

SECTION 4 WATERMAIN AND ACCESSORIES

SECTION 4-0- SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all labor, equipment, appliances and materials, and performing all operations necessary to construct and complete water mains and appurtenances in strict accordance with these specifications, the applicable drawings, and subject to the terms and conditions of the contract.

Section 4-1 - Materials

4.101 Water Mains. All water mains shall be constructed of ductile iron meeting the requirements as specified in these contract documents unless otherwise noted on the drawings.

4.101(a) Ductile Iron Pressure Class Pipe. DIP pipe shall comply with the latest revision of ANSI/AWWA C151/A21.51-96 with the exception that the wall thickness shall comply with 350 PSI (2400 kPa) pressure class pipe for sizes 3 thru 24 inch (76 mm thru 600 mm) unless stated otherwise on the plan drawing. Whenever the plans or specifications call for the installation of polyethylene encasement, provide low density polyethylene film in accordance with the latest revision of ANSI/AWWA C105.

4.101(b) Ductile Iron Pipe Shall Be:

- 1) Interior Lining: Cement-mortar lining per ANSI A21.4-16 (AWWA C104), no asphaltic sealer.
- 2) Outside coating: AWWA C151/A21.51 Minimum of 1 mil thickness (0.025 mm) of bituminous coating (paragraph 51.8.1).
- 3) Pipe Joints:
 - a. Push on joint, ANSI A21.11 (AWWA C111).
 - b. Mechanical joint ANSI A21.11 (AWWA C111).
 - c. Restrained joint pipe for special use (Horizontal Direction Drilling), pipe shall be ANSI A21.51 (AWWA C151) ANSI A21.4 (AWWA C104). See Section 4.103 for pipe restraining.
- 4) In accordance with AWWA C151/A21.51-96 Section 5.1.1.2 provide Affidavit of Compliance.
- 5) Whenever the plans or specifications call for the installation of polyethylene encasement, provide low density polyethylene film in accordance with the latest revision of ANSI/AWWA C105.

4.101(c) Polyvinyl Chloride Water Main (PVC). Polyvinyl chloride water main shall conform to the latest revision of polyvinyl chloride (PVC) pressure pipe 4 inch thru 12 inch cast iron O.D. (100 mm thru 300 mm) for water distribution ANSI/AWWA C900 latest revision. Molecularly oriented PVC (PVCO) pipe must conform to the standards of ANSI/AWWA C909, latest revision for 6 inch through 12 inch pipe cast iron O.D. (100

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mm thru 300 mm). All PVC and PVCO pipe shall be pressure Class 305 unless otherwise stated on the plans. PVC water mains 16 inch through 48 inch cast iron O.D. (400 mm through 1220 mm) shall conform to the latest revision of AWWA C900. All AWWA C900 water mains shall have a minimum DR as noted on the proposal or the drawings.

Polyvinyl Chloride Pipe Shall Be:

- 1) For all PVC and PVCO pipe provided for potable water service, comply with standard AWWA C900-16. Provide NSF61 certification for each class, type, and size of PVC or PVCO to be provided.
 - a. Restrained Joint for Horizontal Directional Drilling (HDD): C900 Certa-Lok RJ PVC Pipe. See 4.103 (a).
- 2) Provide all PVC and PVCO pipe provided shall comply with AWWA C-900 DR-14; **or** 305 PSI pressure class of AWWA C-909 Molecularly Orientated Polyvinyl Chloride Pressure Pipe.
- 3) Provide required quality control certification documentation as noted above in accordance with AWWA C-900 Section 5.2, or AWWA C-909 Section 5, or AWWA C-905 Section 5.2.
- 4) All PVC and PVCO pipe provided for potable water service shall be blue in color. All PVC and PVCO pressure pipe used for reclaim water shall be purple in color.
- 5) In accordance with AWWA C-900 Section 6.3 or AWWA C-909 Section 6.3, or AWWA C-905 Section 6.3, provide Affidavit of Compliance.

4.101(d) High Density Polyethylene Water Mains. All Polyethylene (PE) (HDPE – High Density Polyethylene Pipe) water mains shall have a Ductile Iron pipe size (DIPS). Unless otherwise stated in the specifications or plans the HDPE water main shall have a minimum DR-9. Provide minimum pressure class rating of 250 psi for DR-9 HDPE pipe as per ANSI/AWWA C906 Table 5. The cell classification shall be PE 4710 HDPE according to ASTM D3350. The construction and fabrication of the HDPE water main shall comply with the appropriate standards as set forth in the latest edition of ANSI/AWWA C906.

- 1) Provide Affidavit of Compliance of all HDPE as per ANSI/AWWA C906 Section 6.3.
- 2) Pipe and fittings to be marked in accordance to C906-15 Section 6.1. All HDPE pipe shall be color coded with a blue strip to indicate it is used for potable water.
- 3) Provide FM Fitting MJ adapter kit for all connections to Cast Iron or Ductile Fittings and valves.
- 4) All fusion welds shall be in accordance with manufactures recommendations. All fusion welds shall be completed by properly trained personnel approved by the manufacturer.

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- 5) Flanged and Mechanical Joint adapters to confirm to ASTM D3261. Markings for molded or machined flanged adapters of MJ adapters shall be per ASTM D3261. Fabricated (including machined) flange adapters shall be per ASTM F2206.
- 6) When new HDPE pipe is to be fused with existing HDPE piping, the purchaser of the new HDPE pipe shall inform the manufacturer of the cell classification of the existing HDPE pipe as per ASTM D3350, and obtain from the manufacturer a list of the validated fusion parameters that may be used to join the purchased piping to the existing piping. The manufacturers shall be consulted to determine the appropriate fusion procedures.
- 7) Polyethylene fusion fittings may be molded, thermoformed from pipe sections, or fabricated by heat fusion joining polyethylene components prepared from pipe, molded fittings, thermoformed pipe, or polyethylene sheet or block.
- 8) Butt Fusion Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with minimum cell classification of PE345464C. Butt Fusion Fittings shall meet the requirements of ASTM D3261. Molded and fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified on the plans. All fittings shall meet the requirements of ANSI/AWWA C906. Marking for molded fittings shall comply with the requirements of ASTM D3261. Fabricated fittings shall be marked in accordance with ASTM F2206.
- 9) Electrofusion Fittings shall be made of HDPE material with a minimum material designation code of PE4710 and with a minimum cell classification of PE345464C. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Markings shall be according to ASTM F1055.

4.102 Compact Ductile Fittings. All fittings for pipe sizes 4" thru 24" (100 mm thru 600 mm) shall be Ductile Iron Pressure Class 350 psi (2400 kPa) and shall conform to ANSI A21.53.94 (AWWA C153) current revised edition of said standards as minimum specifications. All fittings for pipe sizes 30" thru 48" (260 mm thru 1200 mm) shall be Ductile Iron Pressure Class 250 and shall conform to ANSI A21.10.93 (AWWA C110) current revised editions of said standards as minimum specifications.

Ductile Iron Fittings Shall Be:

- 1) Interior Lining: Cement-mortar lined, ANSI A21.4.90 (AWWA C104) without coal tar sealer.
- 2) Mechanical joint, ANSI A21.11.90 (AWWA C111).
- 3) Testing, ANSI A21.10.93 (AWWA C110) or ANSI A21.53.94 (AWWA C153).
- 4) Fitting to be cast marked DI or Ductile with pressure rating and size and type fitting.

4.103 (a) Restrained Joint Pipe. Restrained joint pipe is required in all horizontal directional drilled installations. Restraining method shall be achieved with locking joint such as "TR Flex" by U.S. Pipe or equal for DIP and "Certa-Lok" by Westlake Pipe & Fittings for C900 PVC.

Restraining gaskets such as "fast-grip" gaskets by American pipe or approved equal to restrain push on joint pipe can be used when called out on plans.

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When the proposal or drawings require retaining glands, the Contractor shall provide Megalug Series 1100 Mechanical Joint Restraint or equal.

4.103 (b) Restrained Joint Couplings. When noted on the drawings, the Contractor shall erect and install restrained joint coupling(s). The restrained joint coupling shall be a Griffin Bolt-Lok restrained joint, or American MJ coupled restrained joint.

The restrained joint coupling shall provide a positive longitudinal connection between fittings or fittings and restrained joint pipe as applicable. The Contractor shall install applicable thrust blocks as noted on the drawings in addition to the restrained joint coupling.

4.104 Resilient Seated Gate Valves, Cut in Sleeves. All gate valves 4" and larger up to and including thirty inch (30") (260 mm) shall be ductile iron body resilient seated gate valves conforming to AWWA C509, C515, AWWA C111 and ANSI A21.11 specifications and current revisions. All gate valves shall be suitable for mechanical joint connection to ductile iron pipe complete with bolts, glands, and required gaskets. All gate valves shall have a 2" square (50 mm) operating nut and non-rising stem and O-ring type seals. All resilient seated gate valves shall be Mueller Model A-2360-20, M and H Style 3067, Flow Control Series 2500, Clow Model 2638 or 2639 valve or approved equal. When beveled gearing is required, provide valves with a bevel gear assembly to allow the gate to move in a horizontal direction. Cut in sleeves for use with gate valves where required shall be mechanical joint and have stop screw incorporated in body, and shall be Mueller No. H840, H841, or approved equal. For installation requiring a 4", 6", or 8" (100 mm, 150 mm, or 200 mm) cut-in valve, the Contractor shall utilize Mueller C-2360-44 cut-in valves or approved equal. The Contractor shall utilize duck tipped gaskets or plain tipped gaskets as required to complete the field installation. All exposed bonnet and packing bolts shall be ASTM F593 Type 304 Stainless Steel. Gate Valves shall be no more than one year older than the date delivered to the project, or the supplier must show that the valves were stored inside and shall show no signs of wear or damage from storage. All manufacturer tags, bar codes, and SQR tags must remain on the product and must not be removed by the contractor or supplier. City of Hastings Inspector will take pictures and /or remove tags during installation.

4.105 Valve Boxes. All buried valves shall be provided with Buffalo type cast iron valve boxes or alternate as specified.. Valve boxes shall have a screw type extension sleeve and be designed for the size of valve on which it is to be used and for the depth of cover as required. Covers shall have the word "WATER" cast thereon. Valve boxes shall be Mueller No. H10360, Tyler Series 6850 Type 664-S, 666, 668 as required, or approved equal.

4.105(a) High Density Polyethylene (HDPE) Valve Boxes. Whenever the drawings or proposal request installation high density polyethylene (HDPE) valve boxes, the Contractor shall provide and install American Flow Control Trench Adapter Valve Box or equal. The valve body shall be constructed of high density polyethylene material complete with a steel stem extension tube. The unit shall be fitted with an extension stem tested to 1000 pounds of torque. The lid shall be made of gray cast iron with the word "WATER" imprinted end to top of the lid. Provide HDPE boxes of appropriate depth and size as per manufacturer's recommendations.

Adjustment in valve box height shall be considered subsidiary to the valve installation.

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4.106 Solid Ductile Iron Sleeves. Contractor shall furnish couplings for connecting ductile iron to ductile iron pipe or ductile iron to cast iron pipe, or ductile iron to PVC pipe. The inside diameter of the coupling shall be suitable for connecting the ends of either PVC, ductile, or cast iron pipe as required. All solid ductile iron sleeves shall comply with the requirements of 4.102. Provide only long solid sleeves unless otherwise directed by the Engineer. Solid ductile iron sleeves will not be called out on the drawings; however, Contractor shall provide solid sleeves as field conditions warrant and as approved by the Engineer.

4.107 Mechanical Joint Connections. When called for on the drawings or proposal, the Contractor shall provide Foster adaptors or equal for water main size 4" through 24". Provide a ductile iron fitting meeting material and pressure requirement of the current revision of AWWA C110 and as defined by Section 4.102 of these specifications.

Provide tee bolt kits for all applications.

4.108 Fire Hydrants.

Fire hydrants shall be Mueller No. A-423 and comply with Dry-Barrell Fire Hydrants ANSI/AWWA standard C-502 and latest revisions.

- a. Size of Hydrant: 5-1/4"
- b. Inlet Connection: 6" Mechanical Joint
- c. Operating nut and nozzle cap nut: 1-1/2" pentagonal operating nut and open counterclockwise.
- d. Nozzle Connections: 3-way with 2 hose nozzles 180 degrees apart, 1 pumper in between and on the same horizontal plane. All threads "national standard" conforming to NFPA for fire hose connections.
- e. Unit shall be traffic type hydrants with ground break away flange system. Seals shall be O-ring.
- f. Paint: Interior and exterior above and below ground line coated with high performance 2-part epoxy. Exterior above ground – one coat of UV resistant high gloss 2-part polyurethane enamel. Color to be silver with color coded cap and bonnet per NFPA. Private hydrants to be yellow with color coded cap and bonnet per NFPA.
- g. In accordance with ANSI/AWWA C-502 Section 5.1.3 the hydrostatic test shall be conducted at 300 PSI (2100 kPa) for a minimum of 60 seconds with no leakage.
- h. In accordance with ANSI/AWWA C-502 Section 5.3 the supplier shall deliver all hydrants to the City of Hastings for pressure testing at its North Denver Station facilities at an agreed time and during normal business hours. The supplier shall provide 72 hour notice before testing is required.
- i. In Accordance with ANSI/AWWA C-502 Section 6.3 provide Affidavit of Compliance.
- j. All fire hydrants shall be furnished with all connecting bolts, nuts, glands, gaskets, etc., required for immediate installation. Units shall be Mueller No. A-423, American Darling B-84-B-5, Kennedy K81-D or approved equal. All fire hydrants will be 6'-0" (1.8m) bury unless noted differently on plans. To achieve proper hydrant installation, utilize hydrant extensions or Gradelok swing arm fittings when necessary.
- k. All exposed bolts and nuts that are typically buried shall be stainless steel 304 or equal.

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1. Fire hydrants shall be no more than one year older than the date delivered to the project, or the supplier must show that the fire hydrants were stored inside and shall show no signs or wear or damage from storage. All manufacturer tags, bar codes and SQR tags must remain on the product and must not be removed by the contractor or the supplier. City of Hastings Inspector will take pictures and/or remove tags during installation.

4.109 Water Services and Service Line Connections.

- 1) Service Lines 2-inch and Less in Diameter. Plastic water service lines of not more than 2 inches (50 mm) in diameter may be used for residences in lieu of copper service lines, subject to the following:
 - a. Plastic tubing used for water service lines shall meet AWWA C901 Polyethylene pipe, SDR-9 PE3408 ASTM D2737, Pressure Class 200 PSI (1400 kPa) or AWWA C904-06 PEX pipe, SDR-9 ASTM F876 (PEX 1006) Pressure Class 200 PSI (1400 kPa). It shall be O.D. based on sizes 3/4 inch (20 mm) thru 2" (50 mm) conforming to the outside diameter of copper tubing.
 - b. Fittings for plastic water service lines used for plastic water piping shall be brass pack joints and conform to AWWA Standard ASTM B62-Index 115-85-5-5. No plastic fittings or brass flared will be allowed.
 - c. Installation of plastic water service lines shall have a tracer wire installed by Contractor per the standard detail subsidiary to bid. The wire shall be taped to the service prior to backfilling.
 - d. Grounding of electric services when plastic water services are installed: In the event existing metal water line was the source of grounding is abandoned, supplemental electrodes shall be provided. One shall be a rod or pipe electrode as specified in NEC 250.53, and the others shall be as mandated in NEC 250.52.
 - e. For replacement services the interior metal piping system shall remain bonded to the service equipment. If there is not a ground rod already in use, an 8 foot rod (2.4 m) shall be driven and connected to the service equipment. The grounding electrode system shall comply with NEC 250.50.
 - f. The city electrical inspector shall approve the installation after being satisfied that there is appropriate grounding.
 - g. The owner shall pay an additional fee in accordance with the prevailing council fee resolution, for having the plumbing and electrical inspectors make the foregoing inspections.
- 2) Service Lines 3-inch diameter and larger
 - a. Shall meet the City of Hastings watermain specifications.
 - b. Require an inline tee orientated up installed immediately downstream of the service valve.

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- c. The City of Hastings Water Utility will inspect installation as deemed necessary, operate service valve, observe the required pressure test, assist with cleaning, and conduct bacteriological sampling.
 - c.1. Fire mains: Any private service that serves a private fire hydrant and/or fire system is required to be permitted through the fire marshal. Pressure test requirements and test observation completed by the fire marshal.
 - d. Installation of plastic water service lines shall have a tracer wire installed by Contractor per the standard detail subsidiary to bid. The wire shall be taped to the service prior to backfilling.
 - e. Grounding of electric services shall be in accordance to specification 4.109 Water Services; paragraphs 1(d) and 1(e) of this document.
- 3) Service Taps. All taps shall be completed by the City of Hastings through tapping fees, with excepting being contracts with the City. Contracts with the City for watermain work require all material to be supplied by the contractor.

All taps require a service saddle to be installed unless otherwise noted on the plans. All 1" taps require a contractor provided service saddle properly fastened to the main. For taps >1", the city will supply and install the saddle as part of the tap fee with all excavation and trench safety to be completed by the contractor.

- 4) Service Saddles.
- a. DIP: The service saddle must be constructed of high strength ductile iron per ASTM A536 with fusion-bonded epoxy coating having a double wide band and 1/2" UNC threaded studs constructed of type 304 stainless steel. Provide saddles with EPDM rubber gaskets per ASTM D2000. Saddles must be ANSI/NSF Standard 61 for use in drinking water applications and must conform to AWWA C800.
 - b. PVC C900: The service saddle must be constructed of brass conforming to AWWA C800 and NSF 61 certified for use in drinking water applications. All required fasteners shall be silicon bronze and threads conforming to AWWA/CC taper. Saddles shall have a minimum working pressure of 150 psi. Acceptable products are Ford S90 or approved equal.
 - c. HDPE: Require an Electrofusion fitting, Transition Saddle (Corp Saddle). The Contractor shall provide the transition saddle and shall properly fasten the saddle to the main. Electrofusion Transition Saddle shall have a manufacturing standard of ASTM F1055. The Contractor shall provide Electrofusion Transition Saddle equal to Georg Fischer Central Plastics Company with brass 360 alloy outlet materials, and stainless 304 compression ring, and CC Threads or approved equal.
- 5) Corporation Stops. Corporation Stops are included in the tap fee assessed with the City. For contracts held with the City of Hastings where tap fees are not assessed, the contractor is responsible for supplying and installing the corporation stops.

The corporation stop shall meet AWWA C800 standard and NSF61 certification. All corporation stops to be key style with AWWA/CC taper thread by flare fitting with the 1"

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and smaller to include a copper swivel type elbow with AWWA/CC female thread by CTS pack joint. All 1.5" and larger to include a straight copper coupling with AWWA/CC female thread by CTS pack joint (Saddle and valve/corporation stop supplied and installed by the City and assed tap fee). Acceptable manufacturer is FORD METER BOX or approved equal.

- 6) Curb Stop and Box. This item shall consist of one (1) curb stop and one (1) curb box. Curb stops shall be Mueller No. H-15155 or Ford B44 Series, unless otherwise specified, and shall be of the same nominal size as the service line to which they are connected. Curb stops shall be of heavy cast bronze construction and shall be Minneapolis pattern type. Curb boxes shall be extension type, cast iron, adjustable for length, and have Minneapolis pattern base. Lids shall have the word "WATER" cast in them and shall have a provision for being securely held in place.

- 7) Water Service Installation.

City of Hastings of Contracts: All water services shall be constructed and installed by the watermain contractor at a minimum depth of 5'-0" or as by City code and as indicated on the drawings. Any work to be done on the customer side of the curb stop, except for connecting the service line to the curb stop, shall be done by a licensed plumber. All service line work to be completed between the main and curb stop may be done without the services of a licensed plumber. This work shall be deemed to be completed by a water main contractor. All service line work to be done by a water main contractor shall be limited to the work as indicated on the drawings and within these contract documents or as directed by the Engineer.

A licensed plumber shall secure and obtain a plumbing permit for any water service work on private property. All plumbing permits shall be obtained before any work begins.

Privately Constructed Services: A licensed plumber is required to pull a permit for all services with the City of Hastings making the tap.

4.110 Thrust Block. All thrust blocks shall be installed in accordance with the drawings. The class of concrete to be used for thrust blocks around fittings shall be Nebraska Department of Roads Class "47B" or Type "ABX". All concrete shall have minimum 28 day strength of 3000 PSI.

THRUST BLOCK DIMENSION				
Pipe Size Inch	A Feet	B Feet	C Feet	D Inch
4 (100 mm)	1 (0.3 M)	1 (0.3 M)	1 (0.3 M)	3 (75 mm)
6 (150 mm)	1.5 (0.45 M)	1.5 (0.45 M)	1 (0.3 M)	6 (150 mm)
8 (200 mm)	2 (0.6 M)	2 (0.6 M)	1 (0.3 M)	6 (150 mm)
10 (250 mm)	2.5 (0.75 M)	2.5 (0.75 M)	2 (0.6 M)	9 (225 mm)
12 (300 mm)	3 (0.9 M)	3 (0.9 M)	2 (0.6 M)	9 (225 mm)

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14 (350 mm)	3 (0.9 M)	3 (0.9 M)	2.5 (0.75 M)	12 (300 mm)
16 (400 mm)	4. (1.2 M)	3 (0.9 M)	2.5 (0.75 M)	12 (300 mm)
18 (450 mm)	4 (1.2 M)	4 (1.2 M)	2.5 (0.75 M)	12 (300 mm)
20 (500 mm)	4 (1.2 M)	4 (1.2 M)	3 (0.9 M)	16 (400 mm)
24 (600 mm)	4.5 (1.4 M)	4.5 (1.4 M)	3 (0.9 M)	16 (400 mm)
30 (750 mm)	4.5 (1.4 M)	5. (1.5 M)	3.5 (1.0 M)	18 (450 mm)
36 (900 mm)	5 (1.5 M)	5 (1.5 M)	3.5 (1.0 M)	18 (450 mm)
42 (1050 mm)	5.5 (1.7 M)	5.5 (1.7 M)	4 (1.2 M)	24 (600 mm)
48 (1200 mm)	6 (1.8 M)	6 (1.8 M)	4 (1.2 M)	24 (600 mm)

4.111 Machine Tap. City of Hastings will furnish and install all machine taps. Contractor shall provide all excavation and backfill. Minimum excavation at each tapping point will be 4 ft. wide (1.2 M) and 6 ft. (1.8 M) long and shall be sufficiently below the main at point of tap in the installation of bolted sleeve. City of Hastings Water Department Personnel shall make determination in field as to tap location and give specific requirements. In the event that the uncovered water main is at a joint, etc., excavation will be relocated as directed by Water Department Personnel.

4.112 Steel Encasement. Smooth wall casing pipe shall be of welded steel construction and shall be new material with a minimum yield point of 35,000 psi (241,000 Kpa). The pipe shall have a minimum wall thickness of "0.250" (6 mm) or as indicated on the drawings. The casing pipe shall be bare steel.

4.113 Casing Spacer. The Contractor shall use casing spacers. Casing spacers shall be of the type that bolt onto the carrier pipe and constructed of high density polyethylene. The spacer shall be 8" (200 mm) minimum in length. The chocks shall be as manufactured by Pipeline Seal and Insulation Inc., Model C8G-2, Advance Products and System Model SI-8" (200 mm) long with 1" (25 mm) or 2" (150 mm) wide runners, or approved equal.

4.114 Casing End Seal. All steel encasement pipes shall be closed at each end with a standard pull on S-shaped seal as manufactured by Pipeline Seal and Insulator, Inc. (PSI), Model S, Advance Model AC End Seals, or approved equal.

4.115 Manholes. Manholes shall be constructed as indicated on the plans. Manhole ring and cover shall be constructed of Class 35 gray cast iron weighing not less than 450 pounds conforming to ASTM A48-87 and satisfactory to the Engineer. The manhole ring and cover shall be Deeter No. 1030 or Neenah R-1703. Manhole steps are not required unless otherwise noted on plans.

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Manholes of precast sections conforming to ASTM C478 specifications shall be used. Precast concrete sections for manholes shall be installed with bituminous joint filler.

4.116 Submittals. The Contractor shall provide to the Engineer the following submittals, shop drawings, certifications and other related documents for review and approval:

- a. Provide catalog cuts showing weights, dimensions, and sizes of all pipe materials, fittings, glands, bolts, adapters, etc. to be utilized on this project.
- b. Provide catalog cuts of all fire hydrants, gate valves, butterfly valves, fittings, manholes, valve boxes, grounding mechanisms, tracer wire, corporation valves, curb stop, curb stop boxes to be utilized on this project.
- c. Provide catalog cuts showing weight, dimensions and sizes of all casings, casing chocks, and casing ends seals to be utilized on this project.

4.117 Tracer Wire.

- a. For open cut utilize 12- or 14-gauge AWG solid copper wire with 30 mil, high density, HMWPE coating conforming to ASTM B-3, B170, and D1248. Acceptable products are PRO-TRACE COPPER PE30 or approved equal.
- b. For horizontal directional drilling utilize wire rated for this application. Utilize 10- to 14-gauge extra high strength copper clad steel wire conforming to ASTM B1010 and ASTM B227 with 45 mil thick high-density, high molecular weight polyethylene. Acceptable products are Copperhead Industries Soloshot Extra-High Strength CCS Tracer wire, Pro-Trace HDD-CCS PE45, or approved equal. All tracer wire to be color coded to meet APWA standards for utility identification.

4.118 Tracer Station. Tracer wire access point shall be secure, easy to locate, anti-corrosion, color coded per APWA, contain a direct connection point, and intended for method of installation. Acceptable products are Copperhead Industries SnakePit or approved equal.

4.119 Tracer Wire Connector. Locking connectors for direct bury applications filled with dielectric silicone sealant and designed for splicing or connecting multiple wires for continued conductivity. Acceptable products are copperhead snakebite locking connector or approved equal.

4.120 Tracer Wire Grounding. Each test station must include a 1.5-lb drive-in magnesium ground rod or 3-lb high potential magnesium anode properly attached to the tracer wire. Anode chemistry per ASTM B843.

4.121 Utility Marking Bury Tape. Polyethylene material, 6 inches wide with 4.0-mil thickness, color coded per APWA and overcoated graphics. Must be rated for outdoor bury.

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SECTION 4-2 - CONSTRUCTION METHODS

4.201 Excavation. The Contractor shall perform all excavation of whatever substances are encountered to the depth shown on the drawings, or to provide a minimum cover of five (5) feet (1.5 M) over the top of the pipe. The Engineer shall have the right to limit the amount of trench that may be opened in advance of the line of work, along with the duration in which the excavation is open. All excavated materials not required for backfill shall be removed from the project by the Contractor. Banks of trenches shall be kept as nearly vertical as practicable and, where required, shall be properly sheeted and braced. Trenches shall be of sufficient width to provide working space for proper laying and embedment. Excavation around existing utilities and structures shall be limited to minimum invasive practices such as utilization of properly sized trench safety equipment in-leu of benching.

The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except for portions of the pipe sections where it is necessary to excavate for bell holes.

Whenever wet or unstable soil that is incapable of properly supporting the pipe, as determined by the Engineer, is encountered in the trench bottom, such soil shall be removed to the depth and length determined by the Engineer, and the trench backfilled to grade with in-situ soils or other suitable material as deemed appropriate by the engineer.

All grading in the vicinity of trench excavation shall be controlled to prevent surface water from flowing into the trench. Any water accumulating in the trench shall be removed by pumping or other approved method. Material excavated from the trenches shall be stacked in an orderly manner a sufficient distance back from edge of trenches to avoid overloading and preventing slides or cave-ins. Material unsuitable for backfilling shall be wasted by the Contractor as directed by the Engineer. Any unauthorized excavation below grade shall be backfilled at the Contractor's expense with good, well-tamped material.

A minimum of one foot (1') (300 mm) of topsoil (unless otherwise noted on the plans) shall be removed in any and all areas covered by vegetation. This topsoil shall be stockpiled separately from the material removed from the remainder of the trench. After the pipe is installed and the trench backfilled to an elevation one foot (1') (300 mm), (unless otherwise noted on the plans) below grade, the topsoil shall be replaced and compacted as previously described.

Excavation will not be classified. Whatever material is encountered shall be excavated to the proper grades and if, in any locations, such material is not sufficient to provide a uniform, even bed for the pipe, the trench shall be excavated at least six inches (6") (150 mm) deeper than the grade at the bottom of the pipe and the space thus excavated shall be refilled with earth or sand and thoroughly compacted.

4.202 Horizontal Directional Drill (HDD).

Directional drilling to be completed by an experienced Contractor. The contractor shall submit a work plan prior to beginning work which outlines the procedure and schedule to be used while construction is in progress. The work plan must include specific equipment to be used, list of supervisory, technical, and general personnel to be utilized during the project. Any permits

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required but not limited to erosion & sediment control plan, traffic control plan and trench shoring plan to be submitted.

HDD shall utilize a guidance system along with drilling fluid (mud) system. The drilling fluid system shall include a self-contained drilling fluid mixing system adequately sized. The drilling fluids to be mixed thoroughly and be absent of any clumps or clods. No hazardous additives may be used. Used drilling fluid and spilled fluid to be contained and disposed of properly.

The drill path is to be accurately surveyed with entry and exit stakes placed in appropriate locations. The minimum cover required over water main piping is five (5) feet. Additional bury depth may be required as indicated on the plans. In the event the pipe is to be field installed after locating of existing utilities, the contractor must submit a bore plan profile which includes all existing utilities. Excavation around existing utilities and structures shall be limited to minimum invasive practices such as utilization of properly sized trench safety equipment in-leu than benching.

Pilot hole shall be drilled to not exceed the maximum allowed pipe deflection. Upon successful completion of the pilot, the bore will be reamed to a minimum of 25% greater than the outside diameter of the pipe to be installed. The contractor will pull the pipe to be installed back through the bore hole utilizing a swivel to prevent torsional stresses occurring in the pipe. A final bore log must be submitted to the engineer.

4.203 Trench Backfilling. Trench backfill shall conform to following:

- 1) All water mains and services shall be properly bedded with insitu soils unless otherwise directed due to poor soils or soil conditions. The Engineer shall instruct the Contractor in proper operation and fill material if conditions are deemed less than favorable. Insitu soils typically deemed satisfactory are local clay, silt loam, and sandy soils found in the Hastings area.

Ductile Iron Pipe. All ductile iron pipe shall be bedded as shown on bedding detail II of the plans with insitu soils to top of pipe or twelve inches (12") (300 mm) above top of pipe as noted. The bedding process shall be accomplished by mechanical means and by introducing backfill material layers not to exceed six inches (6") (150 mm) depth. Each lift shall be thoroughly compacted before introducing additional backfill material. Hand tamping will be required whenever streets, driveways, or terraces requiring sodding will be placed above the water main installed. The bedding shall be accomplished using a hand tamper for each six inch (6") (150 mm) lift of soil to the top of the pipe. Other mechanical means such as a rolling vibratory sheeps foot can be utilized for the next twelve inches (12") (300 mm) above the top of pipe. **All hand tamping shall be strictly enforced.**

Polyvinyl Chloride Pipe. All polyvinyl chloride pipe regardless of location shall be bedded as shown on bedding detail I of the plans with six inches (6") (150 mm) lifts of soil to a point twelve inches (12") (300 mm) above the top of pipe. **All hand tamping shall be strictly enforced.**

Upon bedding of pipe, fill may be introduced suitable to the type of method that will be used for compaction, i.e., roll compactor, hydraulic vibrator, etc. Lift thickness will be determined in field by inspector and job foreman, with a maximum loose lift thickness of 12" under streets.

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- 3) Compaction test may be taken at random locations and different depths as determined by inspector. Average of two compaction tests will be taken at each 50 lineal foot) (15 M) of trench and test at an elevation to be determined on job site and dependent on depth of trench. Contractor will be required to make excavation for test.
- 4) Test results for compaction shall meet or exceed following:
 - a. 95% standard proctor density for terraces.
 - b. 98% standard proctor density for driveways, sidewalks, streets.
 - c. Assumption that moisture content ($\pm$) 3% of optimum failure of test to reach these minimum results will require re-compaction by Contractor.
- 5) No unsuitable material will be allowed in backfilling, i.e., rock, saturated soils, concrete, brick, motor, vegetation, debris, grasses, etc. Contractor will be required to remove such from job site and replace with adequate amount of approved material. The Contractor shall supply suitable backfill material from an approved borrow site acceptable to the Engineer at the unit price in the proposal.

Any area found unstable because of plastic soils will have to be replaced by the Contractor with suitable material
- 6) Water settling will not be permitted.
- 7) If proper compaction requires additional soil to be brought to the site by the Contractor, all expenses for this additional soil shall be considered subsidiary to the pipe installation.
- 8) Contractor shall return ditch elevations to preexisting elevations as shown on the plans. If it is determined after the construction is complete the Contractor has not done so, he will be required to return the ditch to original elevation at his cost.
- 9) The Contractor shall hand tamp around all fire hydrants, curb stops, and valve boxes with hand tampers or pad tampers ("Jumper Jacks") to insure proper compaction.

In the event settlement of any backfill associated with the project is encountered, the Engineer shall notify the Contractor in writing to repair all defects, including settlement and associated street repair, if it is discovered within the three (3) year maintenance period. No extra monies will be paid for repairs caused by settlement of the backfill.

4.204 Trench Wall Support. All trenches shall be braced or sheeted as to local soil conditions dictate and in full compliance with OSHA, as well as local, State of Nebraska, and other Federal requirements. There shall be sufficient tamped cover over pipe to protect in removal of shoring material.

4.205 Protection of Existing Utilities. The accuracy of location of existing underground utilities as shown on the plans is not guaranteed. It shall be the duty of the Contractor to locate these utilities in advance of excavation, and to protect same from damage after uncovering. House service lines are shown on the plans. The Contractor shall contact the owners of the utilities for assistance in locating these service lines. Any expense incurred by reason of damaged or broken lines shall be the responsibility of the Contractor.

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The Contractor shall not begin any excavation until he has contacted Diggers Hotline at 811.

4.206 Tunneling. Tunneling, when necessary, shall be done under the supervision of the Engineer. Jacking or boring may be permitted where indicated in the plans. Before proceeding with boring or jacking, the Contractor shall submit to the Engineer for his approval a plan sketch showing the frame, bracing, pit details, etc. Whenever a steel casing is required, joints shall be welded with full strength welds. The Contractor shall maintain proper joint alignment and use full penetration welds.

4.207 Pipe Cutting. Cutting of the pipe shall be kept to a minimum and shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise authorized by the Engineer, cutting shall be done by means of an approved type of mechanical cutter. Hydraulic cutters shall be used when practicable.

4.208 Installation of Water Mains.

4.208(a) Installation of DIP Water Mains. The installation of ductile iron water main shall be in accordance with the latest revision of AWWA C600. All DIP (Class 52 and Pressure Class) water main installation shall also be in accordance with the following:

- 1) Pipe and accessories shall be handled in such manner as to insure delivery to the work in a sound, undamaged condition.
- 2) While suspended in a sling and before lowering into the trench, all pipe shall be inspected for defects. Defective, damaged or unsound pipe will be rejected. Deflections from a straight line or grade, as required by vertical or horizontal curves, shall not exceed manufacturer's recommendations and approval by the Engineer.
- 3) Mechanical joints shall be installed under the provisions of the recommendations of the joint manufacturer.
- 4) Fittings at bends or dead ends shall be firmly blocked against the vertical face of the trench to prevent fittings from being blown off the lines when under pressure. Blocking shall conform to the plan for concrete blocking for fittings. Where pipe ends are left for future connections, they shall be valved, plugged or capped as shown on the plans. Where connections are made between new work and existing mains, the connections shall be made by using fittings as required.
- 5) All DIP where noted on the drawings shall have a tracer wire buried beside the invert of the pipe as shown on the drawings. A tracer wire locating station will be supplied to the Contractor by HU. The tracer wire furnished by HU will be a 12 or 14 AWG solid, Protrace HF-CCS PE30 or equal 30 Mil (0.8 mm) HMW-HDPE coated copper wire. The color will be blue. The wire shall be continuous and unspliced from tracer wire locating station to tracer wire locating station. The tracer wire shall be electrically intrinsic with reference to the water distribution system.

All DIP water main or water service lines of 4" (100 mm) diameter or greater shall have warning tape buried 12" (300 mm) to 24" (600 mm) above the top of the pipe. The warning tape will be inscribed with the message "CAUTION BURIED WATER LINE". The warning tape will be a minimum of 3" (75 mm) in width. The warning tape will be a minimum 4 mils (0.1 mm) in thickness. The warning tape will be blue in color and

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furnished to Contractor by HU. Installation of tracer wire and warning tape will be subsidiary to bid.

- 6) The use of pipe gasket lube shall be limited to Blue Lube manufactured by Whitlam Plumb-Pro or equal. The use of yellow gasket grease is not permitted or allowed to be stored on site. Pipe gasket lube shall be NSF Standard 14 and 61 certified for potable use. Care shall be taken to limit the amount of pipe gasket lube applied as this will aid in cleanup of the water main and assemblies.

4.208(b) Installation of PVC Water Main. The installation of polyvinyl chloride (PVC) water main shall be in accordance with the latest revision of AWWA C605.

All PVC water main installation shall also be in accordance with the following:

- 1) Pipe and accessories shall be handled in such a manner as to insure delivery to the work in a sound undamaged condition. All PVC pipe stored on site and expected to be stored for more than 3 months, shall be covered with tarpaulins to protect the pipe from ultra violet light damage as required by AWWA C-605 Section 2.3.1.
- 2) Prior to the pipe being placed in the trench and while suspended in a sling, all pipe shall be inspected for defects. Defective, damaged, scratched, bleached, cut, scarred, or unsound will be rejected. Deflections from a straight line or grade, as required by vertical or horizontal curves, shall not exceed manufacturer's recommendations and approval by the Engineer.
- 3) Mechanical joints shall be installed under provisions of the recommendations of the joint manufacturer.
- 4) Fittings at bends or dead ends shall be firmly blocked against the vertical face of the trench to prevent fittings from being blown off the lines when under pressure. Blocking shall conform to the plan for concrete blocking for fittings. Where pipe ends are left for future connections, they shall be valve, plugged or capped as shown on the plans. Where connections are made between new work and existing mains, the connections shall be made by using fittings as required.
- 5) All PVC where noted on the drawings shall have a tracer wire buried beside the invert of the pipe as shown on the drawings. A tracer wire locating station will be supplied to the Contractor by HU. The tracer wire furnished by HU will be a 12 or 14 AWG solid, Protrace HF-CCS PE30 or equal 30 Mil (0.8 mm) HMW-HDPE coated copper wire. The color will be blue. The wire shall be continuous and unspliced from tracer wire locating station to tracer wire locating station. The tracer wire shall be electrically intrinsic with reference to the water distribution system.

All PVC water main or water service lines of 4" (100 mm) diameter or greater shall have warning tape buried 12" (300 mm) to 24" (600 mm) above the top of the pipe. The warning tape will be inscribed with the message "CAUTION BURIED WATER LINE". The warning tape will be a minimum of 3" (75 mm) in width. The warning tape will be a minimum 4 mils (0.1 mm) in thickness. The warning tape will be blue in color and

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furnished to Contractor by HU. Installation of tracer wire and warning tape will be subsidiary to bid.

- 7) The use of pipe gasket lube shall be limited to Blue Lube manufactured by Whitlam Plumb-Pro or equal. The use of yellow gasket grease is not permitted or allowed to be stored on site. Pipe gasket lube shall be NSF Standard 14 and 61 certified for potable use. Care shall be taken to limit the amount of pipe gasket lube applied as this will aid in cleanup of the water main and assemblies.

4.208(c) Installation of HDPE Water Mains. The installation of HDPE water mains shall be in accordance to the following:

- 1) The pipe and accessories shall be handled in a manner to insure the work is sound undamaged condition.
- 2) All HDPE pipe shall be stored shall be covered with tarpaulins to protect the pipe.
- 3) All HDPE where noted on the drawings shall have a tracer wire buried beside the invert of the pipe as shown on the drawings. A tracer wire locating station will be supplied to the contractor by HU. The tracer wire furnished by HU will be a 12 or 14 AWG solid, Protrace HF-CCS PE30 or equal Gauge, 30 mil (0.8 mm) HMW-HDPE coated copper wire. The color will be blue. The wire shall be continuous and unspliced from tracer wire locating station to tracer wire locating station. The tracer wire shall be electrically intrinsic with reference to the water distribution system. Installation of the tracer wire will be subsidiary to the bid.
- 4) All HDPE water main or 4" (100 mm) or greater shall have a warning tape buried 12" (300 mm) to 24" (600 mm) above the top of pipe. The warning tape will be inscribed with the message "CAUTION BURIED WATER LINE". The warning tape will be a minimum of 3" (75 mm) in width. The warning tape will be a minimum of 4 mils (0.1 mm) in thickness. The warning tape will be blue in color and furnished to Contractor by HU. Installation of the warning tape will be subsidiary to the bid.
- 5) Prior to the pipe being placed in the trench and while suspended in a sling, all pipe shall be inspected for defects. Defective, damaged, scratched, bleached, cut, scarred, or unsound will be rejected. Deflections from a straight line or grade, as required by vertical or horizontal curves, shall not exceed manufacturer's recommendations and approval by the Engineer.
- 6) Joining methods:
 - a) Butt Fusion: HDPE pipe joined by the butt fusion shall be done in accordance with ASTM F2620 or PPI TR-33. All fusion joints shall be made in compliance with the pipe or fitting manufacturer's recommendations. Fusion joints shall be made by qualified fusion technicians per PPI TN-42. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project. Provide copy of Butt Fusion procedure to Engineer 10 days prior to construction for review and approval.
 - b) Saddle fusion: HDPE pipe joined by Saddle fusion shall be in accordance with ASTM F2620, TR-41 or the fitting manufacturer's recommendations and PPI TR-

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41. Saddle fusion shall be used to fused branch saddles, taping tees, and other HDPE constructs onto the wall of the main pipe. Saddle fusion joints shall be made by qualified fusion technician. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on the project. Provide copy of Saddle Fusion procedure to Engineer 10 days prior to construction for review and approval.c)

Electrofusion: HDPE pipe joined by Electrofusion shall be done in accordance with the manufacturers recommended procedure. Other sources of electrofusion joining information are ASTM F1290 and PPI TN-34. The process of electrofusion requires an electric source, a transformer, commonly called and electrofusion box. The electrofusion box must be capable of reading and storing the input parameters and the fusion results for later download to an electronic record file. Qualification of the fusion technician shall be demonstrated by evidence of electrofusion training within the past year on the equipment to be utilized for this project. Provide copy of Electrofusion procedure to Engineer 10 days prior to construction for review and approval.

- d) Mechanical coupling that wrap around the pipe and act as saddles shall be recommended by the manufacturer as being designed for use with HDPE pipe. Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and fittings shall use mechanical joint adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6.
- e) Joint construction records are the critical parameters of each fusion joint. As required by the manufacturer this data shall be recorded either manually or by an electronic data logging device. All fusion joint data shall be included in the Fusion Technician's joint report and provided to the Engineer for review.

- 7) Buried HDPE pipe and fittings shall be installed in accordance with ASTM D2321 or ASTM D22774 for pressure systems, AWWA Manual practice M55 Chapter 7 and as specified within these specifications for the placement of Water Main.

4.208 (d) Installation of Service Lines.

All service lines require a tracer wire to be installed with the pipe and extended up the stop-box for future access. The contractor is responsible for confirming the proper stop box and position of the service valve before re-connecting. Notify customers of any shutdowns and reconnections.

City of Hastings Contracts: All water service line work inside the right-of-way is deemed utility work and can be completed by a watermain contractor when there is relative main work being completed. Any work to be done on the customer side of the curb stop, except for connecting the service line to the curb stop, shall be done by a licensed plumber.

A licensed plumber shall secure and obtain a plumbing permit for any water service work on private property. All plumbing permits shall be obtained before any work begins.

Privately Constructed Services: A licensed plumber is required to acquire a permit for all services. Through a tapping fee, the City of Hastings will make all taps.

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4.209 Pipe Plug. The Contractor shall utilize a water tight mechanical plug or cap of appropriate size to secure the open end of the pipe from debris entering into the pipe. This shall be strictly enforced at the end of each day, during any breaks lasting more than 30 minutes or unscheduled stoppage which the pipe may be left unattended for more than 30 minutes. Buckets, duct tape and other methods will not be allowed.

4.210 Service Interruptions. When it becomes necessary, for the purpose of making connections or for any other reason, to shut off or turn on water in any existing mains, it is the sole responsibility of the Contractor to notify the City Water Department, through the Resident Engineer, as to when and for how long service will be interrupted, and also to notify all water users well in advance to that they might prepare themselves for the period during which service might be interrupted. Water system valves shall not be opened or closed by anyone other than City Water Department personnel.

4.211 Fire Hydrants and Valve Boxes. All fire hydrants, valves, and valves boxes shall be installed in the lines as shown on the drawing and as directed by the Engineer. All apparatuses shall be set plum. Valve boxes shall be centered directly over the valves. Earth fill shall be carefully hand tamped around all valve boxes and fire hydrants. Valves boxes shall have the interiors cleaned of all foreign matter before installation.

All valve boxes shall be installed to permit without restriction valve wrenches. All fire hydrants shall be installed in accordance with the latest revision of AWWA Manual M17, "Installation, Field Testing and Maintenance of Fire Hydrants", and no more than 1/4" per two (2) vertical feet out of plumb in any direction. The engineer shall measure the plumbness of all fire hydrants installed. Any fire hydrant not installed correctly and plumbed shall be straightened and any additional extensions of the barrel to raise it to grade shall be provided without additional reimbursement. Review of the plumbness test by the Engineer shall be requested by the Contractor prior to beginning of the project. If a review is not requested, the Engineer may assume the Contractor fully understands the requirements for proper hydrant installation.

4.212 Cleaning, Disinfection, Flushing and Pressure Testing of Water Mains

A. Cleaning

Procedures for the disinfection of the water mains and service lines 4" and larger shall be in accordance with the latest revision of AWWA C651. Specifically each segment of completed water main to be disinfected shall not exceed a length greater than 1,000 LF unless otherwise approved by the Engineer.

All costs associated with disinfection, flushing and pressure testing of the water mains and appurtenances shall be considered subsidiary to the main installation.

To aid in the cleaning and disinfection of the water main the contractor shall comply with the following:

1. All water main materials shall be shipped in plastic wrap or provided removal plugs to limit contamination during shipping. Water main pipe shall be shipped with a tarp or cover to protect the pipe end (windward end) during transport.

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2. Onsite storage of water main materials shall be placed on skids or blocks to limit contamination while in storage. Provide minimum of 4 inches elevation above the ground line and not located in areas that may become flooded.
3. Tarps or plastic wrap shall be provided to secure the open end of the pipe and water materials from contamination during site storage. Contractor shall limit site storage to amounts that can be installed in a timely manner to limit contamination.
4. Each section of pipe, all fittings and other water main assemblies shall be thoroughly inspected for presence of dirt, oil film(s), and debris prior to installation. Contractor shall remove and clean all visible contamination.
5. During installation the open end of the water main or assembly shall be fitted with a plug to limit contamination. This shall be used at all times. For periods where construction will be delayed for more than 1 hour a tight fitting plug shall be installed that will prevent water intrusion at a pressure of at least 10 feet of hydraulic head.
6. A suggested process for cleaning the water main pipe prior to installation is to power wash the inside of the pipe from each end of the pipe then swab each pipe with a soft foam or soft sponge pig soaked with chlorinated water, swab once from each end using a bull float pole to push the pig through. Then power wash the inside of each pipe one more time. Bag each end of the pipe with a heavy plastic garbage bag and seal with duct tape. After the pressure testing is completed, the pigging process shall consist of running the vinyl covered pig with bristles through the water main at least 4 times, then running the vinyl covered pig without bristles through at least 2 times, then running the non-vinyl covered hard foam pig through at least two times or at such time as the water is clear. New pigs shall be used with each water section thereof. Once the pigging process is completed the water main shall then be chlorinated. City of Hastings will supply two sets of pigs for the first two times of pigging on each section of main being cleaned. Length of each section of main to be determined by the engineer.
7. Use of granular chlorine or chlorine tabs will not be permitted.
8. A pipe cleaning pig launching and receiving assembly shall be supplied and installed. For City contracts, pipe cleaning pigs will be provided for two rounds of cleaning, additional pigs will be the contractors expense along with City of Hastings labor and equipment costs. For private contracted projects, the costs of pigs is responsibility of the owner, along with City of Hastings labor and equipment costs.
9. A written plan for providing cleaning, disinfection and sampling shall be provided to the engineer for approval before main installation begins. A walk thru of the project prior to main installation shall be conducted with the contractor foreman to review disinfection procedures.

Flush Water Disposal

The contractor shall provide all piping, hoses, ditches and other conveyance devices to properly dispose of the water from the water mains. The following procedures shall be used:

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1. Flush water containing chlorine in excess of 1 mg/l shall be directed to the sanitary sewer at rates that do not exceed the capacity of the receiving sanitary sewer. In the event a sanitary sewer is not available to the contractor, City of Hastings Sewer Department shall provide assistance in removing the chlorine., Plan and procedures for de-chlorination shall be approved by the engineer prior to commencing work.
2. Waters containing 1 mg/l or less of free residual chlorine to be flushed from the main shall be directed to appropriate storm sewers, ditches or other drainage ways. Disposal of flushed water shall be the responsibility of the contractor. Erosion caused by flushing activities shall be repaired by the contractor. Repair of right of ways and private property shall be completed to the satisfaction of the property owner or controlling authority.

B. Hydrostatic Pressure Testing:

Utility Owned Mains: Hydrostatic testing shall be in accordance with the latest revision of AWWA C600 Section 4 or AWWA C605 Section 7 as deemed appropriate. Hydrostatic testing shall be performed at a pressure of 140 psi (965 kPa) minimum to 150 psi (1035 kPa) maximum, with an maximum drop in pressure of 2 psi (14 kPa) over a two hour period. All defective materials or improperly installed materials shall be repaired or replaced as deemed appropriate by the engineer. The hydrostatic pressure test shall be repeated after all repairs are completed and until satisfactory results are obtained.

Privately Owned Services: Service lines greater than 2" shall conform to NFPA 24 hydrostatic pressure test requirements. All piping and attached appurtenances subject to system working pressure shall be hydrostatically tested at gauge pressure of 200 psi or 50 psi in excess of the system working pressure, whichever is greater, and shall maintain that pressure at gauge pressure of ± 5 psi for 2 hours.

C. Water Main Disinfection and Flushing

Water main disinfection and flushing shall be completed in a timely manner. As noted above a written plan shall be prepared and provided to the engineer for approval. The plan shall limit the amount of time water is allowed to be placed in the main prior to disinfection procedures are applied. The following terms and conditions shall be used with respect to disinfection and flushing of water mains:

Step 1. Pre-flushing (By HU Forces): Once the water main has been installed and all appropriate control valves placed into service, the water main shall then be flushed with potable water. This shall be done at a minimum velocity of 5 fps or maximum achievable with normal system water pressure. Pre-flushing of the water main shall be conducted for a sufficient period of time until the water is clear and then an additional five (5) pipe volumes of water shall be discharged. See above for flush water disposal requirements. City of Hastings forces shall be responsible for the operation of all Hastings water valves.

Step 2. Hydrostatic Pressure Testing (By Contractor): Immediately after pre-flushing of the main (within 1 hour) the water mains shall be hydrostatically tested.

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Step 3. Aggressive Main Cleaning (Pigging) (By Contractor): Following successful hydrostatic testing (within 1 hour), water mains shall be aggressively pigged. Every effort shall be made to aggressively clean all sections of the water main. Appropriate sized pigs will be pushed through the pipe being cleaned using water system pressure. A set of pigs consist of the following:

Pipe Cleaning Pig Set	
Pig Description	Qty. of Pigs per 1000 ft.
Medium Density Foam Vinyl Coated w/ Plastic Bristle	2
Medium Density Bare Foam with Cone End	2

Run pigs one at a time, starting with the vinyl coated scrubbing pig and repeat until the flush water is clean before repeating the process with the bare foam pig. See above for flush water disposal requirements. City of Hastings forces shall be responsible for the operation of all Hastings water valves.

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Step 4. Initial Disinfection (By Contractor): Immediately after the water main has been aggressively cleaned (within 1 hour), the water main shall be disinfected with chlorine. Sufficient amounts of chlorine shall be used to provide a minimum of 25 mg/l to a maximum of 100 mg/l of free chlorine residual for a minimum contact time of 24 hours. Chlorine shall be added to each section of main using a continuous-feed method. The contractor shall provide, install, and operate all chlorination equipment. Chlorine chemical will be supplied by the owner and placement is the responsibility of the contractor. No additional compensation is provided. City of Hastings forces shall be responsible for the operation of all Hastings water valves.

Step 5. Flushing (By HU Forces): Once the water main has been disinfected the water main shall be flushed. Flushing of the water main shall be conducted for a sufficient period of time to remove all traces of chlorine. A field chlorine test shall be conducted to confirm all chlorine has been removed. See above for flush water disposal requirements and specifically for waters containing chlorine. Once the chlorine is removed flush an additional five (5) pipe volumes. City of Hastings forces shall be responsible for the operation of all Hastings water valves.

Step 6. Bacteriological Sampling (By HU Forces): Once the water main has been flushed of disinfectant samples for coliforms and heterotrophic bacteria (a.k.a. HPC or plate count) shall be collected. The water shall be tested for chlorine residual to insure that all chlorine has been removed. The water samples shall be collected from a sanitary access tap properly sized and approved of by the City. The water main shall not be aggressively flushed during the sample collection. The water main is deemed to be clean once two sets of samples are collected 24 hours apart and show no evidence of coliforms (zero coliforms) or heterotrophic bacteria (a.k.a. HPC or plate count) greater than 500 colony forming units per ml (500 cfu/ml).

All samples will be collected by HU forces and delivered to a third-party testing lab.

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During each sampling event coliform and heterotrophic bacteria samples shall be collected at a point where system water enters the project. These samples are collected to insure the water used for cleaning of the mains is potable.

Step 7. Re-cleaning of the water main (By Contractor): If the water main after testing and flushing as noted above has not been successfully cleaned, then it shall be re-cleaned beginning with Step 3 as noted above. Selection of the pig type and construction shall be reviewed with the engineer for approval. All water used after initial Step 6 as noted above shall be metered using estimated flow rates as determined by City of Hastings. This water shall be purchased by the contractor at current residential (Urban) water rates. Expense of all retesting of the water main for coliforms and heterotrophic bacteria (a.k.a. HPC or plate count) shall be the responsibility of the contractor.

Step 8. Surfactant Cleaning (by Contractor): If deemed necessary by the contractor the water main may be cleaned using a National Sanitation Foundation (NSF) approved surfactant equal to a Johnson Screens NW-400. Application rate of the surfactant shall be as per manufactures recommendation. NW-400 shall be injected at a rate of 1 gallon per 1500 to 2000 gallons of water. Additionally the main shall be provided chlorine at a minimum rate of 25 mg/l and a maximum of 100 mg/l of free available chlorine. The surfactant and chlorine shall be allowed to be in contact with the pipe interior for a minimum of 24 hours and a maximum of 96 hours. Flushing of the surfactant and chlorine shall be deemed complete when there is not chlorine residual present.

4.213 Separation from Sanitary Sewer Mains. There shall be a minimum of eighteen (18) inches (450 mm) clearance between water mains and sanitary sewer mains crossing at approximately ninety degrees (90°). There shall be a minimum of 10' horizontal clearance between water mains and sanitary sewer, manholes and storm sewers measured from outside of pipe to outside of pipe.

4.214 Encasement Pipe. The encasement pipe for railroad and street crossings shall be installed by tunneling. Steel casing sections shall be connected by seam welding. The seam shall be a butt joint. Field welding shall conform to AWWA standard C206.

Casing chocks shall be provided as indicated on the drawings and installed per manufacturer recommendations. The casing chocks shall be securely fastened to the carrier pipe. The casing chocks shall be placed approximately 7'-0" (2.1 M) on center with a casing chock placed 3'-0" (0.9 M) from each end of each section of pipe. On a standard 20'- 0" (6.0 M) length of pipe, three casing chocks shall be installed.

Both ends of the encasement pipe shall be closed with a standard pull-on S-shaped seal as manufactured by Pipeline Seal and Insulator Inc., Model S, Advance Model AC End Seal, or approved equal.

After installation of the smooth steel pipe, City of Hastings shall install two 48 pound (21.8 Kg) sacrificial anodes or as determined by the Engineer shall be attached and buried at each end of the encasement. The anodes shall be attached to the outside of the encasement, one on each side.

SECTION 4-3 - METHOD OF MEASUREMENT AND BASIS OF PAYMENT

4.301 Water Main. Water main shall be measured for payment by measuring the length down the center line of construction of all pipelines installed, with no deduction for fittings or valves. Payment shall be made at the contract unit price per lineal foot for various sizes, including fittings, excavation

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and backfill, complete in place. The cost of providing and installing location tape shall be considered subsidiary to the water main.

4.302 Valves and Boxes. Valves and valve boxes shall be paid for at the contract unit price, complete in place.

4.303 Hydrants. Fire hydrants shall be paid for at the contract unit price, complete in place.

4.304 Manholes. Manholes shall be paid for at the contract unit price bid per manhole, for a depth of five feet (5') (1.5 M), which payment shall include footings, ring and cover. Additional payment shall be made for manholes more than five feet (5') (1.5 M) in depth, measure from top of footings to top of cover, at the contract price for each vertical foot or fraction thereof in excess of five feet (5') (1.5 M).

4.305 Fittings. Fittings such as tees, bends, solid sleeves, MJ to MJ adapters, and reducers including all glands and bolts shall be paid for at the contract unit price, complete in place. If in the event additional fittings are required to be installed, then additional fittings shall be paid for at the unit price per pound of the base weight of the fitting.

All ductile iron fitting weights shall be computed using AWWA C153.D.I. Compact Fittings whenever appropriate. In the event a compact fitting weight is not provided by AWWA C153, then the appropriate ductile iron fitting weight as specified in AWWA C110 shall be used. If in the event special items that are called for on the drawings are not referenced in AWWA C110 or C153, then appropriate manufacturer weights shall be utilized. The fitting weights shall consists of the base weight only; all bolts, gaskets and glands shall be considered subsidiary to the pay item.

The Contractor will be reimbursed for actual installed fitting weights using the manufacturers standard weight schedule.

4.306 Boring and Encasement. The construction of encasement pipe shall include boring, excavation, backfill, casing pipe, and cathodic protection. All other items necessary to complete the installation encasement pipe shall be considered subsidiary to the bid item. The amount of encasement installed shall be measured along the center-line of the encasement and shall be paid for at the contract unit price.

4.307 Hydrant Extension. Hydrant extensions as required or as directed by Engineer shall be paid for on a per extension basis; such as 3" (75 mm), 6" (150 mm), 9" (225 mm), etc. Payment shall compensate the Contractor for all labor, fabrication, installation, backfilling, excavating, and all other incidental work as specified or directed by Engineer.

4.308 Valve Box Extension. Valve box extension shall be considered subsidiary to the installation of the valve and valve box.

4.309 Extra Depth Excavation and HDD. When deemed necessary by the Engineer for extra depth greater than 2.0 feet (600 mm) from plan grades, addition compensation shall be provided a per foot depth per linear foot basis. Payment shall include all excavating, backfilling, labor, and other incidental work as specified.

When bury depth is not indicated and rather to be field determined by the contractor, no additional compensations will be made.

SECTION 4 - WATER MAIN SPECIFICATIONS

No additional compensation will be made when the Contractor varies depth do his operation or failure to control his operation.

4.310 Locating Materials. Material and installation is responsibility of the contractor. Bury tape and tracer wire will be paid for by total feet of main plus total feet of service line. Connectors are subsidiary, tracer stations and anodes will be paid by total quantity.

4.311 Service Connection. The payment for the installation of a service connection for 3/4" to 2" in diameter shall include all excavations, backfilling, re-sodding, re-seeding, service saddles, connections to tracer wire, corporation valves, purchase of materials, fabrications, and all other incidentals for a complete installation. Payment will be made for each class of work and for each size of service required.

4.312 Water Service Lines. The payment for the installation of water service lines for 3/4" to 2" in diameter shall include all excavation, backfilling, re-sodding, re-seeding, service saddles, installation of tracer wire, water service lines, corporation valves, purchase of materials, fabrications, and all other incidentals for a complete installation. Payment will be made for each class of work and for each size of service required.

4.313 Curb Stop. The payment for the installation of a curb stop shall include all excavation, backfilling, re-sodding, re-seeding, curb stops, connection to tracer wire, purchase of materials, fabrication, and all other incidentals for a complete installation. Payment will be made for each class of work for each size of curb stop required.

4.314 Thrust Block. The payment for thrust blocks will be per quantity installed. This will include forming and pouring in place per detail dimensions.

END OF SECTION