Brookings Municipal Utilities (BMU)

Standard Specifications

For

Water Main Construction

(City of Brookings)

Revision Date: March 01, 2023

Brookings Municipal Utilities
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PART 1.0 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. The Contractor shall furnish all the necessary labor, materials, equipment, tools, and supplies that are necessary to install a complete water main system, as shown on the plans, standard plates and/or called for in these specifications or its addenda.

1.2 CONTRACTOR LICENSE AND PERMITS

A. Any Contractor involved with “sewer and water installation”, shall have a valid “Sewer and Water Contractor” or “Sewer and Water Installer” license obtained from the South Dakota Plumbing Commission as defined by SD Administrative Rule Chapter 20:53:01:01, Definitions.

B. Any Contractor installing or repairing private water services, shall obtain a City of Brookings PLUMBING CONTRACTOR LICENSE as specified in Section 22-161-“Required” as found in Article III-PLUMBING of the City of Brookings Code of Ordinances.

1. Contractor shall provide all required documentation needed to secure the City of Brookings PLUMBING CONTRACTOR LICENSE, including, but not limited to, a copy of the “Sewer and Water Contractor” and/or “Sewer and Water Installer” license, current insurance certificate, and performance bond.

C. When required by Section 74-141-“Permit Required” per Article IV-EXCAVATIONS of the City of Brookings Code of Ordinances, the Contractor shall obtain an “EXCAVATIONS PERMIT” issued at no charge from the Brookings City Engineering Office before any installation or repair of water/sewer commences.

D. The Contractor shall obtain any “DEWATERING PERMITS” required from local, state or federal agencies. The discharge area must be prior approved by the Engineer before initiating the dewatering.

E. The Contractor shall be required to obtain any other permits or license required by the project manual. It shall be the Contractor sole responsibility to determine which license and permits are needed for the completion of the project.

1.3 WARRANTY PERIOD

A. The Contractor shall be held responsible for workmanship, materials, settling trenches or any other deficiencies in the water main system during the corrective period. The Contractor shall repair and/or replace all deficiencies in the water system during the corrective period at no cost to the Owner. Any surface restoration costs incurred because of the repairing and/or replacing of deficiencies in the water system shall be borne by the Contractor. The duration of the warranty period is dependent on the method in which the Contract and/or work is completed:

1. When these Standard Specifications for Water Main Construction are included in technical specifications of a project manual, the warranty period for the water system improvements shall be consistent with the warranty period identified in the Agreement, General Conditions, Supplemental Conditions and/or any other project document that defining the corrective period duration.
2. When these Standard Specifications for Water Main Construction are used in conjunction with a project covered by Section 51-64-Street Standards as found in Article VI-SUBDIVISION IMPROVEMENTS AND DESIGN STANDARDS of the City of Brookings Code of Ordinances, the warranty period for water system improvements shall be the same one (1) year period of time as required by the Ordinance.
3. If the work is being completed within an established right-of-way, including excavation in or upon any street, sidewalk, alley or public ground in the city, the Contractor shall be required to obtain a "EXCAVATIONS PERMIT" from the City of Brookings. The corrective period for work covered by the executed Excavation Permit shall be a period of five (5) years as specified in Section 74-148-Warranty as found in Article IV-EXCAVATIONS of the City of Brookings Code of Ordinances.

1.4 BMU FURNISHED MATERIALS & WATER SERVICE TAPPING FEES

A. If indicated on the project plans and/or as indicated on the project bid form, BMU shall furnish fire hydrants and isolation valves to the Contractor to install.

B. BMU provided fire hydrants and isolation valves shall only be used for the operation of BMU water mains in utility easements or public right-of-way as identified in the executed Application to Connect.

1. BMU Provided Fire Hydrants, Gasket and Bolts

   a. On projects that BMU is providing the fire hydrants, BMU shall be responsible for providing fire hydrants, gasket and bolts for each hydrant identified in the plans. BMU shall be responsible for providing fire hydrants with bury depths as indicated in the project plans.

   b. If a hydrant extension is needed to accommodate the indicated bury depth, BMU will provide and install the hydrant extension.

   c. Concrete blocking, tracer wire, grounding rod, restrain joint, hydrant markers and other associated hardware shall be furnished and installed by the Contractor.

   d. Contractor is responsible for including any and all taxes, included but not limited to excise tax, sales tax, and use tax, in the established bid price for all BMU provided fire hydrants.

2. BMU Provided Valves

   a. On projects that BMU is providing the isolation valves, BMU shall be responsible for providing only the valve for each location identified in the plans.

b. Gaskets, bolts, concrete blocking, restrain joints, valve boxes, lids and other associated hardware shall be furnished and installed by the Contractor.

c. Contractor is responsible for including any and all taxes, included but not limited to excise tax, sales tax, and use tax, in the established bid price for all BMU provided fire hydrants.

C. Contractor shall be responsible for payment to BMU for all water tapping fees. Water tapping fees shall be charged to the Contractor at the cost identified on the BMU annually published "SERVICE CHARGES – WATER/SEWER" rate sheet.

1. The Contractor will be responsible for furnishing all pipe saddles and corporation stops needed to complete the project.

2. BMU shall install the saddle, drill and tap the water up to and including 2-inch corporations. Upon completion of work, BMU will generate an invoice and will bill accordingly. Water services 2-inch or larger shall require prior BMU approval.

1.5 QUALITY CONTROL

A. Testing and/or retesting of materials because of nonconformance to the specified requirements shall be performed by an independent firm as per the instructions of the Engineer of Record.

B. Payment for retesting performed during the Contract period and during the warranty period will be the responsibility of the Contractor.

1.6 SUBMITTALS

A. The Contractor shall submit the number of copies that the contract requires plus one copy that the Engineer of Record will retain. The Contractor shall obtain shop drawing approval before any of the work related to that material is performed.

B. Shop drawings and data shall be submitted for, but not be limited to, the following items:

1. Pipe, pipe fittings, bedding material, stabilization material, road topping material, and any other pertinent information concerning construction materials that the Engineer of Record deems necessary for the review of the materials used on the project in accordance with the specifications and drawings.

C. The Contractor shall submit appropriate documentation to the Engineer of Record for any materials not listed in these specifications. The Engineer of Record may forward any shop drawing to the BMU Engineer for consideration. Correspondence shall indicate any discrepancies between the BMU specification requirements and the Contractor provided submittal.

1. BMU Engineer reserves the right to reject any and all materials that do not meet the requirements for water mains as indicated in these standard specifications.

D. If a Temporary Water Main Bypass System is deemed necessary by the Engineer of Record, the Contractor shall submit a comprehensive Temporary Water Main Bypass Plan to the BMU Engineer for approval.

1.7 TRAFFIC CONTROL

A. The Contractor shall furnish, install and maintain any and all traffic control devices as required by the project plans. All traffic control devices shall be provided and installed according to the manual on "Uniform Traffic Control Devices" for streets & highways whenever applicable. The Federal Highway Administrator approves this manual as the National Standard.

1.8 GEOTECHNICAL REPORT

A. In the event that a geotechnical report, prepared by a licensed South Dakota Professional Engineer, exists for the proposed project, the requirements of that report shall be strictly adhered to.

B. Any requirements for, but not limited to compaction requirements, dewatering, testing frequency, the need for imported materials or trench stabilization included in the geotechnical report shall be followed regardless of the specific requirements in the following subsections.

PART 2.0 - PRODUCTS

2.1 TRENCH STABILIZATION MATERIAL

A. In poor trench conditions, or if directed by the BMU Engineer's Representative, the Contractor shall be required to use trench stabilization consisting of 3/4-inch to 4-inch crushed angular, well-graded material.

B. Larger crushed angular material may be required if deemed necessary by the BMU Engineer's Representative to stabilize the bottom of the trench.

C. The use of trench stabilization material will not eliminate the need for pipe bedding material.

2.2 PIPE BEDDING MATERIAL

A. Contractor shall use 1/4" x 3/4" clean angular crushed rock for pipe bedding, with the following minimum percentage gradation requirements:

Table 1- Pipe Bedding Gradation

Sieve Size	Percentage Passing
1-inch	100%
3/4-inch	85% to 100%
1/2-inch	15% to 85%
#4	0% to 15%

2.3 IMPORTED ENGINEERED FILL MATERIAL

A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported engineered fill material for backfilling the water trench.

B. Imported engineered fill material shall be a granular material conforming to requirements for "PIT RUN" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING", processed sand or gravel having a maximum particle size of 1-inch.

2.4 IMPORTED CLAY MATERIAL

A. When native materials are less than ideal for subgrade, or if directed by the Engineer of Record, the Contractor shall use imported clay backfill material for backfilling the water trench.

B. Clay material is available from the Brookings Regional Landfill (605-693-3667). Contractor shall be responsible for contacting the landfill to determine the availability and cost of the material. Contractor shall be responsible for loading, hauling and placing the clay material.

C. The moisture content of the imported clay material shall be 1 to 4% below the optimum moisture content at time of placing and compacting the material. The

Contractor shall be responsible for drying material to obtain the optimum moisture conditions.

2.5 AGGREGATE BASE MATERIAL

A. Aggregate base material shall be provided at any location where a hard road surface (concrete or asphalt) will be placed over the water main trench.

B. The aggregate base material shall conform to requirements for "AGGREGATE BASE COURSE" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING".

C. The 3/4-inch granular material, unless otherwise directed, shall conform to the following sieve analysis:

Table 2- Imported Granular Material Gradation

Sieve Size	Percentage Passing
1-inch	100%
3/4-inch	80% to 100%
1/2-inch	68% to 91%
#4	46% to 70%
#8	34% to 58%
#40	13% to 35%
#200	3% to 12%

2.6 GRAVEL SURFACING MATERIAL

A. The gravel surfacing or road topping material shall conform to requirements for "GRAVEL SURFACING" as indicated in the South Dakota Department of Transportation Specifications, Section 882 "AGGREGATES FOR GRANULAR BASES AND SURFACING".

B. The 3/4-inch gravel surfacing material with a soil mortar or binder, unless otherwise directed, shall conform to the following sieve analysis:

Table 3- Crushed Gravel Gradation

Sieve Size	Percentage Passing
3/4-inch	100%
#4	50% to 78%
#8	37% to 67%
#40	13% to 35%
#200	4.0% to 15%

2.7 POLY VINYL CHLORIDE (PVC) WATER MAIN PIPE

A. Water main pipe 4-inches in diameter and greater shall be Poly Vinyl Chloride (PVC) with a gasket joint. Pipe shall sustain a working pressure of 150 pounds per square inch (psi). Pipe classes shall be as follows:

Table 4- PVC Water Main Material

Pipe Size	PVC Pipe Type
4" – 12"	C900 DR 18
14" – 48"	C905 DR 18

B. All PVC pipe shall be manufactured in full conformance with the most current edition of AWWA C900 and C905 Standards. All PVC pipe shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.

C. Sealing pipe joints for all C900 and C905 PVC pipe shall use the Rieber joining system, which has the gasket formed into the pipe during the pipe manufacturing process. All gaskets shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects.

D. Acceptable Manufacturers are Diamond, JM Eagle, or prebid BMU Engineer approved equal.

2.8 RESTRAINT JOINT PVC WATER MAIN PIPE

A. Spline Lock PVC or Fusible PVC Pressure pipe shall be manufactured in accordance with the dimensions, materials, quality control and markings specifications found in AWWA C900/C905.

B. PVC Material shall conform to a minimum cell classification of 12454 as defined by ASRM D1784. The pipe compound is listed as standard grade material with a Hydrostatic Design Basis (HDB) of 4000 psi.

C. Pipe classes shall be as follows:

Table 5- PVC Water Main Material

Pipe Size	PVC Pipe Type
4" – 12"	C900 DR 18
14" – 48"	C905 DR 18

D. All PVC pipe and gasket materials shall meet NSF/ANSI Standard 61 - Drinking Water System Components, Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.

E. Spline Lock PVC Pipe:

1. Pipe system shall utilize a restrained joint utilizing a precision-machined groove on the pipe spigot and inside the pipe bell or coupling. A spline shall be inserted through an entry hole in the pipe bell, resulting in a continuous circumferential restrained joint that locks the pipe segments together.
2. All PVC pipe supplied for potable water applications shall be blue in color.
3. Standard pipe laying length on 20 feet shall be provided unless otherwise specified on project plans.
4. Acceptable Manufacturers are NAPCO Certa Lok, Certainteed Yelomine or prebid BMU Engineer approved equal.

F. Fusible PVC pipe:

1. Fusible polyvinylchloride pipe shall conform to AWWA C900, AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.
2. Fusible PVC Pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.
3. Fusible polyvinylchloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.
4. Fusible polyvinylchloride pipe shall be blue in color for potable water use.
5. Pipe shall be marked as follows:
    a. Nominal pipe size
    b. PVC
    c. Dimension Ratio, Standard Dimension Ratio, or Schedule 15065-5 RSM – 50 Rev 3.5 2/12/13
    d. AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
    e. AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
    f. NSF-61 mark verifying suitability for potable water service
    g. Extrusion production-record code
    h. Trademark or trade name
    i. Cell Classification 12454 and/or PVC material code 1120 may also be included
6. Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults.
7. Acceptable Manufacturers are IPEX or prebid BMU Engineer approved equal.

2.9 DUCTILE IRON (DI) WATER MAIN PIPE

A. Ductile iron pipe shall only be used if approved by the BMU Engineer, NO EXCEPTIONS.

B. Ductile iron pipe shall be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50 for a minimum 150 psi rated working pressure plus a 100-psi surge allowance. This design standard incorporates a 2 to 1 factor of safety on the sum of working pressure plus surge pressure. The laying condition and water main depth shall be as shown on the project plans.

C. Ductile iron pipe shall be manufactured in accordance with the latest revision of ANSI/AWWA C151/A21.51. The raw material for ductile iron shall have an average minimum recycled content consisting of 90% scrap iron and steel. Ductile iron pipe shall be manufactured in the USA in accordance with ANSI/AWWA C151/A21.51.

D. Each pipe shall be subjected to a hydrostatic pressure test of at least 500 psi at the point of manufacture.

E. Pipe shall have the standard coating on the exterior and shall also have a cement-mortar lining on the interior in accordance with ANSI/AWWA C104/A21.4, of latest revision.

F. The class or nominal thickness, net weight without lining, and casting period shall be clearly marked on each length of pipe. Additionally, the mark of the manufacturer, country where cast, year in which the pipe was produced, and the letters “DI” or “Ductile” shall be cast or stamped on the pipe.

G. All pipe shall be furnished with push-on type joints. Joints shall be in accordance with ANSI/AWWA C111/A21.11, of latest revision, and be furnished complete with all necessary accessories.

    a. Acceptable Manufacturers for ductile iron pipe shall by American Cast Iron Pipe Company, U.S. Pipe or prebid BMU Engineer approved equal.

2.10 RESTRAINT JOINT DI WATER MAIN PIPE

A. All ductile iron restraint joint pipe shall be furnished with positively restrained push-on joints and meet the requirements for ductile iron pipe as indicated in Section 2.9.

    a. Acceptable Manufacturers for ductile iron pipe shall by American Cast Iron Pipe Company Flex-Ring or MJ Coupled Joint, U.S. Pipe TR Flex or BOLT-LOK joint or prebid BMU Engineer approved equal.

2.11 TRACER WIRE FOR WATER MAINS

A. Tracer Wire – Direct Bury

1. All components of the tracer wire system shall be suitable for direct bury applications. The conductor shall be 12 AWG, solid, soft-drawn copper, with a minimum insulation thickness of 0.045-inches of high molecular weight polyethylene, and shall be blue in color.

    a. Acceptable Manufacturers for direct bury tracer wire shall be CCI, Kris Tech, Southwire, Copperhead or prebid BMU Engineer approved equal.

2. Splice kits shall utilize Scotchlok Y electrical spring connector, to electrically connect two or more pre-stripped copper wire ends in a pigtail application and moisture seal the connection for direct burial. The device shall be UL listed as wire connector system for use with underground conductors.

    a. Acceptable Manufacturers for splice kit shall be 3M DBR/Y or prebid BMU Engineer approved equal.

C. Tracer Wire – Pipe Burst or Directional Drill

1. The conductor shall be 12 AWG, 21% conductivity copper-clad hard drawn high carbon steel with copper cladding, pipe burst and extreme horizontal directional drill tracer wire, 4,700 lb average tensile break load, 50 mil high molecular weight-high density polyethylene jacket complying with ASTM D1248, 30 volt rating. Tracer wire shall be blue in color.

a. Acceptable Manufacturers for pipe bursting or directional drill tracer wire shall be Copperhead Soloshot Xtreme PBX-50 or prebid BMU Engineer approved equal.

2. Splice kits shall provide water-proof, corrosion-proof dielectric sealant that protects wires and prevents breaks in wire conductivity. Splice kit shall be provided with a clear body to view/verify that wires are fully inserted into splice kit. Splice kit shall utilize 90-degree twist-lock design that makes wire connections easy and keeps wires locked in place.

a. Acceptable Manufacturers for splice kits in pipe bursting or directional drill applications shall be Copperhead SnakeBite or prebid BMU Engineer approved equal.

D. Ground Rod

1. Ground rods, shall be pointed copperbonded ground rods, 1/2-inch diameter, 60-inch long steel rod uniformly coated with 5-mil metallically bonded electrolytic copper.

2. Acceptable Manufacturers for ground rods shall be Erico, Nvent, Eritech 611350 or prebid BMU Engineer approved equal.

E. Ground Rod Clamps

1. Ground rod clamps shall be standard duty bronze rod clamp used to attach ground wire to rod. Rod camp size shall retain up to 10 solid conductors. Rod clamp shall be suitable for direct burial and UL listed for direct burial in earth or concrete.

2. Acceptable Manufacturers for ground rod clamps shall be Erico, Nvent, Eritech CP58 or prebid BMU Engineer approved equal.

2.12 WATER MAIN FITTINGS

A. Mechanical joint water main fittings with accessories, 3-inch through 48-inch shall be manufactured from ductile iron in accordance with and meet all applicable terms and provisions of standard ANSI/AWWA C153/AWWA C111.

B. Ductile Iron mechanical joint fittings 3-inch through 24-inch shall be rated for 350 psi working pressure. Fittings 30-inch through 48-inch shall be rated for 250 psi working pressure.

C. All fittings shall be cement lined on the interior and 1-mil nominal thickness bituminous coated on the exterior as specified for cast iron fittings. Coating and cement lining shall be manufactured in full conformance with the most current edition of ANSI/AWWA C104/A21.4.

D. Mechanical joint fittings shall be provided with gaskets, glands, bolts, and other appurtenances.

E. Acceptable Manufacturers are Sigma, Star, Tyler-Union or prebid BMU Engineer approved equal.

2.13 FOSTER ADAPTOR

A. Where indicated on the project plans, mechanical joint (MJ) valves and fittings shall be connected using a bolt-through positive restraint mechanism manufactured of U.S.A. ductile iron conforming to ASTM A536, 65-45-12.

B. The positive restraint device shall connect the valves and/or fittings at a linear distance not to exceed three (3) inches and without attachment to pipe.

C. The device shall come complete with all accessories, including standard styrene butadiene rubber MJ gaskets conforming to the latest revision of AWWA C111/ASTM F-477 and blue fluorocarbon coated bolts and nuts.

D. The bolt-through MJ positive restraining device and the ductile iron spacers shall be supplied with an NSF 61, 7-mil. fusion bonded epoxy conforming to AWWA C116/A21.16-09 as well as the coating, surface preparation and application requirements of ANSI/AWWA C550.

E. The device shall be used with standard mechanical joint fittings (AWWA C110 or C153) and valves. Acceptable Manufacturers are Infact Corporation FOSTER ADAPTOR or prebid BMU Engineer approved equal.

2.14 ANCHOR COUPLING ADAPTOR

A. Where indicated on the project plans, provide anchor coupling adaptor to positively restrain all valves to fittings. Fabricated fitting shall utilize a “PLAIN END” mechanical joint fitting with an integral follower gland.

B. The protruding plain end, when fitted with a gasket, is inserted into a standardized mechanical joint bell and bolted together. All bolts and securing hardware shall meet the requirements for these specifications.

C. Anchor coupling shall utilize an epoxy or fusion bonded epoxy coating for corrosion protection.

D. Acceptable Manufacturers of Anchor Coupling Adaptors are Tyler Union, Clow Water System Company, FabPipe or prebid BMU Engineer approved equal.

2.15 BOLTS, NUTS, GASKETS AND OTHER HARDWARE

A. Bolts shall be fluorocarbon coated (Cor-Blue) low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11.

B. Gaskets shall SBR rubber and shall be resistant to water containing normal concentrations of chloramine. Gaskets shall meet NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372 approved for contact with drinking water.

2.16 COUPLING ADAPTORS

A. Coupling adaptor shall be suitable for all pipe materials including Ductile Iron, Cast Iron, Steel and PVC. Provide a long body design that provides extra flexibility and allows connecting pipe of two different pipe materials.

B. Coupling adaptor shall meet AWWA C219 and NSF 61 requirements. Gaskets shall be provided with Ethylene Propylene Monomer Rubber (EPDM) compound

suitable for water and sewer service in accordance with ASTM D2000 and NSF 61.

C. Product shall be available in pipe nominal diameter ranging from 1.5-inch to 24-inch. Coating on coupling adaptor shall be 100% fusion bonded epoxy for corrosion protection. Minimum coating thickness shall be 12 mils.

D. Coupling shall be provided with integral AISI 3054 Stainless steel all thread, bolts, washers and nuts.

E. Acceptable Manufacturers are Krausz Hymax Long Body, Romac Macro or prebid BMU Engineer approved equal.

2.17 MECHANICAL JOINT RESTRAINER DEVICES

A. Restraining mechanisms shall be with wedges or full circle contact and support of the pipe wall. Restraint shall be accomplished by a series of ring or wedge segments mechanically retained inside the gland housing and designed to grip the pipe wall in an even and uniform manner.

B. Restraining devices shall be actuated by bolts featuring twist-off heads to ensure proper installation torque is applied. All components of the restrainer, including the gland, bolts, and restraint segments, shall be of high-strength ductile iron and shall be manufactured in full conformance with the most current edition of ASTM A536.

C. Restrainer devices shall be coated with 12-mil 100% fusion bonded epoxy body with fluorocarbon coated ring/wedge.

D. Appropriate restrainer devices shall be supplied for the specific type of piping material being used on the project.

E. Acceptable Manufacturers are EBAA Iron Inc., Megalug Flanges, Romac Industries, RomaGrip DI Grip Rings, Star Products Starggrip, Tyler Union TuFGrip Series 2000 or prebid BMU Engineer approved equal.

2.18 BELL RESTRAINER DEVICES

A. Restraint for PVC pipe (AWWA C900 or C905 CI O.D.) at the bell shall consist of the following:

1. The restraint shall be manufactured of ductile iron conforming to ASTM A536. A solid, non-split, backup ring shall be used behind the PVC bell.

2. A restraint ring, incorporating a plurality of individually-actuating gripping surfaces, shall be used to grip the pipe, and a sufficient number of bolts shall be used to connect the bell ring and the gripping ring.

3. Restrainer devices shall be coated with 12-mil 100% fusion bonded epoxy body with fluorocarbon coated ring/wedge.

B. Acceptable Manufacturers are for bell restrains shall be EBAA Iron Series 2800, or prebid BMU Engineer approved equal.

2.19 DISMANTLING JOINT

A. Flange spool piece shall be fabricated to meet AWWA Class D Steel ring flange, compatible with ANSI Class 125 and 150 bolt patterns, pipe shall be std weight class per ASTM A53.

B. End ring and body shall be made from ASTM A536 Ductile Iron

C. Provide NBR gaskets made from rubber compound for water and sewer service in accordance with ASTM D200.

D. Provide stainless steel type 304 bolts, nuts and tie-rods.

E. Provide fusion bonded epoxy coating, interior and exterior of dismantling joint.

F. When properly installed on pipe that is within the coupling manufacturer's tolerances, dismantling joint shall be capable of operation at working pressures equal to the maximum rating of the flange.

G. Dismantling joint shall be manufactured by Viking Johnson, Romac, Smith Blair or equal.

2.20 GATE VALVES

A. Resilient wedge gate valves (4-inches to 30-inches) shall utilize ductile iron components and be manufactured in full conformance with the most current edition of AWWA C515. The valve seat shall be rated for 250 psi cold water working pressure.

B. Valves shall have a ductile iron 2-inch ductile iron operating nut and open left (counter-clockwise).

C. Gate valves shall be provided with mechanical joint connections meeting the requirements of AWWA C111.

D. All valves supplied shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.

E. Valves shall have a ductile iron wedge encapsulated with nitrile rubber or an EPDM rubber compound. Wedge shall be symmetrical and seal equally well with flow in both directions. Resilient seats shall be bonded or mechanically attached to the gate.

F. Stems shall be non-rising, bronze or stainless steel, and shall be sealed by three O-rings.

G. All exterior bolting, including but not limited to bonnet and stuffing box bolts, shall be 304 stainless steel. Seal between bonnet and valve body shall utilize a flat gasket with integral O-ring; therefore, allowing bolting to pass through and hold the gasket in place.

H. All internal and external ferrous surfaces shall have a 100% fusion bonded epoxy coating applied electrostatically prior to assembly meeting the requirements of AWWA C550.

I. Tapping valves shall meet all the requirements specified within this section. Tapping valves shall have a mechanical joint end and a flanged end to correspond to the branch flange of the tapping sleeve

J. Acceptable Manufacturers are Waterous, American AVK, American Flow Control (AFC), Mueller or prebid BMU Engineer approved equal.

2.21 VALVE BOXES AND COVER

A. Valve box shall be a 2 or 3 piece cast iron valve box for 4-inch to 12-inch gate valves. Valve box shall be adjustable for required trench depth.

B. Valve boxes shall be domestic (heavy wall) cast iron and shall include all pieces as required for installation. The valve boxes shall meet the following requirements:

1. 5 1/4-inch shaft.
2. Standard drop covers marked “WATER.”
3. Screw-type.
4. Circular base for 8-inch valve.
5. Heavyweight 35,000-pound tensile strength.
6. Adjustable for trench depth.
7. Covers shall have a skirt length of 1 1/2-inch.
8. Extensions shall be in lengths shown and be compatible with the valve boxes bid.

C. The valve box top section extensions and caps shall be compatible with the above valve box specifications.

D. Acceptable Manufacturers are Sigma, Star, Tyler or prebid BMU Engineer approved equal.

2.22 VALVE BOX ADAPTOR

A. Valve box adaptor shall be manufactured from recycled “Green” rubber compound. Adaptor shall be custom-molded for a precise fit on all types and sizes of gate valves 2-inch through 16-inch and can be used with 5 ¼-inch cast iron valve boxes.

B. Valve box adaptor shall be installed between the valve and valve box to eliminate settling and shifting of the valve box over the gate valve, allow proper keying of the valve, and center valve box over the operating nut.

C. Acceptable Manufacturers are VBA-II by Adaptor Inc. or prebid BMU Engineer approved equal.

2.23 FIRE HYDRANTS

A. Fire hydrants shall be open left (counterclockwise), constructed of ductile iron nozzle section, including but not limited to caps, upper/lower standpipes and hydrant base, and meet or exceed AWWA C502, latest revision. The hydrant shall be rated for a working pressure of 250-psi.

B. The section of the hydrant above ground shall be painted with epoxy primer and high-gloss urethane coating. Hydrants shall be provided with Red coating.

Hydrants shall be capable of being extended in 6-inch increment (7'6", 8'0", 8'6", 9'0" and 9'6") and shall be equipped with traffic features that include a breakaway flange and stem with a shaft coupling.

C. Nozzle section shall be designed for easy 360 degree rotation by loosening connecting bolts and rotating entire nozzle section.

D. Fire hydrant shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.

E. The main valve closure shall be of the compression type, opening against the pressure and closing with the pressure. The main valve opening shall not be less than 5 1/4-inches and be designed so that removal of all working parts can be accomplished without excavating.

F. Hydrant shall be provided with an internal travel stop nut located in the top-housing of the hydrant. A double oil reservoir to lubricate the operating threads of the hydrant and utilize a O-ring to seal interior components from water, moisture and foreign materials.

G. The draining system of the hydrant shall be bronze and be positively activated by the main operating rod.

H. Hydrants shall have two 2 1/2-inch hose nozzles and one 4 1/2-inch pumper nozzle, all located on the same horizontal plane. The centerline of the nozzles shall be 24-inches above the ground line groove (16" upper barrel section). Operating nuts shall be pentagon shaped and measure 1 1/2-inches point to flat. Nozzle cap nuts shall be the same dimension and shape as the operating nuts, and the nozzle caps shall be furnished with security chains.

I. All internal and external threads and bolting shall be National Standard threads and utilize a nut and bolt design. Metric, or allen bolts will not be acceptable. All below grade exterior bolting shall be constructed of 304 stainless steel.

J. Provide fire hydrants with a 6-inch mechanical joint connection. Bolts shall be fluorocarbon coated low alloy corrosion-resistant high-strength steel manufactured in full conformance with the most current edition of ANSI/AWWA C111/A21.11.

K. Acceptable Manufacturers are Waterous Pacer WB67-250, Contemporary Style, or prebid BMU Engineer approved equal.

2.24 FIRE HYDRANT MARKER

A. Hydrant marker shall be impregnated polycarbonate material, red color with adhesive reflector, and with a flexible galvanized hinge riveted to hydrant marker.

B. Each marker shall be hinge mounted to bonnet with bonnet bolt at 48-inch length and 3-inch width.

C. Fire hydrant markers to be the FH 800 Series American model manufactured by Flexstake or prebid BMU Engineer approved equal.

2.25 WATER SERVICE PIPE (1-inch, 1.5-inch or 2-inch)

A. Crosslinked Polyethylene (PEX)

1. Crosslinked Polyethylene (PEX) shall be a minimum pressure class of 200 psi, and shall conform to the most current edition of ANSI/AWWA C904.
2. Pipe shall have a co-extruded UV Shield made from UV-resistant high-density polyethylene, color blue. Fittings and valves shall meet the requirements of AWWA C800 and ASTM B62.
3. PEX pipe shall be provided with 304 stainless steel inserts conforming to NSF61 and AWWA C901. Inserts shall be dimpled and flanged to retain placement within service line.
4. PEX pipe shall be either 1-inch, 1.5-inch or 2-inch nominal diameter. No other size is acceptable and shall not be provided.
5. Acceptable Manufacturers are Rehau-Municipex or prebid BMU Engineer approved equal.

B. Copper

1. Copper pipes shall be U.S. Government Type K soft copper tubing. Fittings and valves shall meet the requirements of AWWA C800 and ASTM B62.
2. Type K Copper pipe shall be either 1-inch, 1.5-inch or 2-inch nominal diameter. No other size is acceptable and shall not be provided.
3. Acceptable Manufacturers are Cambridge-Lee Copper, Cerro, Halstead, Mueller Copper Company, and Wolverine or prebid BMU Engineer approved equal.

2.26 CURB STOPS (1-inch, 1.5-inch or 2-inch)

A. No lead brass curb stop with copper tub size (CTS) compression connection shall be Minneapolis pattern valves, conforming to the latest revision of the ANSI/AWWA C800 Standard for Underground Service Line Valves and Fittings, or prebid BMU Engineer approved equal.

B. Curb stops shall not be the drain back type.

C. Acceptable Manufacturers are A.Y. McDonald 6104, Ford B-44 (Compression), Ford B-22 (Flare), Mueller B-25154 or prebid BMU Engineer approved equal.

2.27 CURB STOP BOX

A. Curb stop box shall be adjustable and include a base tapped to attach to the threaded top of a Minneapolis pattern curb valve. The upper part of the box is adjustable and telescopes in the base to allow for grade adjustments.

B. Box shall be furnished with a cast iron lid and brass pentagon plug. Lid shall be provided with a stainless-steel screw for attaching tracer wire to the lid.

C. Curb box shall be provided with an electrostatically applied, cationic epoxy coating system that provides complete corrosion protection.

1. If an epoxy coating cannot be provided on the curb stop box, the cast iron curb stop box shall be furnished and installed with a 5 lb anode bag.

D. All curb stop boxes shall be provided with 60” steel stationary rod with ductile iron tee head socket and brass cotter pin.

E. Acceptable manufacturers for curb boxes shall be Ford EM2-XX-56-XXR-TW Series or BMU Engineer approved equal.

2.28 DOUBLE CHECK VALVE BACKFLOW ASSEMBLY (1/2-INCH TO 2-INCH)

A. Double check valve assembly shall be designed to protect drinking water supplies from dangerous cross-connection in accordance with national plumbing codes. The assembly shall consist of two (2) positive seating check modules with captured springs and rubber seat discs.

B. The check module seats and seat disc shall be replaceable single cover, top entry cover that allows for convenient access for maintenance.

C. The assembly shall also include two (2) resilient seated, quarter turn isolation ball valves and four (4) top mounted resilient seated test cocks.

D. The assembly shall meet the requirements of latest revision of the ASSE STD 1015 and AWWA C510

E. Acceptable manufacturers for double check valve backflow assembly are: Watts Series LF007, or BMU Engineer approved equal.

2.29 PIPE INSULATION

A. Water main insulation shall be an extruded polystyrene board and meet the requirements of ASTM C578, Type IV. The minimum R-value shall be 5.0 as determined by ASTM C518. The minimum compressive strength shall be 25-psi as determined by ASTM D1621. The maximum water absorption shall be 0.1-percent by volume as determined by ASTM C272. The maximum water vapor permeability shall be 1.1-perm as determined by ASTM E96.

B. Water main insulation shall be STYROFOAM™ Square Edge by the Dow Chemical Company, STYROFOAM™ Brand Scoreboard by the Dow Chemical Company, or prebid BMU Engineer approved equal.

2.30 ENCASEMENT PIPE - PVC

A. PVC encasement pipe shall meet the requirements of the “RESTRAINT JOINT PVC WATER MAIN PIPE” specification included in this specification.

2.31 ENCASEMENT PIPE - STEEL

A. Steel casing pipe shall be ASTM A53 or ASTM A139 welded pipe with a minimum yield strength of 35,000 psi.

B. Pipe shall be full circumference welded joint in accordance with AWS D1.1 to withstand excavation forces.

C. Minimum wall thickness and diameter shall be provided as shown in the following table:

Table 6- Steel Encasement Pipe Material

Casing Pipe Size	Wall Thickness
16”	0.281”
18”	0.312”
20”	0.344”
24”	0.375”
30”	0.469”
36”	0.531”
42”	0.625”

2.32 CASING SPACERS

A. Casing spacers shall be constructed of circular T-304 stainless steel segments, which bolt together forming a shell around the carrier pipe. T-304 stainless steel bolts and nuts shall be supplied with the spacers.

B. The spacers shall be designed with risers (when needed) and runners to support and center the carrier pipe within the casing pipe and maintain a clearance of 1/2-inch to 1-inch maximum between the casing pipe inside diameter (ID) and the spacer outside diameter (OD).

C. The band shall be manufactured of 8-inch (SSI-8) or 12-inch (SSI-12-2) wide, 14-gauge T-304 stainless steel. The risers shall be constructed of T-304 stainless steel having a minimum length of 6-inches (SSI-8) or 10-inches (SSI-12-2).

D. Abrasion-resistant runners, having a minimum length of 7-inches (SSI-8) or 11-inches (SSI-12-2), and a minimum width of 2-inches, shall be attached to each riser to minimize friction between the casing pipe and the carrier pipe as it is installed. Runner material shall be of glass reinforced plastic with the following minimum properties:

   1. compression strength of 25,000-psi,
   2. flexural strength of 32,000-psi, and
   3. tensile strength of 22,000-psi.

E. The ends of all runners shall be beveled to facilitate installation over rough weld beads or the welded ends of misaligned or deformed casing pipe.

F. On carrier pipes with an OD of 16-inches or less, each spacer shall have four riser/runner combinations-two on each half. On carrier pipes with an OD of 20-inches and greater, the number of riser/runner combinations shall be as recommended by the Manufacturer, with four being the minimum.

G. Interior surfaces of the stainless steel shell shall be lined with EPDM having a minimum thickness of 0.090-inches with a hardness of durometer “A” 85-90. Placement of the spacers shall be a maximum of 1-foot on each side of the bell joint and one every 6 to 8-feet thereafter.

H. Casing spacers shall be Model SSI-8 for carrier pipes 24-inches in diameter and smaller and Model SSI-12-2 for carrier pipes 30-inches in diameter and greater

as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal.

2.33 CASING END SEALS

A. Full conical-shaped wraparound seals made of 1/8-inch-thick neoprene rubber shall be provided for each end of the casing pipe. T-304 stainless steel banding straps with a 100-percent nonmagnetic worm gear mechanism and pressure sensitive butyl mastic strips shall be provided to seal edges.

B. End seals shall be Model AW Wraparound casing end seals as manufactured by Advance Products & Systems, Inc., Lafayette, LA, or prebid BMU Engineer approved equal.

2.34 TEMPORARY WATER MAIN BYPASS PIPE

A. Temporary water/water main bypass pipe and associated appurtenances that may come into contact with water shall meet the requirements of NSF/ANSI Standard 61: Drinking Water System Components-Health Effects and NSF/ANSI 61 Annex G, NSF/ANSI 372.

B. All PVC piping systems shall be manufactured in full conformance with the most current edition of AWWA C900 and C905 Standards.

C. Temporary water main shall be a minimum of 2-inch diameter unless otherwise specified.

D. Approved Products are CertainTeed-Certa-Lok Yelomine or prebid BMU Engineer approved equal.

2.35 GALVANIC ANODES

A. Anodes utilized for typical galvanic anode system installation are prepackaged magnesium style anodes weighing five (5) or eighteen (18) pounds. Anode composition is to be in accordance with ASTM B843-2003 Table 1, Grade HP, M1C.

B. Anodes are to be packaged in a low resistive backfill consisting of seventy-five percent (75%) gypsum, twenty percent (20%) bentonite, and five percent (5%) sodium sulfate.

C. Anodes shall be provided with #10 AWG stranded copper, single-conductor cable with HMWPE insulation. Lead wire cable shall be rated for six hundred (600) volts and designed for direct burial applications.

D. Lead wires must be of sufficient length for splice-free routing between the anode and the pipe and is to be #10 AWG stranded copper, single-conductor cable with HMWPE insulation. Lead wire cable must be rated for six hundred (600) volts and designed for direct burial applications.

1. Equipment and materials used to bond the #10 AWG HMWPE to the pipeline is of the “CADWELD” type as manufactured by ERICO Products, Inc. of Cleveland, Ohio, or approved equal.

2. Thermite weld caps, designed to protect the CADWELD bonds from corrosion, is to be Royston “Handy Cap 2” or approved equal.

2.36 TAPPING (SERVICE) SADDLE

A. Saddle body, lifter bar and outlet shall be all Type 304 Stainless Steel used for tapping a pipe for branch connection. Saddle shall utilize a two (2) bolt design to conform around the pipe.

B. Stainless steel tap shall be TIG welded to band and be available with AWWA/CC Taper threads in ½” through 2”.

C. All bolts, nuts, and lugs shall be Type 304 Stainless Steel per ASTM A193 and A194. Hex nuts shall be furnished with fusion bonded coating to prevent seizing and galling.

D. Gaskets shall be NBR (Buna-N) per ASTM D2000 with dual ring o-ring design incorporating both hydrostatic and mechanical forces to affect a dynamic seal.

E. Water service saddles shall be intended for use on C900 PVC water main.

F. No lead brass is to conform to AWWA Standard C800 (Latest Revision). Tapping saddles shall have a maximum nominal outlet diameter of 2”.

G. Acceptable Manufacturers for tapping saddle are Ford Meter Box FS313, Powerseal 3412AS, Romac 304/305/306 or prebid BMU Engineer approved equal.

2.37 TAPPING SLEEVE WITH VALVE (WET TAP)

A. Tapping sleeve shall be fabricated from 304 stainless steel with full circumferential seal, triangular side-bars and drop-in bolts. Stainless steel flange shall be have ANSI 125 drilling and be recessed to accept tapping valve.

B. Sleeve shall be provided with a SBR rubber compounded gasket suitable for water and sewer service in accordance with ASTM D2000.

C. GMAW welded tapping sleeve shall be provided with a test outlet welded to the outlet of the sleeve.

D. Valve used for tapping sleeve shall meet the requirements identified in the previous section titled “GATE VALVES”, with the exception that the valve be provided with a flanged by mechanical joint (MJ) connection.

E. Bolts and hardware shall meet the requirements identified in the previous section titled “BOLTS, NUTS, GASKETS AND OTHER HARDWARE”.

F. Acceptable Manufacturers for tapping sleeve are Romac SSTIII, Smith Blair 665 or prebid BMU Engineer approved equal.

2.38 CORPORATION STOPS

A. Corporation stops shall be a quarter turn (1/4) ball type, full 100% flow opening valve with compression outlet. Corporation stop shall be rated for 300 psi working pressure. Corporation Stop shall be provided as the same size as service piping.

B. All brass that comes in contact with water shall be no lead and manufactured in full conformance with AWWA Standard C800 (Latest Revision). Product shall have the letters “NL” cast into the main body for lead-free identification.

C. Inlet Threads are to be AWWA/CC Taper. Outlets shall utilize a EPDM rubber gasket to provide hydraulic seal and pack joint compression nut to secure outlet pipe.

D. Acceptable Manufacturers for corporation stops are Ford Meter Box FB1000, AY McDonald 74701B-22 or prebid BMU Engineer approved equal.

2.39 PACK JOINT COUPLING

A. All brass that comes in contact with water shall be no lead and manufactured in full conformance with AWWA Standard C800 (Latest Revision). Product shall have the letters “NL” cast into the main body for lead-free identification.

B. Coupling shall include pack joint nuts for CTS. Provide a beveled EPDM rubber gasket to provide hydraulic seal on pipe material. Coupling shall have anti-friction washer, integral clamp containing machined grooves for axial restraints and stainless steel screw to activate clamp.

C. Manufacture shall provide pack joint to match a wide variety of pipe materials including, PVC, PEX, Copper, and HDPE and a variety of different sizes.

D. Acceptable Manufacturers for corporation stops are Ford Meter Box C44-XX-NL AY McDonald 74758-XX or prebid BMU Engineer approved equal.

2.40 BLOW-OFF ASSEMBLY

A. Blow-off assembly shall consist of a restrained cap that installs on a plain-end piece of pipe, galvanized piping isolation valve and fittings necessary to route flow to surface.

B. Restrained cap shall be fusion bonded epoxy, ductile iron material meeting ASTM A536 and utilize integral gripper rings to grip the pipe. Draw hooks shall be fabricated from 304 stainless steel . Cap shall have a threaded 2-inch bung to allow connection of piping. Restrained cap shall be Alpha EC as manufactured by Romac.

C. Provide 2-inch galvanized piping and fittings to plumb water from the restrained cap to the surface. Include 2-inch curb stop and box to isolate flow.

2.41 PRESSURE REGULATOR

A. Valve shall be dial set, spring loaded pressure regulating valve capable of providing a constant downstream pressure over a wide range of inlet supply pressures. Valve shall be suitable for potable water applications.

B. Pressure regulating valve shall be constructed of a low lead content brass body with stainless steel and engineered plastics for the internal parts. Regulator mechanism shall be fabric-reinforced diaphragm.

C. Valve shall be capable of reducing downstream pressure from 25 to 90 psi. Valve shall be set at 60 psi at the factory.

D. Provide valve with internal and external threading that allows use in thread-by-thread, single union NPT configurations.

E. Acceptable Manufacturers for pressure regulators are Honeywell DS06-101/102 or prebid BMU Engineer approved equal.

2.42 INSIDE METER SETTERS

A. Inside meter setters shall be horn style interior setting that automatically ensure proper spacing and orientation of water meters. Setter shall include meter coupling threads with rubber meter gasket and meter nut.

1. Provide 7½ -inch laying length for 3/4-inch meters and 10¾ -inch laying length for 1-inch meter setters.

B. Copper tubing shall be constructed with full diameter bends to provide excellent flow capacity and characteristics. Copper shall conform to ASTM B75.

C. All brass that comes in contact with the potable water shall conform to AWWA C800. The product shall have the letter “NL” cast into the main body for lead-free identification.

D. Acceptable Manufacturers for interior meter setter are Ford Meter Box Copperhorns, AY McDonald NL Inside Setter or prebid BMU Engineer approved equal.

2.43 WATER METER (UP TO AND INCLUDING 2-INCH)

A. Meter shall utilize ultrasonic transit time measurement technology and have no moving parts within the meter to wear or replace. The ultrasonic meter shall be fully electronic with encapsulated and sealed circuitry, display and battery.

B. Ultrasonic meters shall meet or exceed the most recent revisions of AWWA C715 Standards. The ultrasonic meters shall comply with the lead-free provisions of the Safe Drinking Water Act and NSF/ANSI Standards 61 and 372.

C. The housing shall be constructed of a lead-free bronze alloy or stainless steel and shall be designed so that at a maximum working pressure, any distortion will not affect the accuracy of the meter. Ultrasonic meters shall operate to a maximum pressure of 175 psi and to a temperature of 140º F without leakage or damage.

D. Manufacture shall be capable of producing 5/8-inch, 5/8 by 3/4-inch, 3/4-inch, 1-inch, 1-1/2-inch and 2-inch ultrasonic water meters. 3/4-inch meters shall be capable of being provided with either 7.5-inch or 9-inch laying length.

E. The metering tube shall have an unobstructed flow passage and shall not be repaired in any manner. The flow direction, meter size, and NSF-61 shall also be cast in the meter housing.

F. The electronic circuit shall be microprocessor based and include nonvolatile memory capable of storing all programmable and accumulated data.

1. The circuit shall control the ultrasonic transducers. The entire meter circuit and related components shall be fully potted and sealed from water intrusion.

2. The registration shall consist of an electronic local display combined with electronic circuitry to provide a high-resolution absolute encoder output. The electronic register assembly shall transmit a signal through properly shielded transmission wire for AMR/AMI connectivity.
    a. Meters shall be equipped with an encoder head that is compatible with the Elster EA Water 3.0 Module (Contact Elster Meter Co. for Specifications). Meters shall be provided with pre-wired 25-foot wire leads.
3. High resolution absolute encoder registration shall be capable of sending an 8-digit or 9-digit encoder output to the endpoint as well as extended status messages. Reading resolution sent to the reading software is based on the output of the endpoint technology the meter is connected to.

G. The register shall be encased in non-corrosive plastic housing, with the circuit board, display, and battery completely potted and epoxy-sealed within to provide moisture resistance to flooded pit or submerged conditions. Ultrasonic meters shall meet and exceed IP 68 rating for submergence.
    1. The size, model, and direction of flow through the meters shall be permanently visible on the topside of all meter displays.
    2. To minimize expense, the ultrasonic meter encoder design shall allow for replaceable registration and transducers that are protected from tampering. The meter must have the ability to detect removal of registration and transducers, and report an empty pipe alarm as indication of removal.
    3. The registration enclosure face shall be slightly curved to prevent sediment buildup, and the registration housing shall have a molded-in clip to provide the option of mounting an approved endpoint to the side.
    4. The LCD shall display the following information:
        a. 8-digit or 9-digit consumption display with decimal and comma separator
        b. Icons for units of measure and time to represent total consumption and flow rate
        c. Icons to represent alarm conditions
        d. Segmented lines above and below digits to represent standard visual billing units for manual reading purposes
    5. The digital display shall provide a totalized consumption resolution to 0.01 cubic feet for 3/4 inch meters.
    6. To conserve battery life, the display shall be off while in resting state. The display shall be activated by a change in light level through the infrared (IR) port. Meter shall not require special tools to activate the display. Opening/closing the lid or blocking/ unblocking the IR port will activate the display to cycle through display screens showing different meter information.
    7. Ultrasonic meters shall be factory programmed to display the following screens.
        a. Standard Total Consumption
        b. Rate of Flow

c. Alarm and Operating Mode shall display current active alarms since the last transmission to the endpoint.

d. Firmware Version

H. Register box enclosures and lids shall be made of engineering thermoplastic or other suitable synthetic polymer.

1. The lid shall have a snap close feature to prevent the lid from opening if installed in a vertical up position. The lid shall overlap the registration enclosure to protect the lens.

2. The name or logo of the manufacturer shall be permanently molded into the lid, and at the option of the utility, a serial number shall be imprinted on the registration lid.

I. Acceptable Manufacturers for water meters shall be Badger E-Series Ultrasonic Meter or Neptune MACH 10 Ultrasonic Meter, No Approved Equals.

2.44 MAGNETIC FLOW METER (3-INCH AND LARGER)

A. The meter shall include bidirectional metering capabilities with programmable totalizers. The meter shall allow for an accuracy of +/-0.25 percent with a flow range of 300:1.

B. The amplifier shall be integrally mounted to the detector or shall available remote mounted. The amplifier shall be housed in a cast aluminum, powered coated, NEMA 4X enclosure. The amplifier shall receive the detectors analog signal, amplify the signal and convert the signal into digital information. The signal shall be converted to both analog and digital signals that shall display rate of flow and totalization. The processor shall control zero-flow stability, analog and frequency outputs, serial communications and a variety of other parameters. It shall include a four-line, 20-character LCD display to at shall indicate rate of flow, forward and reverse totalizers and diagnostic messages.

C. The display shall also serve to guide the user in simple terms though a user-friendly programmable routine. Programmable parameters of the amplifier shall include (but are not limited to) calibration factors, totalizer resets, unit of measure, analog and pulse output scaling, flow alarm functions, language selection, low flow cutoff, noise dampening factor and excitation frequency selection. The amplifiers main function is to detect and condition flow information from the electromagnetic detector.

1. Meters shall be equipped with transmitter that is compatible with the Elster EA Water 3.0 Module (Contact Elster Meter Co. for Specifications).

D. The power consumption shall be 120 VAC, 15 watts. The meter shall provide a variety of analog outputs, digital outputs, pulse outputs, frequency output and miscellaneous outputs. Units of measure shall include ounces, pounds, liters, US gallon, cubic meters, cubic feet and acre feet.

E. The meter shall be supplied and installed with upstream dismantling joint and stainless-steel ground rings.

F. Acceptable Manufacturers for water meters shall be Badger M Series Magnetic Flow meter with M2000 amplifier, No Approved Equals.

PART 3.0 - EXECUTION

3.1 OWNER OPERATE

A. No valve, hydrant or other controls on the existing water distribution system shall be operated for any purpose by the Contractor. BMU staff shall be the only authorized operator of existing valves and hydrants.

3.2 NOTIFICATION OF INTERRUPTION OF SERVICE

A. The Contractor shall coordinate with BMU staff of any interruption of water service at least 24-hours before the interruption of water service. BMU Staff shall notify all customers affected by any the water outage.

B. BMU is providing a courtesy to the Contractor by notifying the customers of a schedule interruption of service. It is the Contractor sole responsibility to develop, communicate and adhere to the schedule that is communicated to the BMU staff. Under no condition does BMU contacting and communicating directly with the customers relieve the Contractor of the requirements of the General Conditions of any other requirements identified in the Contract Documents.

C. Customers shall be verbally notified and provided an interruption of service notice. In the event a consumer cannot be notified, the Contractor may need to reschedule their work until the customers are notified.

D. The Contractor shall communicate and initiate operation of valve and/or fire hydrant requests with BMU staff.

3.3 ALIGNMENT AND GRADE

A. The Engineer of Record shall furnish all the necessary line and grade stakes, benchmarks, or other necessary control.

B. It is the responsibility of the Contractor to protect these stakes, and any replacement of stakes shall be at the expense of the Contractor.

C. The Contractor shall carry alignment and grade into the trench by means of an approved laser beam system and by a surveying level instrument. At no time shall the Contractor change the grade without Engineer of Record and/or BMU Staff approval.

D. If underground interference is encountered at the assigned grade, the Contractor shall notify the Engineer of Record and wait until the revised grade for the water system has been determined, if necessary. As a secondary check to the laser beam device, the Contractor shall check the grade from the grade stake to pipe invert a minimum of every 100-feet using a surveying level instrument.

3.4 WATER PIPE MATERIAL HANDLING & STORAGE

A. All pipe, fittings, valves, hydrants, and accessories shall be loaded and unloaded by a means to prevent shock or damage. Under no circumstances shall such material be dropped.

B. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings, and other appurtenances shall be kept free from dirt or foreign matter at all times. Valves and hydrants shall be drained and stored in a manner that will protect them from damage by freezing.

C. Piping shall not be stacked higher than Manufacturers' recommendations according to size. The bottom tier of piping shall be kept off the ground on timbers, rails, or concrete. Pipe in tiers shall be alternated: bell, plain end; plain end, bell. At least two rows of timbers shall be placed between tiers, and chocks shall be affixed to each timber in order to prevent movement. The timbers shall be large enough to prevent contact between the pipes in adjacent tiers.

D. PVC piping and Crosslinked Polyethylene (PEX) piping that has been exposed to more than the Manufacturers' maximum allowed UV exposure (sunlight) shall be rejected.

E. Gaskets for mechanical and push-on joints shall be stored in a cool location, out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

F. Mechanical-joint bolts shall be handled and stored in a dry location in a manner that will ensure proper use with respect to types and sizes.

3.5 MATERIAL INSPECTION

A. All pipe and appurtenances are subject to inspection by the Engineer of Record and/or BMU staff. Material found to be defective due to manufacture or damage in shipment shall be rejected and removed from the job site.

B. Prior to being lowered into the trench, each pipe shall be carefully inspected by the Contractor and those not meeting the specified requirements shall be removed from the site immediately. Rejections may be made for any of the reasons as stated in the specifications for each specific type of pipe. Pipe having minor flaws not serious enough to cause rejection shall be installed so as to bring such flaws in the top half of the sanitary sewer. Pipe shall be protected during handling against impact, shocks, and free fall.

C. The Engineer of Record and/or BMU staff may perform tests as specified in the applicable AWWA standard to ensure conformance with the standard. In case of failure of the pipe or appurtenance to comply with such specifications, responsibility for replacement of the defective materials becomes that of the Contractor or Manufacturer, even if piping and appurtenance has already been installed.

D. The Engineer of Record and/or BMU staff may require a test of specimens not to exceed 5-percent of the quantity of pipe to be furnished in order to prove the acceptability of the pipe. The Manufacturer shall provide an approved testing stand near the site of the plant.

3.6 BMU ACCESS TO PROJECT SITE

A. The BMU Engineer or Engineers' Representative shall have access to all parts of the job at all times. The Contractor shall furnish personnel, facilities, equipment,

tools, and materials as are necessary to make whatever tests and inspection that are required by the Contract Documents.

B. The BMU Engineer reserves the right to inspect and/or reject any part of, or all unsatisfactory work performed by the Contractor. Rejected or unapproved work shall be promptly replaced or modified to comply with these specifications.

3.7 REMOVAL OF WATER MAIN AND WATER MANHOLES AND SALVAGING VALVES AND FIRE HYDRANTS

A. Water main, water manholes, unsalvageable valves, and unsalvageable hydrants shall be removed at the locations shown on the plans or as directed by the BMU Engineer.

B. Water manholes shall be entirely removed and disposed of by the Contractor.

C. Valves and fire hydrants shall be salvaged at the locations shown on the plans or as directed by the BMU Engineer. Any salvaged items shall be properly disconnected and transported to Brookings Municipal Utilities (BMU) at 525 Western Avenue and neatly stockpiled. The Contractor shall contact BMU prior to delivery of the materials.

3.8 TRENCH EXCAVATION

A. The Contractor shall excavate to the proper depth and width necessary for the construction of the pipe according to the plans and specifications. The width of the trench at the top of the pipe shall be a minimum of 12-inches on each side of the pipe.

B. Trenches shall be excavated with vertical sides from pipe flow line to a point 1-foot above top of pipe where possible.

C. Trench excavation below pipe grade shall be backfilled with bedding material to provide a uniform and continuous bearing and support for the pipe.

D. Wherever, in the opinion of the Engineer of Record, the bottom of the trench does not afford a reliable or suitable foundation, the trench shall be excavated to such additional depth as is required and replaced with trench stabilization material. Pipe bedding material will be required in addition to trench stabilization material where trench stabilization material is used.

E. The Contractor will be fully responsible for constructing the water system on a stable base and any defects resulting from improperly preparing the pipe foundation shall be the Contractor’s responsibility.

3.9 DEWATERING

A. Water resulting from the dewatering operation shall be disposed of in a manner approved by the Engineer of Record and South Dakota Department of Agriculture and Natural Resources (SD DANR). It shall not be pumped onto private property without the property Owner’s approval. Any damage to property, either public or private, shall be rectified to the satisfaction of the Owner and the BMU. All applicable permits must be obtained by the Contractor before the dewatering operation begins.

B. Unless otherwise designated on project plans, it is the Contractor's responsibility to investigate soil conditions and/or review included geotechnical reports to determine what dewatering methods shall be required.

C. Water main installation shall be accomplished in a dry trench. Joints shall not be connected under water. If ground water is encountered, the Contractor shall dewater the trench with suitable pumps and equipment. Lowering of the groundwater level shall be by means of wells, well points, or other suitable means.

D. The water discharged from the dewatering operations shall not be allowed to wash through any excavated material. The Contractor shall be responsible for any damages that might result from this operation.

3.10 WATER MAIN PIPE INSTALLATION

A. Installation of PVC water main shall conform to the latest revision of AWWA C605 "UNDERGROUND INSTALLATION OF POLYVINYL CHLORIDE (PVC) AND MOLECULARLY ORIENTED POLYVINYL CHLORIDE (PVCO) PRESSURE PIPE AND FITTINGS", and BMU Standard Plates.

B. Water main shall be installed in the locations shown on the plans or as directed by a BMU representative or Engineer of Record. Water main shall not be installed in frozen ground or in water, and no water will be allowed to run into or through the pipe. Before installing the water main, it shall be cleaned of all foreign matter and kept clean thereafter. Open ends shall be protected at all times to prevent the entrance of dirt, trench water, animals, or foreign matter into the pipe. The bell and spigot shall be wiped clean and sufficient lubrication placed on the gasket and spigot before the pipe is pushed fully into the bell. The lubricant shall be approved for use with potable water.

C. Water main pipe which is stubbed for future extension shall end with a bell end with a short pipe with cap installed in the bell end which can be removed for future pipe extension.

D. Field cut spigot ends of push-on joints shall have a square end with beveled edge equal to a factory cut prior to being pushed into the bell. Every pipe shall be bedded uniformly throughout its length with water main bedding material. Care shall be taken to not have any part of the pipe bearing on rocks or stones.

E. Water main shall have a minimum of 6.0-foot of cover. If 6.0-foot of cover to the top of the pipe cannot be achieved or maintained, the BMU Engineer shall be notified. In special circumstances that 6.0-foot of cover cannot be obtained over the water main, the BMU Engineer may require the use of insulation over or insulation wrapped around the water main pipe.

F. Pipe shall be carefully installed to line and grade in accordance with line and grade stakes set by the Engineer of Record so that the finished water system will present a uniform alignment. Any noticeable variations from true alignment or grade will be cause for rejection of the work.

G. The bottom of the trench shall be freed of all rocks and stones and shall be hand shaped and bedded with bedding material as hereafter specified, and the pipe shall be in firm contact with the bedding material for its entire length. At each joint of bell and spigot pipe, a hole shall be dug of sufficient size so that the

weight of the pipe will rest on the barrel of the pipe and not on the bells, and the bell hole shall not be compacted. Pipe must be properly fitted together.

H. A suitable plug or cap shall be kept in the end of the pipe so as to prevent any dirt or water from entering during the progress of the work at all times. Any dirt, loose material, or cement mortar which may accumulate in the pipe shall be removed as the work progresses.

I. Standard length pipe shall be utilized for all installations. Shorter lengths will only be allowed for use at fitting locations.

3.11 WATER MAIN CONNECTIONS

A. To keep interruption of service to surrounding properties at a minimum when making a water main connection, the Contractor shall have all materials for the connection on site, and to the extent possible, have fittings assembled and restrained prior to cutting the existing water main and making the connection.

B. Pipe cutting shall be neat and completed in a manner so that damage to the pipe, interior lining, or exterior coating. Cutting shall be performed with an approved mechanical cutter, using a wheel cutter when applicable and practical.

C. Where indicted on plans, the Contractor shall remove an existing plug, cap, reaction blocking or hydrant, prepare the end of the existing water main, and complete the new water main connection.

D. Where indicted on plans, the Contractor shall cut into an existing water main, prepare the ends of the existing water main, and complete the new water main connection.

E. Where indicted on plans, the Contractor shall excavate a trench at the water main to install a smith tap into the existing water main. The Contractor will be required to furnish and install the valve box.

3.12 TRACER WIRE SYSTEM FOR WATER MAINS

A. Tracer wire system, including ground rods and all appurtenances, shall be installed with PVC water mains. The wire shall be installed along the lower quadrant of the pipe, but the pipe shall not be laid directly on the wire.

B. Ground rods shall be installed adjacent to connections to existing piping and in the locations specified on the plans. The tracer wire shall be brought to each fire hydrant and connected to a 60-inch ground rod that extends up to the bottom of the breakaway flange. The ground rod shall be duct taped to the fire hydrant barrel in at least four locations below the ground surface.

C. Tracer wire shall be installed on all water services. Additional requirements for the installation of the tracer wire on services can be found in the “WATER SERVICES” section.

D. All underground splices shall be inspected by the Engineer of Record and/or BMU representative prior to backfilling.

E. Prior to the road surfacing be placed and after the water service connections made, BMU shall be responsible for testing and verifying that the tracer wire has been installed and operates correctly. If the tracer wire system does not function

as intended, the Contractor shall repair the system to the satisfaction of the Engineer of Record or BMU representative. Any costs associated with making the repairs to the tracer wire shall be at the Contractor's expense.

3.13 CONCRETE THRUST BLOCKS

A. The Contractor shall brace all valves, hydrants, fittings, plugs and caps 12-inch in diameter and smaller by means of restrain joint glands and precast concrete thrust blocks.

B. No wood shimming or bracing will be allowed in conjunction with the concrete blocks.

3.14 VALVES AND FITTINGS

A. Valves and fittings shall be installed at the locations shown on the plans or as directed by the Engineer of Record. Valves and fittings shall be installed in accordance with the most current edition of AWWA C600. Proper precast concrete blocking shall be installed under all valves. Pipe shall be supported in such a manner as to prevent stress on the valve.

B. Valves and fittings shall remain exposed until the BMU Engineer or Representative has visually inspected and measured the as-built locations.

C. All mechanical joint valves and fittings shall be installed with two restrainer devices per valve.

D. All mechanical joint valve and fittings connections shall not exceed a horizontal or vertical deflection of 5-percent. In no case shall valves be used to bring misaligned pipe into alignment during installation.

E. Valves and associated valve box shall not be located in areas that will be future curb and gutters or valley gutters. Any valve located in these areas will not be acceptable to BMU Engineer and shall be removed and relocated at no expense to BMU.

F. All new dead-end water mains shall be closed with plugs or caps that are suitably restrained to prevent blowing off under test pressure. All dead-end water mains shall be equipped with suitable temporary fire hydrant or blow-off assembly.

G. If a blow-off valve precedes the dead-end plug or cap it shall have two (2) joint restraint devices included, and rodding to a fitting may also be required, to insure the valve does not blow off when extension of the water main resumes.

3.15 VALVE BOXES

A. The Contractor shall adjust the valve boxes to the final grade as shown on the Standard Plates. All buried valves shall be installed with the valve box adapter to allow secure and aligned placement of the valve box on the valve.

B. The Contractor shall furnish and install valve box extensions (additional sections) as needed if the valve box has inadequate adjustment length remaining or if extra depth water main had been installed that requires the use of an extension.

C. The Contractor shall replace existing valve boxes as specified. This work includes excavating to the existing valve and removing the existing valve box. A new valve box shall be installed and the trench backfilled.

D. All valve boxes, new installation and adjustment of existing valve boxes, shall be backfilled with pipe bedding material to a depth as indicated on the BMU Standard Plates. The Contractor shall ensure that valve boxes are plumb prior to and during backfilling.

E. Valve operating nut within valve boxes shall be clear of any debris. BMU Staff shall check valve boxes so they can be freely operated after backfilling operations, prior to paving, and again prior to the completion of the project. It shall be the Contractor sole responsibility to remove any debris or correct any alignment problems that might prevent BMU staff from properly operating the valve.

3.16 FIRE HYDRANTS

A. Fire hydrants shall be installed at the locations and elevations as shown on the plans or as directed by the Engineer and in accordance with the most current edition of AWWA C600.

1. The centerline of the nozzles shall be a minimum of 24-inches above the finished surface elevation but no higher than 26-inches.
2. The bottom of the breakaway flange shall be a minimum of 2-inches and a maximum of 4-inches above the finished surface elevation.
3. Fire hydrants shall be installed 3 to 5-feet behind the back of curb unless otherwise indicated on the plans, stand plumb, and have their nozzles parallel with or at right angles to the street centerline, with the pumper nozzle facing the street.
4. Hydrants installed near intersections shall be located 5-feet minimum from the intersection sidewalk.

B. The Contractor and/or supplier will be responsible for providing fire hydrants with the appropriate bury depths. If a hydrant is provided with an unacceptable bury depth, supplier shall furnish the necessary hydrant extension to BMU. BMU will be responsible for installing any extensions needed to install the fire hydrant at the appropriate grade and in accordance with BMU standards. BMU may back-charge the Contractor for the labor necessary to install the hydrant extension.

C. Hydrants shall be set on a precast concrete block to prevent settlement. Precast concrete thrust blocks shall be installed against undisturbed soil to prevent movement of the hydrant lead.

D. Hydrant bases shall be backfilled with a minimum of 1/3-cubic yard of pipe bedding material to facilitate drainage from the hydrant weep holes. The bedding material shall be placed at a depth of approximately 36-inches above the hydrant base. Contractor shall install one layer of heavy-duty construction grade plastic at the interface of bedding material and the native backfill material. Plastic material shall be installed to minimize fines from migrating into the bedding material and potentially plugging the hydrant weep holes.

E. Tracer wire and a ground rod shall be installed at each fire hydrant location. Tracer wire and grounding rod shall be installed in strict accordance with BMU requirements indicated in previous sections and standard details.

F. Flushing hydrants installed for testing purposes shall be removed once testing has been completed. If the flushing hydrants will remain in place for the duration of a winter season, they shall be installed behind the existing or proposed curb and gutter.

3.17 GALVANIC ANODES

A. Anodes are to be installed eighteen to thirty-six inches (18" to 36") from fitting and/or the curb box, to a centerline depth in line with the approximate depth of the curb stop.

B. The #10 AWG HMWPE lead wires must be attached to the fitting and/or the curb box. Lead wire connections to the fitting and/or the curb box are to utilize exothermic weld connection methodology and follow the manufacturer's instructions for use.

C. Extreme care shall be taken not to damage the anodes or direct buried lead wires during backfill procedures.

3.18 BEDDING, BACKFILL, COMPACTION AND COMPACTION TESTING

A. Bedding of Pipe

1. The trench base shall be undercut a minimum of 6-inches below the bottom of the pipe and uniformly backfilled with bedding material to 6-inches above the pipe.

2. Pipe shall be installed on top of the first layer of bedding material and the pipe shall be backfilled with bedding material up to the "spring-line" (halfway) on the pipe. The bedding material shall be "shovel-sliced" or hand tamped around and under the haunches of the pipe to assure adequate and uniform support along the bottom of the pipe.

3. Care shall be taken in placing backfill over the crown of the pipe to avoid damage to the pipe. Care shall be taken to prevent dislodging and misalignment of the pipe and to provide adequate bell hole for the pipe.

4. All water service lines shall be installed with bedding material from 2-inches below the pipe to 2-inches above the top of the pipe.

B. Initial Backfilling of Pipe Trench

1. Above the bedding area the pipe shall be backfilled with acceptable native material (Class I, II, and III as described in C605), approved by the Engineer of Record and compacted to 95-percent Standard Proctor Density to 12-inches above the top of the pipe bedding.

2. If unacceptable initial backfill material is not found onsite, Contractor shall furnish and install import engineered fill or clay material in the initial backfilling area. Imported material shall be placed in a minimum of two (2) lifts and compacted to a minimum of 95-percent Standard Proctor Density to 12-inches above the top of the pipe bedding.

3. The initial backfill shall be placed evenly so as not to disturb the grade or line of the pipe.
4. Stones larger than 3 inches in diameter shall not be placed within initial backfill of the pipe trench. Care shall be taken in placing backfill over the pipe to avoid damage to the pipe.
5. Native material for all initial backfilling of the pipe trench shall be free of debris, frozen material, large clods or stone, organic matter or other unstable material. Stones larger than 3-inch in diameter shall not be placed within the initial backfill area.

C. Final Backfilling of Trench to Grade

1. All final backfill material shall consist of acceptable native excavation material, approved by the Engineer of Record, and shall be placed in maximum 12-inch lifts and compacted by suitable and approved compaction methods in a manner to achieve at least 95-percent Standard Proctor Density, or as otherwise specified.
2. If unacceptable final backfill material is encountered in the trench excavations, it shall be replaced with other suitable material available at the project site, imported engineered fill, imported clay material or with other suitable imported material, as approved by the Engineer of Record.
3. At least 12-inches of cover shall be placed over the top of the pipe before the trench is wheel-loaded, and 48-inches of cover shall be placed over the top of the pipe before the trench is hydro-hammered for compaction.
4. Material for all areas of backfilling is to be free of debris, frozen material, large clods or stone, organic matter or other unstable material.
5. In final backfill areas below pavement, the Engineer may direct the Contractor to use native material a specified distance below the pavement elevation to ensure a consistent material is utilized under the pavement section.
6. Excess material not required for final backfilling shall be removed by the Contractor or otherwise disposed of as directed by the Engineer.

D. Moisture Control and Stability

1. The moisture content of backfill material should be adjusted to a moisture level that is within plus or minus two (2) percent of optimum moisture content as determined by a standard proctor (ASTM: D698).
2. The moisture content of granular backfill material should be maintained at a level that will be conductive for vibratory compaction.

E. Road Surfacing Base Material

1. Material used under concrete and asphalt surfacing shall meet the requirements as indicated in the Products section of these specifications for “AGGREGATE BASE MATERIAL”.
2. Base material shall be placed in maximum 6-inch lifts and compacted by suitable and approved compaction methods in a manner to achieve at least 97-percent Standard Proctor Density, or as otherwise specified.

F. Compaction Testing Requirements

1. All bedding and backfill areas shall be subject to compaction testing by nuclear or standard methods according to the latest applicable ASTM Specifications.
2. Frequency of compaction tests shall be completed in accordance with South Dakota Department of Transportation (SDDOT) Standard Specifications for Roads and Bridges, current edition.
3. The areas requiring compaction testing shall include the bedding, initial backfill, final backfill, road surface base and gravel surfacing material, as defined in the previous sections.
4. The Engineer of Record may require random compaction tests of the material. If any of these tests indicate that the material has not been compacted to the required density, the Contractor shall re-compact said material at no additional cost to the Owner, and the Engineer of Record shall then have the right to take additional compaction tests to assure that this material is compacted to the proper density without any additional cost to the Owner.

3.19 UNDERGROUND INTERFERENCE

A. The location of underground public or private utilities may be shown on the plans, as reported by the various utility companies and BMU, but this does not relieve the Contractor of the responsibility of contacting SD ONE CALL and determining the accuracy or completeness of said locations. The Contractor shall determine the location of all underground ducts, conduits, pipes, cables, or structures which will be affected by the work, and shall take steps necessary to support and protect said structures by any means suitable to the Owners of the structure involved and the Engineer of Record.

B. When necessary, the Contractor shall conduct operations as to permit access to the work site and provide time for utility work to be accomplished during the progress of the work.

C. Portions of utilities which are found to interfere with the alignment and grade of the water main will be relocated, altered, or reconstructed by the Owners, or the Engineer of Record may direct changes in the work to avoid interference.

D. Temporary or permanent relocation or alteration of utilities requested by the Contractor for the Contractor's convenience shall be the Contractor's responsibility, and the Contractor shall make all arrangements and bear all costs. In those instances where utility relocation or reconstruction is impractical, the Engineer of Record may order a deviation from alignment and grade.

3.20 WATER MAIN AND SANITARY SEWER MAIN SEPARATION

A. Horizontal Pipe Separation

1. Water main shall be laid at least 10-feet horizontally from any existing or proposed sanitary sewer mains. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot pipe separation, BMU may allow deviation on a case-by-case basis, if supported by data from the Engineer of Record. Such deviation may allow installation of the water

main closer to a sanitary sewer main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sanitary sewer main with the bottom of the water main 18-inch above the top of the sanitary sewer.

B. Vertical Pipe Separation for Sanitary Sewer Crossings

1. The vertical separation between the water main and sanitary sewer main shall be constructed to provide a minimum of 18-inches of vertical separation from the outside of the sanitary sewer main to the outside of the water main. This shall be the case where the water is either above or below the sanitary sewer with preference to the water main located above the sanitary sewer.
2. The crossing shall be constructed so that a full-length water main pipe be used and the pipe joints will be equidistant and as far as possible from the sanitary sewer main.
3. In the event 18-inches of vertical pipe separation cannot be maintained, adhere to one of the following:
    a. Use vertical bends to lower the water main under the sanitary sewer main.
    b. Install an encasement pipe around the water main. The encasement pipe shall be 20-foot minimum in length, centered where the pipes intersect, and sealed at both ends with end seals.

3.21 WATER MAIN AND STORM SEWER SEPARATION

A. Horizontal Pipe Separation

1. Water main shall be laid at least 10-feet horizontally from any existing or proposed storm sewer mains. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot pipe separation, BMU may allow deviation on a case-by-case basis, if supported by data from the Engineer of Record. Such deviation may allow installation of the water main closer to a storm sewer main, provided reinforced concrete pipe (RCP) storm sewer pipe be assembled with either:
    a. A gasket that conforms to ASTM C443 specifications (generally available for round RCP pipe up to 72-inches), OR:
    b. A watertight sealant meeting ASTM C990, AASHTO M 198, and Federal Specification #SS-S-210-A.

B. Vertical Pipe Separation for Storm Sewer Crossings

1. The vertical separation between the water main and storm sewer main shall be constructed to provide a minimum of 18-inches of vertical separation from the outside of the storm sewer main to the outside of the water main.
2. The minimum vertical separation of the water and the storm sewer is dependent on the size of the storm sewer pipe. Larger diameter storm sewer pipes have a greater minimum clearance to prevent water mains from freezing.

3. In the event that vertical pipe separation cannot be maintained, adhere to one of the following:

    a. Use vertical bends to lower the water main under the storm sewer main and install rigid insulation between the storm sewer and water main.

    b. Install an encasement pipe around the water main. The encasement pipe shall be 20-foot minimum in length, centered where the pipes intersect, and sealed at both ends with end seals and install rigid insulation between the storm sewer and water main.

3.22 WATER SERVICES

A. Water services, corporation stops and curb stops for house connections, multiple dwellings, and commercial connections shall be installed as shown on the project drawings or as directed by the Engineer of Record.

B. Water service pipe shall be bedded in accordance with the requirements of ”BEDDING, BACKFILL, COMPACTION AND COMPACTION TESTING”.

1. The BMU Inspector shall observe the backfill and compaction of the water service. If the BMU Inspector questions the licensed Plumbing Contractor’s means and methods for backfill and compaction, BMU will coordinate and hire a SD licensed Geotechnical Engineer to perform a compaction test to determine if the backfilled trench meets the compaction testing requirements.

    a. If the compaction test meets the compaction requirements of these specifications, BMU will pay the Geotechnical Engineer for all the associated costs.

    b. If the compaction test fails, the licensed Plumbing Contractor shall be responsible for reimbursing BMU for the Geotechnical Costs. BMU will pay the Geotechnical Engineer and bill the licensed Plumbing Contractor directly for the costs of a failed tests.

        - Upon a failed test, the Geotechnical Engineer shall provide a recommendation to the Contractor as to how the trench shall be backfilled and compacted to meet the requirements set forth in these standard specifications.

        - The Contractor shall be responsible for all costs associated with backfilling the trench, including but not limited to, removing the failing material, drying, importing and installing dry material, removing failing material from site, compaction and re-testing by the Geotechnical Engineer.

C. For new construction, splices on the water service will not be allowed from the corporation to the curb stop, and from the curb stop to the meter for new construction. Splice locations for rehab or water service replacement shall be prior approved by BMU Inspector.

D. All water services shall be installed with tracer wire from the water main to the curb stop box and from the curb stop box to the structure.

1. Contractor shall provide a loop or slack in the tracer wire at each proposed water service. The loop shall be configured to allow for excess tracer wire to

be used to connect the water service tracer wire to the tracer wire installed with the water main.

2. Contractor shall splice the water service tracer wire to the main line by using a moisture displacement connector kit.
3. Tracer wire shall be terminated on the curb stop box lid from both the main line and the wire extending to the structure.
4. Tracer wire shall be terminated immediately adjacent to the structure foundation with a grounding road and associated connectors.
5. BMU shall verify the installation of the tracer wire by energizing and locate the water service via the tracer wire prior to backfilling of the water service.

E. All curb stops that are installed without a valve box shall be marked to help locate them and prevent breakage when excavating.

1. Water services shall be marked by a vertical section of PVC pipe or an approved marker. The PVC pipe shall be painted blue on the top 1-foot portion of the marker.
2. The marker should be placed near the curb stop or at the termination point of the water service stub-in.
3. The water service marker shall remain in place and be maintained by the Developer or Property Owner until the water service is extended into the property to serve a house, building, or other structure.

F. Contractor shall coordinate with BMU to installed service connections or disconnections with BMU crews. Water service connections or taps to new or existing water main will not be permitted until the water main has passed the necessary pressure testing and disinfection requirements. All service taps/saddles must be adequately supported prior to backfilling.

G. Water saddle and taps shall be installed by BMU, using a service saddle and located at 10 o'clock or 2 o'clock on the circumference of the pipe. If cover over a service line is shallow and frost may become a factor, corporations may be installed at 3 o'clock or 9 o'clock on the water main to get additional cover over the water service.

H. Service connections or disconnects are made using one of the following methods, unless otherwise specified:

1. The Contractor shall excavate a trench to allow BMU crews to install saddles and connect (tap) the water main with a water service corporation stop. The trench shall then be backfilled by the Contractor.
2. The Contractor shall excavate a trench and disconnect the water service at the water corporation stop in the presence of BMU personnel. The trench shall then be backfilled by the Contractor.

I. The trench for the water service taps shall be excavated to meet all applicable OSHA trench safety requirements prior to any work to be completed by BMU personnel. If the trench is unsafe to complete water service tapping operations, the Contractor shall be required to provide the necessary additional work to ensure safety of the trench to the satisfaction of the BMU tapping personnel.

J. Curb stops shall be located directly on the right-of-way/property line. It is acceptable to be installed outside of the right-of-way/property line on private property as long as it is within 18-inches of the right-of-way/property line. Curb stop valve and boxes SHALL NOT be located within in the public right-of-way. Curb stops installed within the right-of-way or outside of the 18-inch designated area, shall be removed and relocated at no expense to BMU.

1. Curb stops installed short of the property line shall be relocated to the property line by removing the entire water service back to the corporation stop and reinstalled to prevent the installation of a splice on the water service.
2. Curb stops installed long of the property line shall be relocated by isolating the water service and cutting the water service back to the property line.

3.23 CASING PIPE VIA BORING (JACKING)

A. Additional technical specifications shall be included with project plans and specification to ensure correct installation of the bore and casing.

B. It shall be the responsibility of the Contractor to maintain the alignment and grade specified. The boring (jacking) specifications shall be in accordance with these specifications, plan sheets, plan notes and Standard Plates.

3.24 TEMPORARY WATER MAIN BYPASS SYSTEM

A. A minimum of 1-weeks prior to operation of the water bypass system, the Contractor shall submit a water main layout and sequence of operations for the temporary water main bypass system for BMU Engineer approval. The BMU Engineer shall be given written notice, at least 2-days in advance, of intent to commence water bypass operations.

B. The Contractor shall provide a 24-hour contact person who has adequate parts and equipment readily accessible to make necessary repairs to temporary water bypass system or temporary water service in a timely manner.

C. The Contractor shall notify BMU staff at least 24-hours prior to the planned outage. The Contractor shall inform BMU staff of the estimated time that the water service will be disrupted. BMU shall coordinate with all property Customers for the planned disruption of water service or accessibility issues created by the temporary water main bypass system.

D. The BMU shall contact customers (that are at the property at the time of service interruption) along the water main project where the customers will have a disruption of water service.

E. BMU shall furnish and install door hangers on each affected property Customers door. The door hanger shall indicate the time when the property will not have water service.

F. Bypass piping required for an extended period of time, if directed, shall be buried or covered by granular material ramps where the pipe crosses bike trails, sidewalks, driveways, roads, pedestrian crossings, entrances, etc.

G. Contractor shall make water service connections either during the day or at other suitable times to minimize the Customers disruption of water service.

H. Contractor shall provide all chlorinating, testing, pipe, necessary isolation valves, bends, fittings, hydrants, all necessary appurtenances, gravel ramp construction, maintenance and removal, and all other materials and labor necessary to construct the temporary water main and flush each individual service before connection to the BMU water system.

1. Temporary water main is required to be disinfected, flushed, and sampled (Two consecutive coliform bacteria tests shall be taken 24-hours apart) prior to any service connections being made. The temporary water main shall be tested at static main pressure for a period of 2-hours.

3.25 SURFACE RESTORATION

A. The Contractor shall replace all surface material and shall restore paving, curb and gutter, sidewalks, lawn irrigation, fences, trees, sod, topsoil, and other items disturbed to a condition equal to or better before the work began; furnishing all labor, materials, and equipment necessary to do this work. Surface restoration shall conform to all City or DOT right-of-way requirements.

3.26 WATER MAIN TESTING SEQUENCE

A. The following sequencing shall be followed by the Contractor unless an alternative sequencing plan is provided in writing by the Contractor and approved by BMU prior to performing any of the required sampling or pressure testing:

1. Contractor shall furnish and place granular chlorine in the water main as the pipe is constructed.
2. Once water main construction is complete, the Contractor shall request to have the pipe segment filled by BMU personnel.
    a. Contractor shall make their request during normal business hours, between 8 a.m. to 5 p.m., Monday-Friday. Filling of the pipe segment will be done by BMU at a time determined by the BMU to have minimal impacts to the existing customers.
3. Contractor shall disinfect the water main as indicated in Section 3.27 - WATER MAIN DISINFECTION.
4. Once the water main has been disinfected, the line segment shall be hydrostatically tested in accordance with Section 3.28 - HYDROSTATIC TESTING.
    a. Should the test disclose damaged or defective materials or leakage greater than that permitted, the Contractor shall at his own expense locate and repair and/or replace any defective materials.
    b. Should the repair of the damaged or defective material compromise the integrity of the water main, the water main shall be disinfected again to ensure sanitary conditions exist by going back to step 3.26.A.1 as indicated above.
    c. The test shall be repeated until the leakage is within the permitted allowance.

5. Once a passing hydrostatic test has been obtained, the water main shall be adequately flushed by BMU personnel.
6. Once flushing is complete, the line segment shall be bacteriological tested in accordance with Section 3.29 -BACTERIOLOGICAL TESTING.

3.27 WATER MAIN DISINFECTION

A. Water mains shall be disinfected in accordance with by one of three acceptable methods as described in the most current addition of AWWA C651 DISINFECTING WATER MAINS. The three acceptable methods are:
   1. Tablet/Granule Method of Chlorination
   2. Continuous-Feed Method of Chlorination
   3. Slug Method of Chlorination

B. Water Mains 12-inch diameter and smaller shall utilize the Tablet/Granule Method of Chlorination. The following specifications and previous Section 3.26 – WATER MAIN TESTING SEQUENCE is based on this method of chlorination.
   1. The Contractor shall place sufficient granular chlorine in the water main as construction progresses. Granules shall be placed at the upstream end of the first section of pipe, at the end of each branch main and at 500 feet intervals.
      a. The quantity of granular chlorine shall be placed in accordance with AWWA C651 to provide a minimum chlorine dose of 25 mg/L.
   2. Once the water main installation is complete, the water main shall be slowly filled with water such that the full pipe velocity is not greater than 1.0 feet per second.
      a. Fill rate must be carefully controlled to ensure that chlorine granules do not migrate throughout the water main.
      b. Precautions shall be taken to ensure that air pockets are eliminated
   3. The chlorinated water shall remain in the water main for a minimum of 24-hours. Upon completion of the minimum contact time, the Contractor shall verify that a detectable free chlorine residual is present at each sampling point.
      a. In order to prevent damage to the pipe and/or pipe lining, heavily chlorinated water shall not remain in contact with the water main for more than 72-hours.
   4. The Contractor shall request to have the water main flushed by BMU personnel. The water main shall be adequately flushed to remove all heavily chlorinated water and remaining particulates.
      a. BMU will be responsible for disposal of heavily chlorinated water such that residual levels of chlorine in the discharge water do not exceed 0.05 mg/L when entering the Waters of the State.

C. Disinfection of 14-inch diameter and larger water mains shall be chlorinated by any one of the three acceptable methods previously indicated.

1. If the Contractor chooses a method other than the Tablet/Granule Method for Chlorination, the Contractor must submit a detailed plan showing compliance with AWWA C651.
2. Plan shall include the following information at a minimum;
    a. Type and concentration of chlorine,
    b. Calculation showing fill and flushing flowrates, dosage, duration of time for fill and flush,
    c. And sequence

3.28 HYDROSTATIC TESTING

A. The Contractor shall furnish all pumping equipment, labor, gauges, and other appurtenances required for the pressure test.

B. Upon completion of the water main installation, the water main shall be hydrostatically tested using the following guidelines:
    1. For water mains, a pressure of 120 psi shall be maintained for a period of 2-hours. The BMU Engineer or his appointed representative shall observe the pressure gauge readings before acceptance of the test.
    2. If after 2-hours the pressure has dropped less than 2.0 psi, the test shall be considered acceptable. If the pressure dropped greater than 2.0 psi, the volume of water needed to re-pressurize the water main shall be calculated and the Contractor shall be responsible for re-pressurizing the main.

C. BMU Engineer or his appointed representative shall observe the pressure gauge readings before acceptance of the test. The BMU representative shall verify that the test hydrant lead valve(s) is in the open position prior to initiating the pressure test.

D. If at any time during the test the pressure drops below the specified test pressure, the Contractor shall re-pressurize the pipe by pumping in potable water in sufficient quantity to bring the pressure back to the original test pressure. Accurately measure the amount of water required to re-pressurize the system to the initial test pressure.
    1. Maximum allowable leakage rate:
    $$Q = \frac{L\ D\ \sqrt{P}}{148{,}000}$$
    Where:
    Q = Allowable makeup water, gallons per hour
    L = Length of pipe section being tested, in feet
    D = Nominal Diameter of pipe, in inches
    P = Avg Test Pressure, PSI Gauge
    ($\sqrt{120psi}=10.95$)

E. If the average measured leakage per hour exceeds the maximum allowable leakage rate, repair and retest the water main. Repair all visible leaks regardless of the amount of leakage.

3.29 BACTERIOLOGICAL TESTING

A. One set of bacteria tests is required for every 1,200 lineal feet of water main installed.

B. Once flushing is complete, BMU personnel will collect a water sample(s) from the water main at an acceptable location for coliform bacteria testing. Contractor shall deliver the water sample(s) to the lab for analysis.

C. After collection of the first water sample(s), the water shall remain in the water main for an additional 24-hours. After a minimum of 24 hours, BMU personnel will collect a second water sample(s).

D. Two consecutive passing samples (coliform bacteria absent), at all of the sample location(s), shall be required for a passing bacteria test. Upon receiving notification of the second sample passing, the water main can be put into service and service lines tapped.

E. If one of the two consecutive coliform bacteria test fails (coliform bacteria present), the Contractor must request that the water main be re-flushed. After the water main is re-flushed, a water sample(s) will be taken and second water sample(s) shall be taken a minimum of 24 hours later than the first re-sample.

F. If one of the two consecutive re-test samples fails, the Contractor is required to re-chlorinate the water main by the AWWA continuous feed or slug method (liquid chlorine injection through a service tap). The sample testing and retesting protocol established in the previous section will be required until consecutive coliform bacteria test passes.

G. Contractor shall be responsible for paying, shipping, delivering and/or transporting all samples to the appropriate testing laboratory. Contractor shall provide Engineer of Record and BMU staff a copy of the successful bacterial testing results.

3.30 WATER METER INSTALLATION

A. Contractor shall purchase meter from BMU and install the meter, make meter connections, install remote reading device, cable and caulking, as required. BMU must be notified during appropriate construction phases so proper meter installations can be complete. Contractor shall schedule a new meter install with BMU a minimum of 24 hours prior.

B. BMU will install water meters in water meter settings which conform with the following standards:

1. The water meter shall be located inside the building and as close as possible to the point at which the water service pipe enters the building. The water meter must be located in an area which is heated by the building's heating system. Meters shall NOT be installed in crawl spaces, NO EXCEPTION. The customer is ultimately responsible for protecting the water meter from freezing; heat tapes and building insulation are not recommended for this purpose;

2. The pipe adjacent to the water meter setting shall be arranged so the water meter is, and will remain, accessible for installation, reading, inspecting and changing the water meter. The meter and adjacent valves shall not be obstructed as to prevent meter installation or replacement. Enough working

room, typically two feet in front of the meter, must be cleared by the property owner as to allow for meter replacement, as well as a clear path to the water meter. Property owners are responsible to maintain accessibility to the water meter.

3. It is recommended that a floor drain be located near the water meter setting.
4. The water meter shall be installed in a vertical run of pipe, copper male by female swivel jointed meter yoke, ball valve with a graspable handle upstream of the meter, a suitable reducer/s and a pipe support on each side of the water meter; the vertical run of pipe shall be at least 1 foot, but not more than 3 feet from the floor. Piping and yoke shall be mounted so that the meter dial is mounted in the horizontal plane, NO EXCEPTION.
    a. Backflow prevention devices are required and must be installed immediately downstream of meter setter. No connections are allowed between the meter and the backflow preventer.
    b. The isolation ball valve shall be immediately upstream of the meter setter. The meter isolation valve shall be the only valve on the water service between the water meter and the curb stop valve, NO EXCEPTION.
5. Complete installation of empty ¾-inch or larger Flexible PVC electrical conduit shall be installed from the meter setter to the remote reading point.
    a. Total length of conduit from the meter setter to the remote reading point shall not exceed 90 feet. Flexible PVC conduit shall be installed in such a manner that pull boxes and splices to the conduit are unnecessary.
    b. The remote reading point shall be a box that BMU will supply for structure with only one (1) water meter. All other types of installations must be pre-approved by the BMU water department.
    c. The remote reading point box shall be mounted to the structure and connected to conduit.
        - The remote reading point shall be mounted on the outside wall of the building, 48 to 66 inches above the ground and within five (5) feet of the electrical meter.
        - The remote reading point shall not be covered or enclosed as to inhibit meter reading or meter maintenance.

C. If two or more water meters are to be installed per account holder, the piping shall be arranged to prevent the water meters from operating in series.
    1. Water meters may be installed in parallel piping arrangements for redundancy, or to increase water flow capability while not sacrificing low flow registration capability provided a swing check valve is installed in the outlet piping of both meters.
    2. Irrigation meters shall be plumbed prior to the domestic meter and installed in parallel piping. In no case shall the domestic and irrigation be installed in series such that metering and billing for the irrigation meter being a series of calculation to determine monthly irrigation water. NO EXCEPTIONS
D. BMU will analyze each building's water requirements to ensure adequate water meter size. Meter sizing decisions are at the sole discretion of BMU.

E. Commercial meter (3-inch and Larger) installations shall include a 120 VAC, single phase power supply to power the meter. The commercial customer shall be responsible for paying for all costs associated with installation and powering the water meter. Commercial meter installations shall also include a dismantling joint immediately downstream of the meter.

   1. For commercial water meters, BMU shall furnish the water meter for installation by others. All work is subject to inspection and approval by BMU.