.250”
14"	24"	0.312”
16"	24"	0.375”
18"	30"	0.375”
20"	30"	0.375”
24"	36"	0.375”
30"	42"	0.375”
36”	54”	0.500”
42”	60”	0.562”
48”	72”	0.625”

3.23.1 Casing Spacers

All casing pipe with carrier pipe shall have casing spacers. The water line carrier pipe shall be inserted and centered within the casing by use of 8" stainless steel casing spacers

Casing spacer shall be a two-piece shell made from T-304 stainless steel of a minimum 14-gauge thickness. Each shell section shall have one bolt flange formed with ribs for added strength and one hook and eye section for added shear strength. Each connecting flange shall have a minimum of three 5/16" T-304 stainless steel bolts. The shell shall be lined with PVC extrusion to prevent slippage. Bearing surface (runners) shall be ultra-high molecular weight polymer with abrasion resistance and a low coefficient of friction. The runners shall be attached to support structures (risers) at appropriate positions to properly support the water pipe within the casing and to ease installation. The runners shall be attached mechanically by bolt. Risers shall be made of T-304 stainless steel of a minimum 10 gauge. All risers over 6" shall be reinforced and welded to the shell. All welds and metal surfaces shall be chemically passivated.

Configuration CENTERED positioning within the casing will require the risers and runners to be dimensioned to center the water pipe in the casing with a top clearance of one half-inch minimum. Spacer will be installed centered in the casing to provide restraint against movement of the water pipe. Installation shall be according to manufacturer's recommendation. Provide four runners per spacer.

For ductile iron carrier pipe less than 24" diameter, the spacers shall be a minimum of 8" wide and installed with a minimum of 4 spacers per joint unless a pipe joint exceeds 20 ft in length which would require additional spacers. A spacer should be installed to support the carrier within 2 feet of the ends of the casing pipe.

End Seals shall be installed on all ends of casing. Casing spacer end seals shall be a pull-over type construction and made from Neoprene with T-304 stainless steel bands for securing the ends of the end seal to the casing pipe and carrier pipe.

3.24 TYPE "A" SERVICE INSTALLATIONS

3.24.1 Fittings, Corporation Stops & Curb Stops - All fittings shall be constructed of 85-5-55 ASTM B612 brass. Curb Stops shall be 1/4 turn, full port with 200 psi minimum working pressure and shall be 1" compression X 1" ball valve X 1" Fipt.

3.24.2 **Meter Box** – – Meter boxes shall be a minimum 13” x 24” for Type A-1 and minimum 15” x 27” for Type A-2. Both shall have straight walls with white interior. Type A-1 boxes shall have a depth of not less than 18”. Type A-2 boxes shall have a depth of not less than 24”. Both boxes shall have a full cast iron meter box lid with 6” x 9” reader lid with AMR antenna hole plugged or a poly lid filled with light weight poly concrete with 6” x 9” reader lid with AMR antenna hole plugged. Meter boxes and lids shall have H-20 loading capacity. Boxes with a depth of 18” must be all one piece; not stacked and no extensions. Boxes with a depth of 24” may be all one piece or comprised of an 18” box with a 6” extension; no other stacked combinations are acceptable.

3.24.3 **Water Meters** - The District shall furnish meters.

3.24.4 **Meter Yoke** - Type A-1 Meter Yoke shall be compression by multipurpose tailpieces with 3/4” male iron pipe swivel on District side and 3/4” double purpose union swivel on customer side. Meter Yokes shall be one inch (1”) male inlet with 360° locking ball valve with 200 psi minimum working pressure and top loading full flow cartridge dual check with 3/4” dual purpose outlet.

Type A-2 Meter Yoke shall be compression by multipurpose tailpieces with 1” male iron pipe swivel on District side and 1” double purpose union swivel on customer side. Meter Yokes shall be one inch (1”) male inlet with 360° locking ball valve with 200 psi minimum working pressure and top loading full flow cartridge dual check with 1” dual purpose outlet.

3.24.5 **Service Saddles** - - Service saddles shall be stainless steel (single or 2-strap per manufacturer’s specification) with 304 stainless steel studs, nuts and washers Services on ductile iron pipe of minimum wall thickness as determined by **DISTRICT** shall be direct tap.

3.24.6 **Pipe** - Minimum one-inch PEXa pipe or other material as specified by plans shall be used throughout. Minimum one-inch (1”) pipe shall be used from the tap to the curb stop.

3.25 TYPE "B" SERVICE INSTALLATIONS (PRV installations)

3.25.1 Fittings, Corporation Stops & Curb Stops - All fittings shall be constructed of 85-5-55 ASTM B612 brass. Curb Stops shall be 1/4 turn reduced port with 200 psi minimum working pressure and shall be 1" compression X 3/4" ball valve X 1" Fipt.

3.25.2 Meter Box– Meter boxes shall be a minimum 17" x 30" and shall have straight walls with white interior. Boxes shall have a depth of not less than 24" and shall have a full cast iron meter box lid with 6" x 9" reader lid with AMR antenna hole plugged or a poly lid filled with light weight poly concrete with 6" x 9" reader lid with AMR antenna hole plugged. Meter boxes and lids shall have H-20 loading capacity. Boxes may be all one piece or comprised of an 18" box with a 6" extension; no other stacked combinations are acceptable.

3.25.3 Water Meters - The District shall furnish meters.

3.25.4 Meter Yoke - Meter Yoke shall be compression by multipurpose tailpieces with 3/4" male iron pipe swivel on District side and 3/4" double purpose union swivel on customer side. . Meter Yokes shall be one inch (1") male inlet with 360° locking ball valve with 200 psi minimum working pressure and top loading full flow cartridge dual check with 3/4" dual purpose outlet.

3.25.5 Regulator – Pressure Regulator shall be installed as directed

3.25.6 Service Saddles - - Service saddles shall be stainless steel (single or 2-strap per manufacturer's specification) with 304 stainless steel studs, nuts and washers Services on ductile iron pipe of minimum wall thickness as determined by **DISTRICT** shall be direct tap.

3.25.7 Pipe - Minimum one-inch PEXa pipe or other material as specified by plans shall be used throughout. Minimum one-inch (1") pipe shall be used from the tap to the curb stop.

3.26 MARKER POSTS

3.26.1 Curb Stop -C**urb stop** locations will be marked with a two (2") inch PVC post at a minimum of seven (7) feet long. Post shall be driven a minimum of 36 inches (36") in the ground beside curb stop and shall have a minimum height of 48 inches (48") above ground. Post shall have a blue sticker installed on the top 12 inches (12") (Sticker to be furnished by the Utility).

3.26.2 Valve locations outside the roadway and along the water line shall be marked by an approved Marker Post. The Post shall be 90" in length with a direct bury base. Post shall be Blue in color topped with a Black cap. Caps shall have white reflective decals installed on each side. Marker post shall read "Warning Water Pipeline." Post shall be equipped with internal tracer wire terminals beneath the removable cap. Cap shall be equipped with an optional Cap Lock and the Utility shall be provided 2 keys with each installation project (i.e. 2 keys for each completed and accepted project, phase, section or subdivision). Post shall be direct bury and shall be cut to length as needed per location.

3.26.3 Tracer Wire -Tracer Wire shall be installed on **ALL** pipe including Ductile Iron Pipe. However, tracer wire shall not be directly taped to HDPE, or PEX pipe but shall instead be installed three inches (3") above pipe within the 12 inches (12") stone backfill above the pipe. Tracer wire shall be constructed of a steel inner core with a copper cladding metallurgically bonded to the surface. Tracer wire shall be #12 AWG with a copper clad conductor with an O.D. of 0.0808", 0.045" HDPE insulation for an overall wire O.D. of 0.171" #12 AWG wire shall have a minimum tensile strength of 452 lbs. Wire shall be blue in color and shall either be attached directly to the pipe as it is installed, and/ or installed atop the gravel cover as directed by the resident Inspector. If a field splice cannot be made at a locator post, a SCB-01 for direct splices and 3WB-01 for third leg add-ons, such as services or new taps, shall be used. **CONTRACTOR** shall demonstrate the continuity of all tracer wire installed prior to acceptance of the project by the **DISTRICT**.

3.27 FLOWABLE FILL – All flowable mortar shall be in accordance with the Standard Specifications for Road and Bridge Construction except as modified herein.

MATERIAL	SUBSECTION
Portland Cement, Type I	901.01
Fly Ash, Class C or Class F	AASHTO M295
Water	918.01
Chemical Additives	918.09

Fine aggregate shall conform to the requirements Subsection 903.01.

Fine aggregate for concrete except that the gradation shall be as follows:

SIEVE SIZE	PERCENT PASSING
¾ - inch	100
No. 200	0-10

Flowable fill mortar shall be proportioned as follows:

MATERIAL	PER CUBIC YARD
Portland Cement, Type I	100 lbs. (Maximum)
Fly Ash, Class C or Class F	250 lbs. (Minimum)
Fine Aggregate	2800 lbs.
Water	60 gal (Approximate)

The above proportions may be adjusted by the ENGINEER to obtain the consistency required for satisfactory flow. Consistency shall be determined as follows:

Place an open-ended cylinder (pipe) three inches in diameter by six inches in height in an upright position on a smooth, level surface. Fill the cylinder with a representative sample of the flowable fill mortar proposed for use. Remove the cylinder by lifting it straight up thus allowing the sample to diffuse on the smooth, level surface. The flowable fill mortar should diffuse into a circular shape having an approximate diameter of not less than eight inches.

4 EXCAVATION & BACKFILL

4.1 GENERAL – The **CONTRACTOR** shall perform all required excavation and backfilling incidental to the installation of water mains and other appurtenances under this contract. Excavation shall be carried to the depths indicated on the drawings or as necessary to permit the installation of pipe, bedding, structures or appurtenances. Care shall be taken to provide a firm, undisturbed, uniform surface in the bottoms of trenches and excavations for structures. Where the excavation exceeds the required depth, the **CONTRACTOR** shall bring the excavation to proper grade with an approved incompressible backfill material (generally crushed stone or fill concrete, depending upon the nature of the facility to be placed thereon). In the event unstable soil conditions are encountered at the bottom of the excavation, the **INSPECTOR** may direct the **CONTRACTOR** to continue the excavation to firm soil or to provide pilings or other suitable special foundations.

The **CONTRACTOR** shall take such precautions as may be necessary to avoid endangering personnel, pavement, adjacent utilities or structures through cave-ins, slides, settlement or other soil disturbance resulting from his operations.

Backfilling shall be carried out as expeditiously as possible but shall not be undertaken until the **INSPECTOR** has been given the opportunity to inspect the work. The **CONTRACTOR** must carry out all backfilling operations with due regard for: the protection of pipes, structures and appurtenances; the use of prescribed backfill materials; and procedures to obtain the desired degree of compaction.

The **CONTRACTOR** shall be responsible for storage of excavated material, disposal of surplus excavated material, trench dewatering and other operations incidental to excavation and backfilling operations.

4.2 CLASSIFICATION OF EXCAVATION – Excavation shall be unclassified on this project.

4.3 **TRENCH EXCAVATION –** Trenches shall be neatly excavated to the alignment and depth required for the proper installation of pipe, bedding material and appurtenances. Trenches shall be opened far enough ahead of pipe laying to reveal obstructions, but in general shall not include more than 300 feet of continuous open trench at any time. The **CONTRACTOR** will be required to follow up trenching operations promptly with pipe laying, backfill and clean-up, and in event of failure to do so, may be prohibited from opening additional trench until such work is completed.

4.3.1 **Closures** - The **CONTRACTOR** shall plan his operations so as to cause a minimum of inconvenience to property owners and to traffic. No road, street or alley may be closed unless absolutely necessary, and then only if the following conditions are met:

- Permit is secured from appropriate State, County or Municipal authorities having jurisdiction.
- Fire and Police Departments are notified before road is closed.
- Suitable detours are provided and are clearly marked.
- Traffic Control plans shall be submitted to and approved by the City of Murfreesboro's traffic engineer prior to any road closures that lie within the Murfreesboro city limits.

No driveways shall be cut or blocked without first notifying the occupant of the property. Every effort shall be made to schedule the blocking of drives to suit the occupant's convenience, and except in case of emergency, drives shall not be blocked for a period of more than eight (8) hours.

The **CONTRACTOR** shall furnish and maintain barricades, signs, flashing lights, and other warning devices as necessary for the protection of public safety. Flagmen shall be provided as required on heavily traveled streets to avoid traffic jams or accidents.

4.3.2 **Trench Geometry -** Trench width shall be held to a minimum consistent with proper working space for assembly of pipe. Minimum trench width shall be diameter of pipe plus twenty-four inches (24"). Maximum trench width up to a point one foot above top of pipe shall be limited to the outside pipe diameter plus thirty inches (30"). Boulders, large stone, shale and rock shall be removed to provide clearance of eight inches (8") below the pipe and replaced with Type "A" crushed stone.

Trench walls shall be kept as nearly vertical as possible with due consideration to soil conditions encountered and when necessary,

sheeting or bracing shall be provided to protect life and property.

Where unstable soil conditions are encountered at the trench bottom, the **CONTRACTOR** shall remove such additional material as may be directed by the **INSPECTOR** and replace the excavated material with Type “A” crushed stone.

The **CONTRACTOR** shall excavate by hand wherever necessary to protect existing structures or utilities from damage or to prevent over-depth excavation in the trench subgrade.

Excavated material shall be stored safely away from the edge of trench and in such a way as to avoid encroachment on private property.

The trench shall be excavated to sufficient depth to permit a minimum of thirty-six inches (36”) of cover to be maintained over the top of water mains below final grade of road or drainage ditch. The bottom of the trenches must be excavated to a point 8 inches below pipe and brought back to grade with Type “A” crushed stone. The bottom of the trenches must be shaped by hand and bell holes must be dug so that the full length of the pipe is resting on trench bottom. Blocking shall not be used, and neither shall the pipe be laid on a trench bottom that has not been leveled to provide support throughout the full length of the pipe.

The bottom of all trenches for service pipe must be excavated to a point 6 inches below the pipe and brought back to grade with Type “B” (quarter-down) crushed stone.

4.3.3 Obstructions - The **CONTRACTOR’S** attention is called to the fact that the thirty-six inches (36") depth of cover is a minimum and may be exceeded in instances where obstructions are encountered in trenching operations. The **CONTRACTOR** will be permitted to lay the water pipe above the obstruction only if the minimum cover required can be obtained while providing a cushion at least eight (8") thick between the bottom of the pipe and the top of the obstruction. Where this minimum cover and the required clearance cannot be obtained, the **CONTRACTOR** will be required to lay the pipe under the obstruction and will receive no additional compensation for the additional depth of trench required for constructing the line in this manner. The **CONTRACTOR** will also be required to gradually increase the depth of trench when approaching cuts, creek banks, or other changes in grade in order to avoid the use of fittings, wherever it is practical to do so.

4.4 **EXCAVATION FOR STRUCTURES -** Excavation for structure shall be only as large as may be required for the structure and for working room around the structure. In earth, excavation shall generally extend to the outer limits of the structure at the bottom and shall slope outward at such angle as may be required for stability of excavated face. In rock, excavation shall be carried to a point eight inches (8") outside the structure so that no rock is left within eight inches (8") of the finished structure.

Care shall be taken as the excavation approaches the desired grade to avoid over-depth excavation and provide a firm and undisturbed soil surface on which footings, slabs or foundations are to be placed. Should the **CONTRACTOR** excavate below the desired grade level, the excavation shall be brought to grade using concrete or compacted crushed stone at the expense of the **CONTRACTOR**. The use of tamped earth backfill under foundations, footings or slabs will not be acceptable.

Where structures rest partially or wholly upon rock, the rock shall be excavated to a point eight inches (8") below bottom of structure and compacted crushed stone shall be used to bring the excavation back to grade, provided however, that where the structure will rest completely on sound solid rock, the **ENGINEER** may at his discretion permit the footing, foundation or slab to be placed directly upon the rock surface.

Where the **CONTRACTOR** is permitted to place concrete directly on the rock, all dirt and weathered rock shall be removed, and any seams or crevices shall be cleaned and filled with grout or mortar prior to placement of the structural concrete.

Should the material found at the desired subgrade appear to be unstable or otherwise unsuitable for support of the structure, such condition shall be immediately called to the attention of the **ENGINEER**. The **ENGINEER** may direct that such unsuitable material be removed and replaced with compacted crushed stone.

The **ENGINEER** may modify the foundation design to suit the condition, or he may determine that the bearing capacity of the material is suitable for the load to be supported; but in any case, he shall provide written instructions to the **CONTRACTOR** as to the procedure to be followed.

4.5 **ROCK EXCAVATION -** Rock excavation shall consist of loosening, removing and disposing of all rock larger than 9 cu. ft. in volume, which in the opinion of the **ENGINEERS** can only be removed by blasting or other equivalent methods. Such materials to be classified as solid rock shall include boulders, bed rock, or solid concrete but shall not include pavement or shoaly materials that can be loosened by other methods.

Where rock excavation is encountered in trenches the excavation shall be carried to a depth of eight inches (8") below the bottom of the pipe. The rock shall also be removed to a width of at least the minimum trench width as delineated in Section 4.3 **"Trench Excavation."** Where rock is excavated in the bottom of the trench, the trench shall be brought back to grade using Type "A" **crushed stone**.

The **CONTRACTOR** shall exercise all necessary precautions in blasting operations. Suitable blasting mats shall be provided and utilized as required. Blasting shall be done only by experienced, licensed, and insured personnel. Careless shooting, resulting in the ejection of stones or other debris during blasting, shall be corrected immediately by the **CONTRACTOR'S** representative.

No blasting shall be done unless the **CONTRACTOR** has taken out the necessary insurance to fully protect the **OWNER** from all possible damages resulting from the blasting operations. The blasting shall be done in accordance with all recognized safety precautions and in accordance with regulations of authorities having jurisdiction. In addition, the **CONTRACTOR** shall exercise the necessary care to safeguard and adequately protect stored blasting materials. The **CONTRACTOR** is responsible for a pre-blast survey and any damages caused by blasting.

Where rock is encountered in the immediate vicinity of gas mains, telephone cables, building footings, gasoline tanks, or other hazardous areas the **CONTRACTOR** shall remove the rock by means other than blasting. Care shall be taken in blasting operations to see that pipe or other structures previously installed are not damaged by blasting. In general, blasting shall not be done within twenty-five feet (25') of the completed pipeline.

Excavated rock that cannot be utilized in trench backfill as permitted under Section 4.9 shall be removed from the site and disposed of as directed by the **ENGINEERS**.

4.6 **REMOVAL OF WATER -** The **CONTRACTOR** shall be responsible for handling run-off and ground water in such a way as to maintain trenches and excavations in a dry condition until the work is completed. Pumps, piping, well points, labor, fuel, and other facilities necessary to control, intercept, remove and/or dispose of water shall be provided by the **CONTRACTOR** at his own expense.

Water shall be kept out of trenches and other excavations to the extent necessary to protect the supporting strength of the foundation material, permit efficient and satisfactory assembly or replacement of facilities, and to prevent floating or misalignment. Water removed form trenches or holes shall be discharged to natural drains in such a way as to avoid danger or damage to adjacent property owners or sewers.

Where the **CONTRACTOR** fails, refuses, or neglects to control water in trenches or other excavations, and corrective work is deemed by the **ENGINEER** to be necessary as a consequence thereof, such work shall be at the **CONTRACTOR'S** expense.

4.7 **STORAGE OF EXCAVATED MATERIAL -** Excavated material shall be deposited in such a manner as to avoid danger to workmen, water line, or traffic, and to cause minimum inconvenience through blocking of drives, sidewalks, natural drains, etc. Where indicated on the drawings, or necessitated by conditions prevailing, the **CONTRACTOR** shall haul away and stockpile excavated material.

4.8 **DISPOSAL OF SURPLUS EXCAVATED MATERIAL -** Excavated material that is unsuitable or unnecessary for backfilling shall be removed from the job site and disposed of at the **CONTRACTOR'S** expense. The **CONTRACTOR** must not sell or give away surplus excavated material suitable for backfilling or surfacing until the excavation has been refilled and surfaced. **CONTRACTOR** shall have the approval of each property OWNER and the **DISTRICT** prior to the removal of excess material. The **CONTRACTOR** shall make his own arrangements for disposal. If excavated material is crushed on-site to be used for bedding, backfilling, or surfacing material, all material must be used on-site. If surplus material is generated from crushing the excavated material on site, the **CONTRACTOR** is responsible for obtaining any necessary permits from local authorities for removal and disposal off site.

4.9 **BACKFILL FOR TRENCHES -** Backfilling of trenches will proceed as pipe laying progresses so that the trench will be filled in as rapidly as possible after the pipe has been assembled and inspected. The **CONTRACTOR** shall, however, afford the inspector ample opportunity for observing and to GPS the assembled pipeline before placing the backfill and, if requested by the inspector, delay the backfilling operation when the inspector is not present at the site.

Should the **CONTRACTOR** fail, refuse or neglect to systematically exclude or remove oversize rock from the backfill material, he may be required to place and compact the backfill material by other suitable methods which will ensure the rocks being removed.

No cuttings from any trenching operations shall be used as bedding or backfill until the crushed stone backfill reaches a depth of twelve inches (12") over the top of the pipe,

The backfill for areas not ordinarily subjected to traffic, may consist of suitable excavated material placed by machine after the crushed stone backfill reaches a depth of twelve inches (12") over the top of the pipe, and the backfill shall be compacted by means of a suitable wheeled

vehicle such as a tractor or front end loader running longitudinally along the trench. After the backfill has been compacted in this manner, additional fill material shall be placed in the trench to restore the original grade and provide a slight mound over the trench. This material shall again be compacted by means of a suitable wheeled vehicle. **No rock larger than six inches (6") in any dimension may be used in the backfill over the pipe and no rock larger than one half inch (1/2") may be used in the top six inches (6") of the backfill.**

Crushed stone backfill up to the spring line of the pipe shall be placed as pipe laying progresses in order to maintain proper grade and alignment. Additional backfill shall not be placed until after the pipe has been inspected by the **ENGINEERS** and approved for backfill.

The backfill around all service lines shall consist of twelve inches (12”) of Type “B” crushed stone.

4.9.1 Categories - Backfilling procedures will normally fall under three categories as follows:

- Category One – Under streets, highways and driveways with permanent type pavement (hot mix, concrete, etc.).

- Category Two – In areas subject to light or occasional traffic, either under temporary paving such as surface treatment, or in unpaved areas (this category will include road shoulders, unless otherwise indicated on plans).
- Category Three – Open field or other areas not covered under Item 1 or Item 2 above.

4.9.1.1.1. Category One - Backfill under streets, or highways having permanent type pavement as indicated in category one shall consist of crushed stone suitably compacted for a depth of twelve inches (12”). Type “A” crushed stone (No. 67 stone) shall be carefully placed around and under the pipe in layers not to exceed six inches (6") in depth and shall be compacted by means of hand tamps or other approved tamping procedure. Type “B” crushed stone (quarter-down) shall be placed and compacted in the top twelve inches (12”) of all trenches subject to traffic. For all City and County Roads, the area from 12 inches (12”) above the pipe to 10 inches (10”) below the surface shall consist of flowable fill. Above the flowable fill, eight inches (8”) of TDOT 307 “B” Modified Binder shall be placed as per TDOT specifications. The top 2 inches (2”) shall consist of TDOT 411 “E” Mix extending 50 feet on each side of the ditch, or as directed. This 50-foot area shall be milled to 2 inches (2”) in depth to accommodate the placement of the “E” mix.

4.9.1.2. Categories Two and Three - For categories two and three, the backfill around and up to a point twelve inches (12") above the top of the pipe shall be Type “A” crushed stone (number 67 stone). When the backfill has been placed to a depth at least twelve inches (12") above the top of the pipe, the remainder of the backfill in category two (areas subject to light traffic) shall consist of suitable excavated material placed and compacted in layers not exceeding twelve inches (12") in depth. No rock larger than six inches (6") in any dimension may be included within the backfill. In the event the excavated material is not suitable backfill material, additional crushed stone backfill will be required.

4.10 **ACCEPTABLE BACKFILL MATERIAL -** Where crushed stone backfill is required, the crushed stone shall be the specified size as designated by Tennessee Department of Transportation Specifications and shall meet all requirements of the TDOT Specifications for crushed stone used in road surfacing**.** If stone is to be crushed on-site, the material used as backfill must be certified to meet TDOT specifications.

Where crushed stone is not required, but the excavated material is unsuitable for use in the backfill, the **CONTRACTOR** may use fine dry selected earth or clay as backfill material. **Material containing excessive organic matter, stumps, roots, refuse or foreign matter or hard clay lumps that cannot readily be compacted will not be acceptable for use as backfill**.

5 PAVEMENT REPLACEMENT

5.1 GENERAL - The **CONTRACTOR** shall be responsible for replacement of pavement removed or damaged by his operations. Pavement replacement shall be in accordance with this section of the specifications and in every case shall be equal to or better than the quality of pavement damaged or removed. The **CONTRACTOR** shall also be responsible for subsequent pavement failures during the warranty period, where such failures occur over or adjacent to trenches or other excavations by the **CONTRACTOR** and result from insufficient compaction of the backfill.

5.2 PAVEMENT REMOVAL - Where existing paved streets, roads, parking lots, drives or sidewalks must be disturbed during construction of the project the **CONTRACTOR** shall take the necessary steps to minimize damage. Permanent type pavement shall be cut or sawed in a straight line before removal and care shall be taken during excavation to avoid damage to adjacent pavement. Where trucks or other heavy equipment must cross curbs or sidewalks, such areas shall be suitably protected.

5.3 PAVEMENT REPLACEMENT - Before trenching in paved areas the **CONTRACTOR** shall cut through the pavement in a straight line along the sides of the proposed trench so that the pavement may be removed, and the trench may be dug without damage to the adjacent pavement. During construction suitable precautions shall be taken to protect the pavement edges and surfaces and minimize damage.

As soon as the pipe has been installed the trench shall be backfilled as specified in Section 4.9 and a temporary pavement patch shall be provided in paved areas. The temporary pavement shall consist of a single or double surface treatment which will protect the base, prevent "potholes" or "chuck holes" and provide a reasonable smooth pavement surface until the permanent patch is made.

The permanent pavement patch shall not be made until the job is nearing completion in order to allow maximum time for any further settlement. The permanent pavement patch shall conform to the following schedule:

- **Principal highways, including traffic lanes, and turn lanes** - Eight inches (8") thick reinforced concrete slab over excavated areas plus two inches (2") of hot plant mix.

- **Paved parking areas, paved shoulders, turnouts and driveways with bituminous concrete or equivalent surfacing** - two inches (2") of TDOT 411 “E” mix extending two feet (2’) each side of trench wall and over eight inches (8") of crushed stone base.

- **Secondary streets, parking areas, shoulders, turnouts and driveways with surface treatment or equivalent pavement** - double surface treatment over eight inches (8") crushed stone base. Replacement shall be of equal to the original.

- **Concrete driveways, sidewalks, curbs and gutters, etc.** -Class A concrete of thickness equivalent to original construction.

- **County Roads** - Two inches (2") of TDOT 411 “E” Mix topping (trench width plus 50 feet) over eight inches (8") of TDOT 307 “B” modified binder extending three feet (3’) beyond each side of the trench wall in accordance with applicable County Road requirements.

- **City Roads** - Two inches (2") of TDOT 411 “E” Mix topping (trench width plus 100 feet) over eight inches (8") of TDOT 307 “B” modified binder. The volume twelve inches (12”) from the top of the pipe to the bottom of the binder shall consist of flowable fill. All materials and workmanship shall be in strict accordance with City Road requirements.

The hot mix and surface treatment applications shall be in accordance with standard specifications and recommended practices of the Tennessee Department of Transportation.

Pavement replacement for all County roads shall extend a minimum of twenty-five feet (25’) beyond each side of trench wall and for all City roads shall extend a minimum of fifty feet (50') beyond each side of the trench line and shall include replacement of all defective pavement resulting from the **CONTRACTOR’S** operations, regardless of whether caused by blasting, trenching, equipment operation, cave-in or other cause. The area on each side of the trench shall be milled to a depth of two inched (2”) and two inches (2”) of TDOT 411 “E” Mix placed in accordance with the latest TDOT specifications. Irregular or uneven patches will not be permitted.

The **CONTRACTOR** shall be responsible for maintaining temporary patches during construction and shall promptly repair any defects. Upon completion of the work the paved surfaces shall be left in as good or better condition than before the start of construction.

The **CONTRACTOR** shall obtain a road cut permit and contract from the County Highway Department for each County Road crossing or from Murfreesboro city street department if within Murfreesboro city limits. The **CONTRACTOR** shall conform to all conditions of said permit and any additional local jurisdiction requirements and bear all costs associated with said permit.

6 INSTALLATION OF WATER PIPE AND ACCESSORIES

6.1 GENERAL – Prior to installation of any water pipe and accessories the **CONTRACTOR** shall submit all shop drawings to the **DISTRICT'S** engineering department for review and approval. Water pipe shall be furnished and installed in accordance with details shown on the drawings. The work shall be done by experienced workmen employed by a general contractor licensed in the State of Tennessee with the appropriate classification. Pipe, fittings, valves and accessories shall be installed in strict accordance with these specifications and the recommendations of the manufacturer. Gaskets, bolts, lubricants and other accessories shall be furnished by or as recommended by the manufacturer.

The **CONTRACTOR** shall use top quality materials throughout and shall exercise care in the storage, handling and installation of the pipe and accessories. Trench bottoms shall consist of a minimum of 8 inches of crushed stone and must be carefully graded by hand to provide continuous support for the pipe except at bells where bell holes must be dug.

No pipe, services, valves, fire hydrants, or any other water accessory shall be installed, backfilled, tested, or handled when the ambient air temperature falls below 20^{o}F (degrees Fahrenheit).

6.2 HANDLING PIPE AND ACCESSORIES - All water pipe, fittings, valves and other appurtenances shall be stored in a protected location where they will not be subject to physical damage or contamination. Pipe may be delivered to the trench site only if it is unloaded with suitable mechanical equipment and left in an area where it will not be a hazard or obstruction and will not be subject to flooding. Pipe, fittings, valves, hydrants shall not be rolled or dropped from trucks or trailers and shall not be left in roadside ditches.

Pipe clamps, slings, hooks, hoists, booms or other equipment as required for safe and efficient handling of pipe and accessories shall be provided at the trench site whenever pipe laying is in progress.

A suitable swab or brush shall be provided and shall be run through each joint of pipe to insure the removal of dirt and foreign objects. The pipe shall be inspected for defects immediately before being lowered into the ditch.

6.3 INSTALLATION OF DUCTILE IRON PIPE - Ductile iron pipe shall be installed in accordance with AWWA Standard C600 and the manufacturer's recommendations using Laying Condition Type 4 as a minimum unless a more stringent condition is stipulated in Section 4 of these specifications or as shown on plans.

After the pipe has been swabbed and inspected it shall be lowered into the trench. The spigot end of the pipe and the bell or socket of the previously laid pipe shall be wiped clean. The gasket shall be lubricated and inserted, lubricant shall be applied to the pipe, and the joint shall be made up by shoving the pipe home. All water pipe gaskets shall be maintained at a minimum temperature of 40^{o}F until the pipe is installed. Care shall be taken to ensure that the gasket is not twisted or dislodged and that the pipe spigot is inserted at the proper distance into the socket. When making up mechanical joints the bolt shall all be tightened to the proper torque at the time the joint is made up to ensure proper torque and even spacing between the gland and the face of the flange at all points by partially tightening and alternating between top and bottom bolts in a stepwise manner.

Pipe shall be cut with a suitable wheel or power saw and shall be neat and true with cut being made perpendicular to pipe axis.

A coarse file or power grinder shall be used to smooth the face of the cut and bevel the outside edge to prevent damage to the gasket.

Fittings and valves shall be installed in the line as shown on the drawings and as directed by the **ENGINEER**. Valves shall be installed in a horizontal run of pipe with valve stem in a vertical position. Buried valves shall have a two inch (2") square operating nut and extension stems shall be provided as required to bring the operating nut to within thirty inches (20") of the finished ground surface.

Pipes shall be laid to a reasonably uniform grade without kinks or other irregularities. Curves or changes in grade will be laid by making deflections at the pipe joints where feasible but the maximum permissible deflections shall be as shown in published tables of the Ductile Iron Pipe Research Association.

6.4 **INSTALLATION OF PIPE AT SEWER CROSSING –** When installing water main perpendicular to a sanitary or storm sewer, the water main, whenever possible, shall be installed over the sewer and a minimum of eighteen inches (18”) of vertical clearance shall be between the bottom of the water main and the top of the sewer line. If the vertical clearance that can be obtained is less than eighteen inches (18"),

- The sanitary sewer main or water main shall be encased to ten feet (10') on each side of the crossing, for a total of twenty feet (20").
- The section of sewer main crossing the water main shall be constructed of ductile iron and tested as delineated in Section 7.2 of these specifications.

Water mains installed under sewers shall have:

- a vertical separation of at least eighteen inches (18") between the bottom of the sewer and the top of the water line.
- adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking the water mains.
- that the length of water pipe be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.
- both the sewer and the water main shall be constructed of ductile iron and tested as delineated in Section 7.2 of these specifications.

6.5 **INSTALLATION OF PIPE UNDER ROADWAYS** – Water main installed under roadways shall be ductile iron pipe with restrained joint fittings. In addition, the water main shall be encased following the specifications listed under Section 3.23. Steel casing shall be used with an auger bore and HDPE pipe shall be used with a directional bore.

6.6 **INSTALLING FIRE HYDRANTS -** Fire hydrants shall be located as shown on the Plans and as directed by the **ENGINEER**. The hydrant shall be set in a vertical position at the edge of the street right-of-way with the pumper nozzle facing the street.

The hydrant shall be set on a poured in place concrete pad, which shall also serve as a kicker against the undisturbed trench face.

The concrete shall have horizontal and vertical bearing areas of at least 3 square feet against the undisturbed trench bottom and side respectively but shall not cover the flanges or drain ports. At least 7 cu. ft. of crushed stone shall be provided around the hydrant for drainage.

Hydrants shall be set so that the finished ground level will be just below the breakable flange or at the bury level indicated on the hydrant; however, no more than two extensions shall be used to get fire hydrant to ground level.

The lower barrel of the hydrant shall be of sufficient length to enable the hydrant head to be installed horizontally even though the hydrant may be in an embankment.

Installed hydrants shall have an undamaged enamel coating and oil reservoirs shall be filled.

6.7 THRUST BLOCKS OR RESTRAINTS - Poured in place concrete thrust blocks must be provided at all points of unbalanced pressure where the pipeline could pull apart. Thrust blocks shall conform to details and minimum bearing areas as shown on the drawings and shall bear against the undisturbed trench face. Contractors may elect to use an approved type of locked flexible joint extending on each side of bend as per standard drawings.

All fittings, valves and hydrants shall be installed with mechanical restraint joints.

Where over bends (downward bends) cannot be avoided the fitting must be held in place by one of the following methods:

- Poured concrete under pipe of sufficient volume to counteract unbalanced force with steel clamp and anchor bolts to hold fitting to concrete as per standard drawings.

- Approved type of locked flexible joint extending on each side of bend as per standard drawings.

6.8 VALVE BOX INSTALLATIONS - Valve boxes shall be centered over the valve operating nut and installed in a vertical position. Box shall be of the proper length to extend to the ground surface and allow the adjustable upper section to be positioned approximately midway between upper and lower limits. Backfill shall be carefully tamped around valve box and suitable support shall be provided under and around the upper section to prevent future settlement. All valve boxes shall include a valve box alignment device and shall be Boxlok by EMMA Sales or approved equal.

6.9 CONNECTIONS TO EXISTING MAINS – The **CONTRACTOR** shall make connections to existing mains as shown on the drawings or described herein. Connections to existing mains presently in service shall be made with tapping sleeves and valves without taking the existing main out of service.

The **CONTRACTOR** shall coordinate with the **DISTRICT** to make all existing main line taps up to twenty-four inches (24”) in diameter, subject to current associated tapping fees. Arrangements to tap main lines larger

than twenty-four inches (24”) in diameter shall be contracted through a third party but coordinated through the **DISTRICT**. Where connections are to be made to pipe previously installed but not placed in service, the **CONTRACTOR** shall remove existing plugs and make the tie in by use of mechanical joint sleeves. Plugs removed from existing mains shall remain the property of the **DISTRICT** and shall be protected from damage or loss until they are turned over to the designated representative of the **DISTRICT**.

Where existing mains must be valved-off to make connections, the **CONTRACTOR** shall notify the District not less than twenty-four (24) hours prior to the making of the connection and the actual time of the service interruption shall be subject to approval by the **DISTRICT**.

It shall be the responsibility of the **CONTRACTOR** to measure outside diameters of existing pipes before ordering tapping sleeves or other fittings intended for connecting to existing mains.

6.10 SERVICES AND SERVICE REPLACEMENTS AND RECONNECTIONS - Services shall be installed as indicated on drawings and at locations as directed by **ENGINEER**. In all applications, the **CONTRACTOR** shall furnish and install three-inch (3”) Schedule 80 PVC or DR 13.5 HDPE pipes as casings for service line that cross under streets. Where applicable, the PVC casings shall be installed before road base stone is applied and excavation for casing shall be backfilled with crushed stone to the full depth. Care shall be taken to maintain not less than thirty inches (30") minimum cover over service line, including ditch line crossings. All service line crossings of existing paved roads shall be installed with casing pipe by boring and jacking, or by horizontal directional boring using DR 13.5 HDPE pipe. Pneumatic punching under any County, State or Federal road is prohibited. In addition, no couplings shall be installed on service lines that are encased under the roadway.

6.11 PROTECTION OF PIPE - Whenever pipe laying operations are suspended for any reason, including lunch hour or temporary interruptions, a test plug shall be inserted in the open ends of the pipe.

The installed pipe shall always be adequately protected against the entrance of dirt, animals, mud, sewage or other foreign material. Pipe shall not be laid in a ditch containing standing water.

6.12 EXISTING SERVICE RENOVATION - Where directed by **ENGINEER**, the **CONTRACTOR** shall excavate the existing meter box and service pipe necessary to install approved water pressure regulator in existing service line. Fittings, nipples and new meter box shall be approved by **ENGINEER** prior to start of renovation. Excavation, installation and

backfill shall conform to good construction practices and these specifications.

6.13 REPAIR OF WATER FACILITIES - In the event a water leak occurs in any water line or if any other defect is discovered, the water line in question shall be removed as directed from the trench and made available to the **DISTRICT**. The length of the water line to be removed shall be determined by the **DISTRICT'S** Inspector. The replacement pipe shall be inspected and approved by the **DISTRICT'S** Inspector. The pipe shall be reconnected by use of solid MJ long sleeves with an approved restrained joint system. All applicable portions of these specifications shall be adhered to in performing the removal and replacement of damaged/defective pipe.

If a leak or any defect is discovered in any other water system component, said component shall be removed and replaced as directed. The on-site repair of any defective water system component will ***NOT*** be allowed.

7 TESTING AND DISINFECTION - WATER MAIN

7.1 GENERAL - Upon completion of the construction work under this contract all water lines shall be disinfected and subjected to the necessary pressure and leakage tests. In the event the pressure or leakage test is unsatisfactory, or bacteriological tests indicate that disinfection is incomplete, corrective measures shall be taken and the tests repeated until satisfactory results are obtained.

7.2 PRESSURE AND LEAKAGE TESTS - All water lines shall be subjected to a hydrostatic pressure of 200 psi or 1.5 times the working pressure as determined by the **ENGINEER**, whichever is greater for a period of two (2) hours, and any defective work revealed by the test shall be repaired or replaced by the **CONTRACTOR.**

The amount of leakage under the stated pressure shall be no greater than as calculated in

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

where L is allowable leakage in gallons per hour, S is the length of pipe tested in feet, D is pipe diameter in inches and P is test pressure in psi. Should the amount of leakage exceed the above limit, the CONTRACTOR shall locate and repair the defective joints until the leakage is within the specified limits.

In no event shall the leakage exceed the allowable leakage as per the latest revisions of the AWWA Standards.

All services shall be installed and tested with the main lines as directed by the **DISTRICT**.

The **CONTRACTOR** shall provide all labor, tools, equipment and materials for making the tests.

The **CONTRACTOR** should note that 200 psi test pressure is required although some large Butterfly Valves are bottle tight only to 150 psi across the valve. Attention should be given that at least 50 psi system pressure be on the low side or that valve be installed such that direction of pressure is on that face of the valve closure that provides the highest bottle tight pressure.

7.3 **DISINFECTION -** All water lines, including pipe, valves, meters, etc., shall be disinfected prior to being placed in service in accordance with the latest revision of AWWA C651 Standards, after the system has been flushed to remove dirt or foreign objects which may have been accidentally introduced into the line.

For this work, the **CONTRACTOR** shall furnish suitable plugs or caps for the pipe, injection pumps, pipe connections, chlorine and other equipment with all labor required.

The **CONTRACTOR** shall provide sample connections with valves and piping at the beginning, end, and at a maximum of 1,200-foot intervals or as directed by the **DISTRICT** as required to meet approved standards

The method of chlorine residual testing shall be the DPD color comparator method. While the disinfectant is being applied to any section of the system, the water shall be allowed to escape all extremities of this section. After the main is filled with water, chlorine residual shall be checked and be a minimum of 25 mg/l. The disinfectant shall be allowed to remain in the pipe for 24 hours, after which the main shall be tested and have residual chlorine of at least 10 mg/l. The main shall then be thoroughly flushed until only the residual chlorine found in tap water is present. The main shall be held another 48 hours after which the main shall be tested and have residual chlorine of at least 0.2 mg/l. If the main has residual chlorine of at least 0.2 mg/l, the sample points are then flushed until residual chlorine found in tap water is present and samples are taken. If the main does not have residual chlorine of at least 0.2 mg/l, samples are not taken and the main is flushed until only the residual chlorine found in tap water is present, held another 48 hours, and once again checked for residual chlorine of at least 0.2 mg/l.

Samples of the water shall be taken by DISTRICT personnel at the beginning of the job, every 2,500 feet, at the end of any branch lines, and at the end of the job and shall be submitted to DISTRICT'S laboratory for bacteriological testing. If the constructed facility yields positive bacterial samples, the main will be flushed, held a minimum of 48 hours and a full set of bacteriological samples collected and submitted to the DISTRICT'S laboratory for bacteriological testing. If the repeat samples are positive, re disinfection of the main line, and new line procedures followed until the bacteriological samples yield negative results for coliform and e coli in accordance with DIVISION RULES.

8 SPECIAL CONDITIONS

8.1 GENERAL - The **CONTRACTOR'S** attention is called to the special conditions indicated on the plans or described in this section of the specifications. Special conditions may include construction on highway or railroad right-of-way, construction in the vicinity of existing utilities, and special surface restoration.

8.2 WORK ON HIGHWAY RIGHT-OF-WAY - The **CONTRACTOR** shall be responsible for complying with the requirements of the appropriate Highway Department. In the event a surety bond is required, such bond will be provided by the **CONTRACTOR**.

8.3 WORK ON RAILROAD RIGHT-OF-WAY - Should it be necessary to do any excavating or trenching on railroad rights-of-ways, the **CONTRACTOR** shall notify the railroad and shall conform to their requirements when performing work on their rights-of-way.

8.4 COORDINATION WITH OTHER UTILITIES - The **CONTRACTOR** shall cooperate with other utilities and shall take every reasonable precaution to avoid conflicts. In instances where the proposed water lines will be located near existing or proposed utility lines, the **CONTRACTOR** shall take the necessary steps to avoid damage to the utility lines and shall notify the **DISTRICT** of any potentially hazardous situations.

8.5 SEEDING - In all areas damaged or disturbed by **CONTRACTOR** operations where established ground cover was present before beginning of construction, **CONTRACTOR** shall be responsible for restoring this ground cover after completion of construction unless noted otherwise on drawings. In areas of established lawns, **CONTRACTOR** will be required to separate and preserve best of excavated material or, if no acceptable material has been excavated, haul in an acceptable material for use in making top six inches (6") of finished grade. No rock will be permitted in this top six inches (6") of finished grade for established lawns. All areas seeded shall be graded smooth prior to seeding and **CONTRACTOR** shall be responsible for maintenance of this smooth finished grade until grass growth is established.

After designated areas have been carefully hand graded, soil shall be prepared for seeding. Where necessary, **CONTRACTOR** will sod slopes and embankments, and remaining areas may be seeded.

A well-made lawn is desired, and **CONTRACTOR** will be responsible for any necessary regrading or reseeding required to produce an acceptable grass as cover. The seed of the same type of grass existing before construction shall be used.

The soil shall be fertilized with a commercial fertilizer of a grade and at a rate recommended by vendor of seed.

All seeded areas shall be covered with clean straw uniformly distributed to approved density.

8.6 **TUNNEL CONSTRUCTION -** The conduit which is to be constructed by the tunnel or mining method shall be completely lined on the inside with structural steel liner plates meeting all the requirements of applicable AASHTO, Tennessee Department of Transportation (TDOT) and CSX Transportation, Inc. (CSXT) Standards and Specifications.

Construction of the tunnel shall be carried on in such a manner that settlement of the ground surface above the tunnel shall be held to an absolute minimum. When ground conditions are unstable, poling plates or poling boards shall be used to prevent caving of material above the tunnel before the liner plates can be installed. Steel liner plates shall be installed as soon after the excavation is removed as possible and excavation shall not be removed more than 24 inches ahead of the installed liner plates. Excavation shall be carried on in such a manner that voids behind the liner plates will be held to a minimum. However, should any boulders larger than one foot in diameter be encountered, they shall be removed so that none are closer than six inches to the outer face of the liner plate. Should piling be encountered, each pile shall be cut so that no portion remaining shall be closer than one foot to the outer face of the liner. While boulders or piling are excavated, the holes shall be backfilled by grouting as approved by the **ENGINEER**.

Voids existing outside the liner plates shall be filled with Portland Cement grout plated under pressure.

No blasting or water jetting will be permitted without explicit written approval of the applicable authority and the **ENGINEER**.

All working operations of the **CONTRACTOR**, its subcontractor, and/or its agents or employees must be subordinate to the free and unobstructed use of the highway and/or railroad track for the passages of traffic without delay or danger to life, equipment, or property. The **CONTRACTOR** shall conduct its operations in such a manner that all work will be performed below highway or track level and without obstructions on the roadbed. Tunneling shall be conducted on a 24 hour per day basis when working within 25 feet of the centerline of any track unless otherwise approved by the **ENGINEER**. If work is stopped for any reason, the exposed face of excavation shall be fully protected with a bulkhead satisfactory to **ENGINEER**.

The **CONTRACTOR** shall inspect the location where the tunnel is to be installed and familiarize itself with the conditions under which the work will be performed and with all necessary detail as to the orderly prosecution of the work. The omission of any details for the satisfactory installation of the work in its entirety, which may not appear herein, shall not relieve the **CONTRACTOR** of full responsibility.

If, in the opinion of the **ENGINEER** or his representative, the installation of the tunnel is being conducted in an unsafe manner, the **CONTRACTOR** will be required to stop work and bulkhead the heading until suitable agreements are reached. The **OWNER**, ENGINEER, TDOT, CSXT will not be responsible and shall be saved harmless in the event of delays to the **CONTRACTOR'S** work resulting from any cause whatsoever.

The **CONTRACTOR** must be fully equipped and experienced in the installation of structures by tunneling methods. As evidence of its experience in this type of work, the tunnel liner installer shall submit to the **ENGINEER** specific information covering the successful installation by its company of at least three similar structures under heavy highway and railroad traffic. Any project involving the installation of less than a 60-inch diameter culvert or tunnel or length of less than 250 feet will not be considered as satisfactory evidence of experience. The installer must also provide proposed tunneling pit, bulkhead, and excavation specification including tunnel shield, if required, for approval prior to performing any work.

The **OWNER** reserves the right to review the qualifications of the proposed tunnel liner installer and to reject the **CONTRACTOR'S** selection if, in the opinion of the **OWNER**, **ENGINEER**, TDOT, or CSXT, it is unqualified to perform such work.

Whenever tunnel liner is installed, the steel lining shall consist of plates 18 or 16 inches wide; each circumferential ring shall be composed of the number and length to complete the required diameter. The **CONTRACTOR** shall submit details of the lining for approval.

The strength of the casing or tunnel will be sufficient to withstand the static or dead load and Cooper E-80 live loading. The **CONTRACTOR** shall have the liner plate manufacturer submit detailed calculations to the **ENGINEER** who will evaluate and forward to appropriate agency, which demonstrate the liner plate's capability to carry the total load indicated. Regardless of the liner plate's load carrying capability, the minimum allowable pate thickness shall be 0.1644 inch.

All plates shall be punched for bolting on both longitudinal and circumferential seams or joints and shall be so fabricated as to permit complete erection from the inside of tunnel. The longitudinal seam shall have staggered bolt construction, so fabricated as to allow the cross-

section of the plate to be continuous through the seam. All plates shall be of uniform fabrication and those intended for one size shall be interchangeable.

The material used for the construction of these plates shall be new and unused and suitable for the purpose intended. Workmanship shall be first-class in every respect.

After the plates are formed to shape and after all holes are punched, the plates shall be galvanized on all surfaces by the hot-dip process. A coating of prime western spelter, or equal, shall be applied at the rate of not less than two ounces or more per square foot of surface in accord with ASTM A123-78. If the average spelter coating as determined from the required samples is less than the amount specified above, or if any one specimen shows a deficiency of 0.2 ounce, the lot shall be rejected. Spelter coating shall be of first-class commercial quality free from injurious defects such as blisters, flux, and uncoated spots.

All nuts and bolts shall be galvanized.

Plates shall be fabricated with grout holes to facilitate grouting above and around the tunnel liner. These grout openings shall be two-inch I.P.T. half-couplings welded into a hole in the center corrugation of a plate, and a galvanized C.I. plug shall be provided for each opening to permit tight closure after grout is pumped. All rings are to be provided with grout holes so that the spacing of holes will be a maximum of 18-inch centers at the top of the tunnel and at the top quarter points, staggered with the holes at the top.

When installing liner plate by the tunneling method, the excavation shall be performed in such a manner that voids between the undisturbed earth and the liner plate shall be maintained at a minimum. Any void occurring shall be filled with a Portland Cement and sand grout pumped under pressure through grouting openings in the liner plate.

The minimum provision for grouting openings shall be one opening in a top plate of the tunnel or conduit at locations not to exceed 54 inches apart. Additional plates with grouting openings are to be installed at the top quarter points on each side between the top openings. The openings shall be staggered but shall not exceed 54 inches in any one line.

The grout shall consist of Portland Cement, water, sand, and 2% approved additive (Bentonite, Septamine Stearex, Hydrocide Liquid, etc.). One-part Portland Cement with additive shall be combined to four parts clean sand and sufficient water added to provide a grout having the consistency of thick cream when well mixed.

A pump shall be provided for placing the grout, which shall be capable of exerting sufficient pressure to assure the filling of all voids between liner plate and the undisturbed ground. Minimum acceptable pressure will be five pounds per square inch.

Pumping of grout shall be done (1) at the completion of the installation of approximately each nine feet of liner plate, (2) at more frequent intervals than nine feet if conditions indicate the necessity, and (3) at the end of a work shift or for stopping of work for any reason.

The minimum acceptable tunnel liners neutral axis diameter shall be as shown on the plans and may be constructed of 2 or 4 flange liner plate provided by the following safety factors are observed.

- Seam Strength Factor of Safety (FS) = 3.0
- Buckling Factor of Safety (FS) = 2.0

Minimum stiffness for the installation shall be as follows with a Factor of Safety of 3.

- 2 – Flange Liner Plate: $(EI/D^2) = 50$ minimum.
- 4 – Flange Liner Plate: $(EI/D^2) = 111$ minimum.

8.7 **SERVICE REPLACEMENTS AND RECONNECTIONS -** The service replacements and reconnections shall consist of installing a new service line from the proposed main to the new meter setting on the existing customer service line as directed by the **DISTRICT**. All existing service regulators or control devices on the existing customer line shall be relocated. The **CONTRACTOR** shall be responsible for lowering customer service lines to depths as necessary for proper connection. The **CONTRACTOR** shall furnish a new saddle, corporation stop, yoke, curb stop, pressure regulator (if required), and meter box at each location. All service line installation shall be installed as delineated herein.

8.8 **CASING PIPE -** Is intended to be installed by bore and jack. Installation may be made by open cut only if authorized in writing by the **DISTRICT**, and generally only after an attempted bore is unsuccessful. In no event will construction method be contradictory of instruction of the Railroad or Highway Department. In the event of any unsuccessful bore attempts, the bore hole will be refilled according to instructions of the Railroad or Highway Department or outside their jurisdiction by leaving jacked casing in place and sealing end with brick and mortar.

8.9 AQUATIC RESOURCE ALTERATION PERMIT & STORM WATER POLLUTION PREVENTION PLANS

The **CONTRACTOR** shall conform to all conditions and terms of the Aquatic Resource Permit. The **CONTRACTOR** shall obtain from the Tennessee Department of Environment and Conservation (TDEC) a Construction Storm Water Permit, and the **CONTRACTOR** shall develop the required Storm Water Pollution Prevention Plan. Said plan shall be completed, implemented, and maintained in accordance with TDEC. The **CONTRACTOR** shall obtain and conform to all necessary permits as required by the State, City, and County governments including but not limited to any necessary roadway or land disturbance permits. The **CONTRACTOR** is to pay all fees and costs associated with all permits. No separate Measurement and Payment will be made for this work. It will be considered a subsidiary obligation of the **CONTRACTOR** under other bid items to which it relates.

8.10 ABANDONING EXISTING LINES – Where indicated on plans or within these specifications, the **CONTRACTOR** shall disconnect, at all points, all main lines, service lines, fire lines, and other water system facilities from the lines designated to be abandoned. All lines or facilities presently connected to the lines designated to be abandoned shall be reconnected, as directed, to the proposed line(s) or other water lines determined to remain in service. All abandoned lines shall be plugged, capped, and concreted as directed. The **CONTRACTOR** shall remove and deliver to the **DISTRICT** all valve boxes, fire hydrants, meter boxes, air release valve assemblies, blow-offs, and all other facilities not earmarked to be reconnected to the proposed water line or other lines assigned to remain in service. The sequence of activities for accomplishing the various tasks shall be as directed by the **ENGINEER**. No additional compensation will be forthcoming for any of the activities described above

CONSOLIDATED UTILITY DISTRICT
TECHNICAL WATER SYSTEM SPECIFICATIONS
APPENDIX 'A' - APPROVED PRODUCTS & MANUFACTURERS
April-25

Specification Section	Material	Manufacturers	Product Name, Series, Model, Part No., etc. (if applicable)
3.12	Ductile Iron Pipe	American (ACIPCO)	Fastite
		McWane Ductile	
		U. S. Pipe	Tyton
3.12	Ductile Iron Pipe Restrained Joint (As Detailed on Plans)	American (ACIPCO)	Fast-Grip, Flex-Ring, Lok-Ring
		McWane Ductile	TR Flex
		U. S. Pipe	TR Flex, USIFlex, HDSS, Field Lok 350
3.13, 3.24.6 & 3.25.7	Cross-Linked Polyethylene	Uponor AquaPEX	PEXa
		Rehau	
3.14	Multilayer Composite Service Pipe	Flowguard® Bendable	
3.16	Ductile Iron Fittings	American	
		McWane Ductile	
		Sigma Corporation	
		SIP Industries	
		Star Pipe Products	
		Tyler Union	
		U.S. Pipe	
3.16	Ductile Iron Mechanical Joint Fittings & Valve Restraints	EBAA Iron Sales, Inc.	1100 Megalug
		Sigma Corporation	ONE-LOK
		SIP Industries	EZ GRIP
		Star Pipe Products	Stargrip Series 3000
		Tyler Union	Series 1000 Tufgrip
3.16	Ductile Iron Fittings Dismantling Joints	Romac Industries, Inc.	Style DJ400
		Smith - Blair	Style 975
3.17	Gate & Tapping Valves	American Flow Control	Series 2500
		Clow	Model 2639 & Model 2638 ; Models F-6100 MJ & F-6114 Tapping
		M & H	Style 4067 ; 4751 Tapping : Style 7000; 7590 Tapping
		Mueller	A-2361 MJ; T2361 Tapping
3.17	Gate Valves Restrained Joint Systems	American Flow Control	ALPHA Design
		Mueller	AquaGrip
3.18	Butterfly Valves	Dezurik	HP
		M & H	4500 Class 250
		Mueller	Lineseal XP Class 250
		Pratt	Triton HP-250
3.19	Ductile Iron Mechanical Joint Tapping Sleeves	American	Series 2800-C
		Clow	F-5205
		M & H	Style 1174Flange or MJ Swivel
		Mueller	H-615

CONSOLIDATED UTILITY DISTRICT
TECHNICAL WATER SYSTEM SPECIFICATIONS
APPENDIX 'A' - APPROVED PRODUCTS & MANUFACTURERS
April-25

Specification Section	Material	Manufacturers	Product Name, Series, Model, Part No., etc. (if applicable)
3.19	Stainless Steel Tapping Sleeves	Ford	FAST
		Mueller	H-304SS
		PowerSeal	3490AS
		Smith-Blair	663 SS Flange
3.19	Tapping Sleeves Greater than 30" in Diameter	Cascade	Style CST-EX Extra Heavy
3.20	Valve Boxes - Risers	Hula Concrete Products	HCP-1 with Footing Blocks
3.20	Valve Boxes - Lids	Russell Pipe & Foundary	Nashville Standard
		John Bouchard & Sons	No. 8006
3.22	Fire Hydrants	American Flow Control	American-Darling B62B with Series 2100 Hydrant Security Check Valve
		M & H	Model 129S Hydrant with Model 507 Kenflex Check Valve (MJ)
		Mueller	Super Centurion 250/HS (High Security)
3.23.1	Casing Spacers	BWM Company	Model BWM-SS with Model BWM-PO/WR End Seals
		PowerSeal Pipeline Products	Model 4810 Type 301 Stainless Steel with End Seals
		Cascade Waterworks Mfg.	Model CCS with Model CCES End Seals
		CCI Pipeline Systems	Model CSS8 with Model ESW/ESC End Seals
3.24.1 & 3.25.1	1" - Corporation Stops	AY McDonald	74701BQ-1
		Ford	FB1000-4-QNL with Q nut
		Mueller	B-25146RN
3.24.1 & 3.25.1	1" - Curb Stops	AY McDonald	76102WQ 1 x 1 x 1
		Ford	B41-444-W-Q-NL
		Mueller	B-25170N 1 STRT BMV CTSXFIP NL
3.24.2	Meter Boxes Type A-1	Carson Midstates	MSBCF 132418
		Raven/Sigma	RMB 132418-SW-W
3.24.2	Meter Boxes Type A-2	Carson Midstates	MSBCF 152718 with 6" 1527 Riser
		Raven/Sigma	RMB152718-SW-W with RMB1527-EXT6-W
3.24.2	Meter Box Lid Type A-1	Raven/Sigma	RMB1324-L-XRTDC or LC 1324T-D
3.24.2	Meter Box Lid Type A-2	Raven/Sigma	RMB1527-L-XRTDC or LC 1527T-D
3.24.4	Meter Yokes Type A-1	AY McDonald	720-207UDMD 44 X 484
		Ford	VBHC72-9WR-81-33 NL
		Mueller	236B2404-R9A-N plus applicable tail pieces
3.24.4	Meter Yokes Type A-2	AY McDonald	720-412TMMD 44 X 484
		Ford	VBHC74-12WR-81-44-NL
		Mueller	390B2404-R9A-N plus applicable tail pieces

CONSOLIDATED UTILITY DISTRICT
TECHNICAL WATER SYSTEM SPECIFICATIONS
APPENDIX 'A' - APPROVED PRODUCTS & MANUFACTURERS
April-25

Specification Section	Material	Manufacturers	Product Name, Series, Model, Part No., etc. (if applicable)
3.24.5 & 3.25.6	Service Saddles 1" Taps	PowerSeal	3417AS
3.25.2	Meter Boxes Type B	Raven/Sigma	RMB173018-SW-W with RMB1730-EXT6-W
3.25.2	Meter Box Lid Type B	Raven/Sigma	RMB1730-L-XRTDC or LC 1730T-D
3.25.4	Meter Yokes Tandem 1"	AY McDonald	750-207HFMD 43x468x6.16
		Mueller	B-2404R-3-6AN Tandem 1" x 12"
3.25.5	1" Pressure Regulator	Wilkins	600XLLUSC
3.26.2	Marker Posts	Rhino	TriView Tracer Ped
3.26.3	Tracer Wire Blue	Copperhead Industries, LLC	1245BHS
		Paige Electric	AWG 12, Insulation Thickness-45 mils Color-Blue
		Priority Wire & Cable, Inc.	HS-CCS Part No. 12SOLTW-CCS-HS-45
		Pro-Line Safety Products Co.	HS-CCS PE45, Part No. 744420241