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# SECTION 4 - WATER SYSTEM CONSTRUCTION

## 4.1 GENERAL

4.1.1 Description – This work shall consist of the construction of water main and services utilizing plant fabricated pipe and other appurtenant materials, installed for conveyance of potable water. The work includes the construction of water main pipe, valves, hydrants, services, and other related items as specified.

All work must be performed in accordance to these specifications, the Blaine Standard Detail Plates, the plans, and applicable MNDOT Standard Plates.

4.1.2 References – All general pipe installation requirements and materials shall be in accordance to Section 2 "Pipeline Installation Requirements" of these specifications.

4.1.3 Extra Materials – See Section 2.1.2 of these specifications for Extra Materials requirements.

4.1.4 Shut off of Existing Water System – A minimum of 24 hours written notice must be given to water system users prior to the system being shut down. The Contractor will be responsible for performing the notification on City provided "tags".

## 4.2 PRODUCTS

### 4.2.1 Water Main Pipe and Fittings

A. Ductile Iron Pipe – Ductile iron water main pipe shall be ductile iron class 52 for pipe less than 12 inches in diameter, class 50 for pipe 12 inches and larger in diameter, and shall conform to the requirements of AWWA C151 (ANSI A21.51).

B. Polyvinyl Chloride Pipe (PVC) – PVC shall conform to AWWA C900 for 4-inch to 12-inch diameter pipe and AWWA C905 for 14-inch to 36-inch diameter pipe. The pipe shall be pressure class with a DR rating of 18 and conforming with the outside diameter dimensions of cast iron pipe. All materials shall meet the specifications and approval of the Underwriters Laboratories Factory Mutual and the National Sanitation Foundation (NSF) standard. PVC pipe meeting AWWA C909, pressure class 150, is allowed for diameters 4-inch to 12-inch.

C. Fittings – All water main fittings shall meet the requirements of AWWA C153, latest edition. Bolts and nuts shall be stainless steel "Cor-Blue" meeting AWWA C111, latest edition, and ASTM F593.

D. Lining and Coatings – All pipe and fittings shall be furnished with cement mortar lining meeting the requirements of AWWA C104 (ANSI A21.4) for standard thickness lining.

All interior and exterior surfaces of the fittings shall have an epoxy coating meeting the requirements of AWWA C116. Spotting or thin coating, or poor coating adhesion, shall be cause for rejection.

E. Joints – Pipe three inches and larger in diameter shall have slip on joints. Fittings shall have mechanical joints. The rubber gasket for both type joints shall conform to AWWA C111 (ANSI A21.11).

F. Electrical Conductivity – Copper straps shall be welded or otherwise permanently affixed to each pipe or appurtenance to provide a positive means of conveying electricity from pipe or fitting, to pipe or fitting. Conductive pipe gaskets may be used on pipe-to-pipe connections if approved by the Engineer. Size and method of affixing strap shall be subject to the approval of the Engineer and shall be sufficient to meet or exceed the criteria for conductivity testing set forth in this specification.

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G. Retainer Glands – All joints requiring thrust restraint must be provided with a Mechanical Joint Restraining Device. The device shall have a working pressure of at least 250 psi with a minimum safety factor of 2:1. The following devices shall be used or approved equal:

1. "Mechanical Joint Retainer Gland" manufactured by Tyler Pipe, Tufgrip Series 1000 for DIP, and Series 2000 for PVC.
2. "Megalug" manufactured by EBAA Iron, Inc.
3. "GripRing" manufactured by Romac Industries, Inc.
4. "MJ Gripper Gland" manufactured by U.S. Pipe for DIP only.

The Contractor shall submit to the City for review a plan and/or schedule of how the water main fittings will be restrained. This document must show fitting type, length of restraint, and other pertinent data, all based on the fitting manufacturers guidelines. For 12" and larger water main, thrust blocking and retainer glands shall be required see Blaine Standard Detail Plate WS-6.

### 4.2.2 Fire Hydrants

A. Fire Hydrants shall be Pacer model WB-67 as manufactured by Waterous Company, and shall conform to AWWA C502.

Hydrants shall be furnished in conformance with the following supplementary requirements:

1. Five-inch (nominal diameter) main valve opening of the type that opens against water pressure with a one piece pentagonal operating nut with one-inch sides (nominal 1.5 inches from point of pentagon to opposite side), and opening counterclockwise (left).
2. Barrels shall be two piece, non-jacket type, with flanged joint above finished grade line, sixteen-inch break off extension, and with mechanical joint connection at the hub end for joining a six-inch ductile iron branch pipe.
3. Hydrants bury depth, measured from the top of the branch pipe connection to the finished ground line at the hydrant, shall be a minimum 7-feet-6-inch (8-feet-0-inch to bottom of connecting pipe per Waterous definition of "Bury").
4. Hydrants shall have two outlet nozzles for 2½-inch (I.D.) hose connection and one outlet nozzle for 4½-inch (I.D.) pumper connection. Threads shall conform to NFPA No. 194 (ANSI B26) and shall be: hose connection - 7½ threads per inch, 3.062 inch nominal outside diameter (National Standard Thread); pumper connection - 4 threads per inch, 5.562 inch nominal outside diameter (Minneapolis Thread). Nozzle caps shall be nut type with chain.
5. Hydrant operating mechanisms shall be provided with "O" ring seals preventing entrance of moisture and shall be lubricated through an opening in the operating nut or bonnet.
6. Drain holes shall be left open.
7. Hydrants shall contain oil reservoir.
8. Hydrants flags shall be 3-inch wide, 4-foot long, Model FH800, "Flex Stake Hydrant Marker", as manufactured by Flexstake, or approved equal. The flag shall be white with reflective orange markings.

4.2.3 Valves – Six-inch to twelve-inch valves shall be resilient seated gate valves, larger than twelve inches shall be butterfly. Tapping tees shall have resilient seated gate valves. All

## SECTION 4 - WATER SYSTEM CONSTRUCTION

valves shall be for buried service. All bolts used to construct the valves shall be stainless steel.

- A. Butterfly Valves – Butterfly valves shall conform to the requirements of AWWA C504 and the following requirements:
  - 1. Working pressure rating of 150 psi minimum.
  - 2. Two inch square operating nut opening counterclockwise (left).
  - 3. Double "O" ring or split V-type stem seal.
  - 4. Traveling nut type operator permanently sealed and lubricated.
  - 5. Mechanical joints.
  - 6. Manufacturers: Dresser, Pratt, American-Darling, Mueller, or approved equal.
- B. Gate Valves – Gate valves shall conform to AWWA C515 for Resilient Seated Valves, and shall comply with the following supplementary requirements:
  - 1. Working pressure rating of 200 psig for all sizes.
  - 2. Two-inch square operating nut opening counterclockwise (left).
  - 3. Double "O" ring stem seal, one above and below the stem seal.
  - 4. Weather seal on bonnet cover. All cover bolts shall be stainless steel.
  - 5. Non-rising stem.
  - 6. Mechanical joints.
  - 7. Manufacturers: American-Darling, Mueller, Kennedy, Tyler Pipe, U.S. Pipe, or approved equal.
- C. Valve Stem Extensions – Valve stem extensions shall be self-centering in the valve box, have a mechanical connection to the valve stem, and come in 12-inch length increments. Valve stem extensions will be required for valves nine feet deep or deeper.

4.2.4 Valve Boxes – Valve boxes shall be 5¼-inch diameter shaft suitable for 7.5 feet of cover over the top of the water main. Boxes shall be screw type two-piece boxes with the word "water" on the lid. Valve boxes shall be Tyler 6850 with 4-inch drop lid, or approved equal. On development projects with an interim surface course, gate valves shall be adjusted to the interim grade within one week of paving.

- A. Valve Box Adapters – All valves shall have a valve box adapter to keep the box centered on the valve. The adapter shall be as manufactured by "Adapter, Inc.", West Allis, Wisconsin, or approved equal.
- B. Steel adjusting rings for valve boxes shall be as manufactured by Ess Bros. & Sons, Inc. or approved equal.

### 4.2.5 Water Service Pipe and Appurtenances

- A. Pipe – Water service pipe shall be installed per the following:

Type	Copper	DIP	PVC*	HDPE* **
Sizes	1" to 2"	3" and greater	3" and greater	1" to 2"

Copper pipe shall be Type K, seamless copper water tubing, soft annealed temper and conform to the requirements of ASTM B 88.

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DIP shall conform to the requirements in Section 4.2.1.A above.

PVC shall conform to the requirements in Section 4.2.1.B above.

HDPE shall conform to the requirements of ASTM D2737, for "EndoPure" Water Service Tubing, PE 3408-200 psi, SIDR 7 (IPS), as manufactured by Endot Industries. Appurtenant fittings for HDPE pipe shall be per manufacturers recommendation, as approved by the City Engineering Department.

\*Tracer wire must be installed per Section 4.2.9.

\*\* Diameter is minimum inside diameter for HDPE.

### Appurtenances

1. Corporation Stop – For use with flared copper service pipe, and the inlet threaded with the standard AWWA taper thread.
2. Curb Stop – For use with flared copper service pipe both ends, inverted key, and Minneapolis pattern.
3. Curb Box – Minneapolis pattern base, 72-inch stationary rod, 12-inch box adjustment with 96-inch length when fully extended, lid with tapped plug, and 1¼-inch diameter, one piece, upper section. Curb box lid must have a stainless steel bolt for the connection of a tracer wire.

*Manufacturers: 1" – 2" only*

<u>Service</u>	<u>Manufacturer's Number</u>		
<u>Appurtenance</u>	<u>Mueller</u>	<u>A. Y. McDonald</u>	<u>Ford</u>
<u>Corporation Stop</u>	H-15000	74701	F-600-4
<u>Curb Stop</u>	H-15154	76104	B22-444M-1" B22-666M-1½" B22-777M-2"
<u>Curb Box</u>	H-10300	5614	EM2-80-46-78R

4. Service Saddle – Only double strap banded saddles will be allowed. The following saddles are acceptable: Smith-Blair Nos. 323 and 372; Mueller Co. Nos. BR 2 B Series or the BR 2 S series. The Contractor must obtain approval for all double band saddle types from the City Engineering Department, prior to using them on a project. Service saddles are required on all PVC water main service connections.

4.2.6 Polyethylene Encasement Material – Polyethylene encasement material shall conform to AWWA C105 for tube type installation and 8 mil nominal film thickness.

4.2.7 Insulation – Pipe wrapped insulation shall be three (3) inches of DOW Styrofoam FB brand plastic foam, or approved equal, wrapped around the entire pipe, pipe joints and bends for those areas designated on the plans. The insulation shall be installed with bands as per the manufacturer's specification.

Sheet insulation shall be two-inch thick, four-feet wide by eight-feet long foam waterproof insulation in accordance with MnDOT Specification 3760. Sheets shall be centered on the pipe and installed above or below the pipe in accordance with Blaine typical detail plates.

4.2.8 Valve and Meter Manholes

- A. Manholes for valves and meter shall meet the requirements of MNDOT Standard Plate 4007 for the size and depth as shown on the plans, and the Blaine Detail Plates.

## SECTION 4 - WATER SYSTEM CONSTRUCTION

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- B. Castings shall be Neenah R-1733 with "Platen" lid meeting the requirements of MNDOT Standard Plate No. 716, or as specified on the plans. Lids shall be marked "WATER". On development projects with an interim surface course, manholes shall be adjusted to the interim grade within one week of paving in accordance to Blaine Detail Plates.

### 4.2.9 Tracer Wire for PVC Pipe

- A. Tracer wire for PVC pipe shall be No. 12 AWG solid, PRO-TRACE HF-CCS PE45, as manufactured by Pro-Line Safety Products, or approved equal. Conductor shall be soft-drawn, 21% IACS, copper clad steel, utilizing a AISI 1006 low carbon steel core, with break load of 282 lbs (55,000 psi). Conductor shall be extruded with a 45 mil, high density polyethylene, and meet the APWA color code for buried water main. Tracer wire shall be rated for direct burial use at 30 volts and RoHS compliant. Wire splices shall be made with a PRO-TRACE TW Connector (Part No. 73901) rated for direct burial use filled with silicone sealant, or approved equal. Tracer wire shall be fastened to fire hydrant with "Hydrant Tracer Wire Bracket" and 3/4" diameter PVC tubing protection sleeve as manufactured by Vait Products, or approved equal.
- B. On PVC water services over 100 feet long, tracer wire access boxes shall be installed every 100 feet. Access boxes shall be manufactured by C. P. Test Services - Valvco, represented by Rischer, Harris & Associates, 1-800-224-7579, or approved equal.

## 4.3 **EXECUTION**

All water main items shall be installed in accordance to Section 2 "Pipeline Installation Requirements" of these specifications except as modified or supplemented herein.

### 4.3.1 Ductile Iron Pipe Joints

- A. Push-On Joints – The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket. A thin film of approved gasket lubricant shall be applied to either the inside surface of the gasket or the outside surface of the spigot end, or to both. Care shall be taken while inserting the spigot end to prevent introduction of contaminants. The joint shall be completed by forcing the spigot end to the bottom of the socket by the use of suitable prybar or jack type equipment. Spigot ends which do not have depth marks shall be marked before assembly to insure full insertion. Field cut pipe shall be filed or ground at the spigot edge to resemble the manufacturer's fabricated detailing. The use of the bucket on the excavation equipment shall not be used to force pipe into socket.
- B. Mechanical Joints – The last eight inches of the outside spigot surface and the inside bell surface of each pipe and appurtenance joint shall be painted with a soap solution, after being thoroughly cleaned. The ductile iron gland shall then be slipped on the spigot end with the lip extension toward the socket or bell end. The rubber gasket shall be painted with soap solution and be placed on the spigot end with the thick edge toward the gland. An approved lubricant provided by the pipe manufacturer may be used in lieu of the soap solution.

After the spigot end is inserted into the socket to full depth and centered, the gasket shall be pressed into place within the bell evenly around the entire joint. After the gland is positioned behind the gasket, all bolts shall be installed and the nuts tightened alternately to the specified torque, such as to produce equal pressure on all parts of the gland.

Unless otherwise specified, the bolts shall be tightened by means of a suitable torque-limiting wrench within a foot-pound range of: 40 to 60 for 5/8-inch bolts; 60 to 90 for 3/4-inch bolts; 70 to 100 for 1-inch bolts; and 90 to 120 for 1 1/4-inch bolts. After

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tightening, all exposed parts of the bolts and nuts shall be completely coated with an approved bituminous rust preventive material such as Koppers 505. Final tightening of bolts shall be with a hand wrench, not pneumatic or electric.

C. Retainer Glands – Retainer glands and other mechanical restraint devices shall be installed in accordance to the manufacturer's instructions for the device.

4.3.2 Aligning and Fitting of Pipe – The cutting of pipe for inserting valves, fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe and leave a smooth square-cut end. Ductile iron pipe shall be cut with approved mechanical cutters. The electric-arc cutting method, using carbon or steel rod, will be approved for use on the larger size pipe where mechanical cutters are not available. Flame cutting will not be allowed under any conditions. All rough edges shall be removed from the cut ends of pipe and, where rubber gasket joints are used, the outer edge shall be rounded or beveled by grinding or filing to produce a smooth fit.

Wherever it is necessary to deflect the pipe from a straight line either in the vertical or horizontal plane, to avoid obstructions, plumb stems, or produce a long radius curve when permitted, the amount of deflection allowed at each joint shall not exceed the allowable limits for maintaining satisfactory joint seal as given in AWWA C600 for mechanical joints and push-on joints, or as otherwise allowed by the pipe manufacturer.

The following table is reproduced from AWWA C600 for convenience. The Contractor shall check to ascertain if this is the most current data and complies with the pipe manufacturer's recommendation.

*Maximum Deflection Full Length Pipe  
- Push-on Type Joint -*

<i>Pipe Diameter in.</i>	<i>Deflection Angle deg.</i>	<i>Maximum Deflection - in.</i>		<i>Approx. Radius of Curve Produced by Succession of Joints - ft.</i>	
		<i>(18' length)</i>	<i>(20' length)</i>	<i>(18' length)</i>	<i>(20' length)</i>
6	5	19	21	205	230
8	5	19	21	205	230
10	5	19	21	205	230
12	5	19	21	205	230
14	3	11	12	340	380
16	3	11	12	340	380
18	3	11	12	340	380
20	3	11	12	340	380
24	3	11	12	340	380

4.3.3 Restraining of Pipe, Hydrants, and Appurtenances – All plugs, caps, tees, tapping tees, bends, and other thrust points shall be provided with mechanical restraining devices and concrete thrust blocking.

All necessary fittings, bands, nuts, and washers, and all labor and excavation required for installation of reaction restraints shall be furnished as a part of the associated work item.

All metal parts of the restraints shall be galvanized or coated with approved rustproofing.

4.3.4 Polyethylene Encasement of Pipeline – Wherever so required by the Plans or Special Provisions, the pipeline, including valves, fittings, curb stops and appurtenances, shall be fully encased in polyethylene film of 8 mil nominal thickness. The film shall be furnished in tube form for installation on pipe and all pipe-shaped appurtenances such as bends, reducers, offsets, etc. Sheet film shall be provided and used for encasing all odd-shaped appurtenances such as curb stops, valves, tees, crosses, etc.

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Installation shall be in accordance with AWWA C105.

- 4.3.5 Insulation – Insulation shall be installed in accordance with the detail plate. Where sheets of insulation abut, the sheets shall overlap by 6 inches.
- 4.3.6 Water Service Installations – Water service facilities consisting of Tap Service Lines and Branch Service Lines, complete with all required appurtenances, shall be installed in accordance with all pertinent requirements for main line installations and as supplemented as follows.

It shall be the responsibility of the Contractor to keep an accurate record of the location, depth and size of each service connection and other pertinent data such as the location of curb stops and pipe endings. Tap locations shall be recorded in reference to survey line stationing. Curb boxes shall be tied to definable landmarks such as building corners, fire hydrants, manholes and telephone pedestals. Pipe terminals at the property line shall be marked with a 6-foot-2-inch by 2-inch wood post wired securely to the curb box, and the top six inches painted blue. If the service is to a vacant lot, a 6-foot steel fence post shall be used in place of the wood post. If the water service is installed in the same trench as the sanitary sewer service, the same metal post shall be used to mark both services.

Water service lines shall normally be installed by trenching. When water service lines are installed alongside of sanitary or storm sewer service lines, installation shall maintain the minimum specified clearances between pipelines and provide proper and adequate bearing for all pipes and appurtenances. For separate installation, the trench width shall be not less than two feet. Subject to minimum clearances, the water lines may be laid in a common trench excavated principally for sewer installation, either by widening the trench as necessary or by providing a shelf in the trench wall where ground stability will permit.

Unless otherwise specified, installation of water service lines shall provide for not less than 7½-feet of cover over the top of the pipe and for not less than 18 inches of clearance between pipelines. Also, at least 6 inches of clearance shall be maintained in crossing over or under other structures. Where the service pipe may be exposed to freezing due to insufficient cover or exposure from other underground structures, the water pipe shall be insulated as directed by the Engineer.

If curb stop is in a driveway or sidewalk, a “Ford Type A1”, or approved equal, must be installed.

Service trenches shall be restored and compacted as specified for pipelines.

- A. Branch Service Lines – Branch service piping shall be Ductile Iron Water Pipe of the size specified. The pipe and appurtenances shall have rubber gasketed push-on or mechanical joints. Minimum pipe size for branch service installations shall be 6 inches nominal inside diameter. Hydrant leads shall be 6 inches in diameter. Larger than minimum size branch service lines shall be provided as required by the Plans.
- B. Tap Service Lines – Tap service piping shall be Seamless Copper Water Tube of the size and type specified. Pipe size for tap service installations shall be from one-inch to two-inch nominal inside diameter. All taps to PVC water main shall be with a saddle connection.

Unless otherwise indicated, tap service piping may be laid directly on any solid foundation soil that is relatively free of stones and hard lumps.

Tap service piping shall be installed in one piece without intermediate joint couplings between the corporation stop at the water main tap and the curb stop. All pipe and appurtenances shall be joined by means of approved flared type threaded couplings. The tap connection shall be made while the water main is under pressure.

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The flaring of copper tubing ends shall be accomplished only with the use of the proper size and type of tools as designated for the purpose, and will provide accurate sizing and rounding of the ends. Tubing shall be cut squarely and all edge roughness shall be removed prior to flaring.

All couplings shall be tightened securely, so the flared end fits snugly against the bevel of the fitting without leakage. The flared joint couplings shall be made up without the use of jointing compounds.

Connection of tap service lines to the water main shall be made with an approved corporation stop, with the water main tap being made from horizontal to an angle of not more than 22 degrees from the horizontal. Expansion loops shall be directed horizontally from the tap. A minimum of 3 full threads of the corporation stop must engage the water main tapped or a saddle must be used for the connection.

### *TAP CONNECTION TO CLASS 52 DIP*

*T = Direct Tap\* S = Saddle on Water Main*

*(Based on 3 engaged threads on corporation stop)*

<i>Water Main Diameter (inch)</i>	<i>Corporation Stop Tap Size (inch)</i>			
	<i>1</i>	<i>1-1/4</i>	<i>1-1/2</i>	<i>2</i>
<i>6</i>	<i>S</i>	<i>S</i>	<i>S</i>	<i>S</i>
<i>8</i>	<i>T</i>	<i>T</i>	<i>S</i>	<i>S</i>
<i>10</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>S</i>
<i>12</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>S</i>
<i>14</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>S</i>
<i>16</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>T</i>
<i>18</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>T</i>
<i>20</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>T</i>
<i>24</i>	<i>T</i>	<i>T</i>	<i>T</i>	<i>T</i>

*\* Note: Where direct tap is indicated, a saddle may be required due to size and type of tapping machine and size of corporation.*

Unless otherwise indicated, tap service lines shall be installed on a straight line at right angles to the water main or property line. The service line shall be terminated with a curb stop and box at the property line, unless otherwise indicated on the plans or detail plates.

The service pipe and curb stop coupling depth shall maintain not less than the specified minimum cover and provide for a standard service box installation. The service box shall be screwed onto the curb stop coupling and be firmly supported on a concrete brick. Service boxes shall be installed plumb and be braced effectively to remain vertical during and after completion of backfilling. The service boxes shall be brought to final surface grade when the final ground surface has been established.

- 4.3.7 Setting Valves, Hydrants, Fittings, and Specials – Valves, hydrants, fittings, and specials shall be provided and installed as required by the plans and Blaine detail plates, and with each installation accomplished in accordance with the requirements for installation of mainline pipe to the extent applicable. Support blocking, restraining devices, and anchorage devices shall be provided as required by the plans and Blaine detail plates. Valves 12-18 inches shall be set on a single 15-inch by 7-inch by 7-inch concrete block, with holes horizontal, and valves larger than 18 inches shall be set on two 15-inch by 7-inch by 7-inch concrete blocks.

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Hydrants shall be installed plumb, with the height and orientation of nozzles as shown on the detail plates. Hydrants shall be connected to the mainline pipe with a 6-inch diameter ductile iron branch pipe, controlled by an independent valve.

A drainage pit one-half cubic yard in volume shall be installed around the hydrant base and shall be filled with one-half cubic yard of 1 inch clean, washed rock firmly compacted under and around the hydrant base as shown on the detail plate. The clean rock shall be covered with at least 8 mil polyethylene prior to placing backfill thereon. Drain holes shall be left open.

Valve boxes shall be centered over the wrench nut of the valve and be installed plumb, with the box cover flush with the surface of the finished pavement or at such other level as may be directed. Valve boxes shall not be installed so as to transmit shock or stress to the valve. Valve boxes installed outside the paved roadway a metal post and sign meeting Blaine Standard Detail Plates shall be installed adjacent to the valve. The sign shall be 6" high blue background, with 4" high white letters "GV" and no border. The cost of this sign shall be incidental to the cost of the valve. Post is not required when the valve box is installed with a hydrant.

Special appurtenances shall be provided and installed as required by the Plans and Special Provisions.

All dead ends shall be closed with approved plugs or caps and restrained. If line size is reduced at the end of the line, restraints shall be sized for the line size prior to reduction. Install a 2-inch by 2-inch wood post vertically from the pipe end invert to 2.0 feet above the ground surface with the top six inches painted blue.

When tapping a water main to an existing water main, the connection shall be made while the existing water main is under pressure using an AWWA approved drilling machine, tapping sleeve and tapping valve. Conductivity must be maintained from the existing main to the new main. The Contractor shall verify the size of the existing main prior to ordering, the fittings for the connection.

The installation of hydrant flags shall be determined in the field by the Engineer. Refer to Section 4.2.2.A.9.

- 4.3.8 Disinfection of Water Mains – Disinfection shall be performed according to AWWA Standard C651-05. Water lines shall be flushed prior to disinfection, except when tablet method is used. Acceptable chlorine disinfectants are calcium hypochlorite granules, sodium hypochlorite solutions, and calcium hypochlorite tablets. Acceptable methods of inducing chlorine are by continuous feed or tablets. Briefly each method is described following. Refer to AWWA C651-05 for the complete description.

Assure valve closure at existing system in order to prevent chlorine flowing into existing water system. The Contractor shall furnish all materials and perform the disinfecting, flushing, and testing for meeting the water quality requirements.

*Chlorine-Water Solution Method:*

*Chlorine Required To Produce 25 Mg/ Concentration in 100 feet of pipe by Diameter*

<u>Pipe Size</u> <u>Inches</u>	<u>100% Chlorine</u> <u>pounds</u>
4	0.13
6	0.30
8	0.54
10	0.085
12	0.12

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*Tablet Method:*

May be used only when scrupulous cleanliness has been practiced to exclude all foreign materials and ground water during pipe installation. If ground water has entered pipe during pipe installation, the water main shall be flushed and the chlorine-water solution method shall be used. Place tablets with adhesive in each pipe joint in top of pipe in accordance with following table:

*Number of Tablets*

*(65% available chlorine per tablet)*

*Required for 25 Mg/l initial concentration*

<i>Length Feet</i>	<i>Diameter of Pipe Inches</i>					
	<u>4</u>	<u>6</u>	<u>8</u>	<u>10</u>	<u>12</u>	<u>16</u>
	<i>Number Tablets</i>					
<i>13 or less</i>	1	1	1	2	3	4
<i>18</i>	1	1	2	3	4	6
<i>20</i>	1	1	2	3	4	7

Chlorination Residual of 25 mg/l chlorinated water shall be retained in pipe line for minimum of 24 hours. During retention period all valves and hydrants shall be operated to disinfect. At end of 24-hour period, chlorine in system shall contain no less than 25 mg/l throughout length of pipe system tested. Samples must be taken and results submitted to the Engineering Department for approval. When section being tested meets 25 mg/l chlorine after 24 hours, flush main.

After the chlorinated water has been in the water main for its 24-hour period, the Contractor shall flush the main until the replacement water is equal to the water quality in the existing public water system. Flushing of mains must be supervised by the City's Public Works Department. A minimum of 48 hours notice must be given to the Public Works Department at 763-785-6137. The Contractor shall have the water tested for residual chlorine content and bacteria. Test results must be submitted to and approved by the Engineer prior to the new water main being put into service.

Water samples taken shall show no coliform organisms. If water in pipe does not meet the Minnesota Department of Health requirements disinfection procedure shall be repeated until meeting requirements. Acceptance forms from governing agency shall be furnished Engineer.

- 4.3.9 Electrical Conductivity Test – The Contractor shall perform a conductivity test within one week after completion of pressure testing of the main on all iron pipe water mains to establish that electrical thawing may be carried out in the future. The Engineer or Owner may require the Contractor to test the first section of pipe installed to demonstrate the Contractor's ability to install the pipe in an acceptable manner. When the connection to the existing system is not made with a valve, the Contractor shall test the existing section to the first available valve(s) to determine the condition of the existing system, or the Contractor may make provisions to test his work separately, prior to connection to the existing system, in a manner acceptable to the Engineer.

The system (pipeline, valves, fittings and hydrants) shall be tested for electrical continuity and current capacity. The electrical test shall be made after the hydrostatic pressure test and while the line is at normal operating pressure. Backfilling shall have been completed. The line may be tested in sections of convenient length as approved by the Engineer.

Direct current of 350 amperes plus or minus 10% shall be passed through the pipeline for 5 minutes. Current flow through the pipe shall be measured continuously on a suitable ammeter and shall remain steady without interruption or fluctuation throughout the 5-

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minute test period. For a PVC water main, all sections must be located with an electronic testing device. The Contractor shall provide a certified testing company to supply the device and perform the test.

The current control should be set at minimum before starting. After starting the machine, advance the control until the current indicated on the ammeter is at the desired test value.

Insufficient current or intermittent current or arcing, indicated by large fluctuation of the ammeter needle, shall be evidence of defective contact in the pipeline. The cause shall be isolated and corrected. Thereafter, the section in which the defective test occurred shall be retested as a unit and shall meet the requirements.

Sources of D.C. for these tests may be motor generators, arc welding machines, or other approved sources. All such equipment shall be furnished by the Contractor and subject to the approval of the Engineer.

Cables from the power source to the section of system under test should be of sufficient size to carry the test current without overheating or excessive voltage drop.

Connections for the test can be made at hydrants or valves. Hydrants shall be in the open position with the caps on during the test. The cable shall not be clamped to the top operating nut. Where hydrants or valves are not available connections will be made to straps welded directly to the pipe.

*Note: After the test the hydrant shall be shut off and a cap loosened to allow hydrant drainage. Tighten cap after drainage.*

- 4.3.10 Hydrostatic Testing of Water Mains – Each valved section shall be subjected to the pressure test. Testing for the two hours duration shall be with hydrants closed, and valves on hydrant leads and dead end water lines open. Once this portion of the test is completed, the valve on the hydrant leads and dead end water lines shall be closed, and hydrants opened. The specified test pressure shall be applied, and the test repeated for 15 minutes to establish the condition of the hydrant lead valves. The Engineer or Owner may require the Contractor to test the first section of pipe installed to demonstrate the Contractor's ability to install the pipe in an acceptable manner. When the connection to the existing system is not made with a valve, the Contractor shall test the existing section to the first available valve(s) to determine the condition of the existing system, or the Contractor may make provisions to test his work separately, prior to connection to the existing system, in a manner acceptable to the Engineer. The Contractor shall furnish the pump, pipe connections, gauges, and measuring equipment, and shall perform the testing in the presence of the Engineer. The pressure gauge for the test shall be an Ashcroft Model 1082 with 4½-inch dial face and 1 psi increments. Where permanent air vents are not provided, the Contractor shall provide and install corporation cocks at the high points as needed for release of air as the line is filled with water.

If concrete reaction blocking is approved by the Engineer, the water main shall not be subjected to hydrostatic pressure until at least 5 days have elapsed after the concrete casting, with the exception that this period may be reduced to 2 days where high early strength concrete is used.

Any defective joints, pipe, fittings, valves, or hydrants, revealed during the testing or before final acceptance of the work shall be satisfactorily corrected and the test shall be repeated until the specified requirements have been met.

- A. Pressure Test – The section being tested shall be slowly filled with water and the specified test pressure shall be applied after all air has been expelled from the pipe. A hydrostatic pressure of 150 pounds per square inch, gauge pressure, measured at

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the lowest point of elevation, shall be applied by means of a pump connected to the pipe in a satisfactory manner.

The gauge pressure shall be checked after a minimum of two hours. A pressure drop of 1 psi or less will be cause to accept the test section.

- 4.3.11 Adjust Gate Valve – Gate valve box shall be adjusted by raising or lowering to conform to the finished grade in accordance with the Standard Detail Plates and these specifications. The existing valve box and cover shall be salvaged and reused. Where the existing valve box is tilted and/or far enough off center on the valve nut to make valve operation difficult, the Contractor shall plumb and center the valve box over the valve nut as a part of the work. If the existing valve box is not usable, the City shall pay the Contractor the invoice cost of the material plus 10% for overhead in addition to the unit price for adjust gate valve. Any damage to an existing valve box caused by the Contractor due to his negligence shall be replaced by the Contractor at no additional cost to the City.
- 4.3.12 Adjust Hydrant – Hydrants shall be adjusted to finished grade by installing extensions in accordance to the Standard Detail Plates and these specifications. Any damage to an existing hydrant caused by the Contractor due to his negligence shall be replaced by the Contractor at no additional cost to the City.

### 4.4 METHOD OF MEASUREMENT AND PAYMENT

Measurement and payment for each item shall be in accordance to MNDOT Standard Specifications for Construction, 2014, and current supplements, unless modified or supplemented herein. The specifications numbering references used herein shall refer to MNDOT Specifications.

Payment shall be at the Contract Bid price for each item shown on the bid form. The bid price shall include furnishing, installing, and removal as specified. All bid items shall include labor and materials for a complete job.

Principal components are listed in each description and do not necessarily include all component parts required. All component parts required by the plans, specifications and detail plates shall be considered included in the Contract Bid Price. Payment for the items shown on the bid form shall be payment in full for a complete job as specified.

Work required by this contract and obviously necessary for the timely and successful completion of the project, but not specifically provided for in the bid proposal, shall be included in the bid prices of the associated construction items.

- 4.4.1 Remove Water Service – Measurement and payment shall be on an each basis for each type of service removed and shall include removal and salvaging of all pipe, valves, and appurtenances, and plugging at main. Salvaged materials shall be delivered to Blaine's Public Works Department.
- 4.4.2 Relocate Existing Water Main – Measurement and payment shall be on the length of existing main removed measured through fittings, and includes dewatering, excavation, salvaging existing water main, cleaning as directed by the Engineer, reinstallation at proposed location, new gaskets, bolts, glands, backfilling, and restoration to original ground surface at the removed location. Any materials intended for reuse, damaged by the Contractor through negligence or mishandling, shall be replaced at no additional compensation.
- 4.4.3 Relocate Fitting – Measurement and payment shall be on an each basis for each type of fitting relocated, and includes dewatering, excavation, salvaging fitting, removal and

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disposal of reaction blocking and for restraining devices, reinstallation at proposed location and new restraining devices, glands, gaskets, and bolts. Any materials intended for reuse damaged by the Contractor through negligence or mishandling shall be replaced by the Contractor at no additional compensation.

- 4.4.4 Relocate Hydrant – Measurement and payment shall be on an each basis for each hydrant relocated and includes excavation, dewatering, salvaging the existing hydrant, 6-inch gate valve, 6-inch ductile iron pipe between the hydrant and valve, and the 6-inch ductile iron hydrant branch pipe, removal and disposal of reaction blocking and/or restraining devices, installing a permanent 6-inch plug on the existing fitting (if specified), installation of the hydrant at the proposed location in accordance to Blaine Detail Plates, including new mechanical joint restraining devices, backfilling and restoration to original ground surface grade at the original location. Any materials intended for reuse damaged by the contractor through negligence or mishandling shall be replaced at no additional compensation.
- 4.4.5 Salvaging Fitting – Measurement and payment shall be on an each basis and includes excavation, dewatering, removal of the fitting, removal and disposal of reaction blocking and/or restraining devices, and delivery of fitting to Blaine's Public Works Facility. If fitting is damaged by the Contractor through negligence or mishandling, the fitting then becomes the property of the Contractor and no payment shall be made.
- 4.4.6 Remove Water Main – Measurement and payment shall be based on linear feet of existing water main removed and includes excavation, dewatering, removal of water main to an existing joint, disposal, backfilling, and restoration to original ground surface grade.
- 4.4.7 Connect to Existing Water Main – Measurement and payment shall be on an each basis for each connection made, regardless of size and includes excavation, dewatering, removal of existing plug, reaction blocking and/or restraining devices, cleaning of existing water main, connection of new water main and backfilling. If separate fittings are required for the connection, they shall be measured and paid for as specified herein.
- 4.4.8 Cut-In Fitting – Measurement and payment shall be on an each basis for each type of fitting installed, and includes excavation, dewatering, cutting main, cleaning main, and backfilling. The fittings and pipe required for the installation shall be measured and paid for as specified herein.
- 4.4.9 Wet-Tap Connection – Measurement and payment shall be on an each basis for each size of wet-tap connection made and shall include excavation, dewatering, tapping tee or saddle, restraining devices, tapping valve and box, and backfilling.
- 4.4.10 Water Main – Measurement and payment shall be on a lineal foot basis for each size of water main installed and includes the furnishing of the pipe, rubber gaskets, joints, delivery of materials, handling, laying, excavation, dewatering, backfilling, testing, shop inspection, grade control and all other materials and work necessary to install the pipe complete in place as shown on the plans. Measurement shall be the actual overall length measured along the axis of the pipe without regard to intervening valves or fittings. Measurement of branches will be measured from the centers of connecting pipes to the centers of the valve or fittings. All lengths will be measured in a horizontal plane unless the grade of the pipe exceeds fifteen percent. Tracer wire material and installation shall be incidental to water main pipe.
- 4.4.11 Valves and Boxes – Measurement and payment shall be based on each type and size of valve installed and includes the valve, box, lid, and any necessary extensions. If the main is installed deeper than nine feet, an extension to the valve stem shall be provided and installed by the Contractor to bring the valve stem to a normal operating depth. The extension shall be incidental to the cost of the valve.

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- 4.4.12 Abandon Valve – Measurement and payment shall be based on each valve abandoned and includes excavation, dewatering, removal and salvaging valve box, and backfilling. The salvaged valve box shall be delivered to Blaine's Public Works Facility.
- 4.4.13 Fittings – Measurement and payment shall be based on weight per pound of each fitting installed and furnishing and installation of all materials and accessories necessary. Glands, gaskets, bolts, and restraining devices shall be excluded from the weight of the fittings. Weights for fittings will be based on Blaine Detail Plates.
- Fittings used with wet tap connections shall not be paid for under this item, but shall be included in the item for wet-tap connection.
- Fittings required for connections between different pipe materials shall be incidental.
- 4.4.14 Hydrants – Measurement and payment shall be per each hydrant installed and includes furnishing the hydrant, excavation, dewatering, crushed rock, concrete base, restraining devices, 6-inch gate valve with box, and 6-inch ductile iron pipe water main between valve and hydrant, testing, and backfilling.
- 4.4.15 Hydrant Branch Line – Measurement and payment shall be per lineal foot of ductile iron pipe water main installed between the connecting main and hydrant gate valve, and includes excavation, dewatering, furnishing pipe, gaskets, joints, handling materials, testing, and backfilling.
- 4.4.16 Water Service Connection – Measurement and payment shall be on an each basis per complete connection installed and includes excavation, dewatering, furnishing all necessary materials, corporation stop, curb stop with box, tapping materials, saddle where required, tapping the main, testing, connections to main and service pipe, and backfilling.
- 4.4.17 Insulation – Measurement and payment shall be on a linear foot basis for wrapped style and on a square foot basis for sheet style complete and installed and includes all materials necessary to secure in place.
- 4.4.18 Service Pipe – Measurement and payment shall be on a linear foot basis for actual pipe installed and includes excavation, dewatering, handling, delivery, installation, cutting, flaring, testing, and backfilling.
- 4.4.19 Valve and Meter Manholes – Measurement and payment shall be in accordance to MNDOT 2506.502 for each size and type of manhole installed.
- 4.4.20 Adjust Gate Valve – Measurement and payment shall be per each gate valve adjusted to finished grade and shall include excavation, dewatering, backfilling, and all necessary materials, labor, equipment and appurtenances.
- 4.4.21 Adjust Hydrant – Measurement and payment shall be per each hydrant adjusted to finished grade and shall include excavation, dewatering, backfilling and all necessary materials, labor equipment, extension kits and appurtenances.