

CITY OF FARGO SPECIFICATIONS
WATER MAINS

PART 1
DESCRIPTION OF WORK

The work to be done under this section of the Specifications and the accompanying plans consists of the furnishing of all labor, material, accessories and equipment necessary to construct water mains in the City of Fargo. The work includes excavation, furnishing, laying and jointing pipe; making connections to existing water mains as necessary; installing new valves, valve boxes, or valve manholes; installing hydrants; protecting existing utilities and public and private property; backfilling trenches and other work as may be necessary to in order that the work may be completed in accordance with these Specifications and the plans accompanying them.

PART 2

MATERIALS

All products (treatment chemicals and material) that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 & 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, The Underwriters Laboratories, or other organizations accredited by ANSI to test and certify such products.

2.1. POLYVINYLCHLORIDE (PVC) PRESSURE PIPE

2.1.1. MATERIAL

The PVC material shall conform to the requirements of ASTM D-1784, Class 12454-B.

2.1.2. PIPE MANUFACTURE

The pipe shall be marked to indicate compliance with NSF 61, Factory Mutual (FM) and be either marked or tagged with the Underwriter Laboratory (UL) approval. All PVC pressure pipe shall be manufactured in accordance with the latest revision of AWWA Standard C900. The pipe shall be DR 18.

2.1.3. PIPE JOINTS

PVC pipe joints shall be rubber gasketed conforming to the requirements of ASTM D-3139-98 or the latest revision.

2.2. DUCTILE IRON PIPE

2.2.1. MATERIAL

Ductile iron pipe shall conform to AWWA C-151 Standards.

2.2.2. PIPE MANUFACTURE

Ductile iron pipe shall be American made and conform to a Class 53 standard thickness class unless otherwise specified.

2.2.3. *PIPE JOINTS*

Ductile iron pipe joints shall be slip joints with rubber gaskets and meet AWWA C-111 Standards.

2.2.4. *LINING*

The ductile iron pipe shall be lined with cement mortar in accordance with AWWA C104. Cement for mortar shall be Portland Cement conforming to current ASTM specifications. The thickness of the lining shall not be less than the following:

1/16" for 3 to 12 inch pipe

3/32" for 14 to 24 inch pipe

1/8" for pipe larger than 30 inches

2.2.5. *PIPE COATINGS*

Ductile iron pipe shall be coated with a 1 mil asphaltic coating.

2.2.6. *POLYETHYLENE WRAP*

All ductile pipe shall be wrapped with polyethylene plastic film having a minimum thickness of 8 mils or with a cross woven polyethylene plastic film having a minimum thickness of 4 mils. All water service taps on ductile iron main shall be wrapped for a minimum distance of 3 feet from the water main.

2.3. FITTINGS

All fittings shall be PVC or Ductile Iron, and shall be “push-on” or “slip-joint” unless specified otherwise in the plans or special instructions to bidders. Cast iron fittings will be used only when approved by the Engineer.

2.3.1. PVC FITTINGS

PVC fittings shall be injection molded conforming to the requirements of AWWA C-907 and carry a working pressure of at least 150 psi. Molded fittings shall be made of PVC compound with a minimum hydrostatic design basis of 4,000 psi.

2.3.2. DUCTILE IRON FITTINGS

Ductile Iron fittings shall conform to AWWA C153, and shall be cement mortar lined on the interior and bituminous coated on the exterior. Cement lining shall conform to AWWA C104, and joints shall conform to AWWA C111. All ductile iron fittings shall be wrapped with polyethylene plastic film as specified for the ductile iron pipe, which must be securely fastened to the pipe on each side of the fitting. Mechanical joint fittings, where allowed by the Engineer, shall be bid complete with gaskets, glands, and stainless steel bolts.

2.3.3. COUPLINGS

All pipe couplings up to and including 12” in diameter shall be epoxy coated ductile iron meeting or exceeding the requirements of ASTM A 536, grade 65-45-12. Couplings shall meet the requirements of AWWA Standard C219. The coupling shall carry a minimum working pressure of 300 psi, having end rings that are segmented and joined with a pinless hinge, gaskets formed from virgin Nitrile Butadiene Rubber (NBR) compounded for water and sewer service in accordance with ASTM D2000, and 304 stainless steel armor. Fasteners shall be 304 stainless steel.

Couplings up to and including 12” in diameter shall be Romac Macro HP, Hymax DI High Pressure, or approved equal. Couplings larger than 12” shall be mechanical-joint long body sleeves meeting the requirements of AWWA C153.

2.4. GATE VALVES

2.4.1. GENERAL

Cast iron resilient-seated gate valves and tapping valves shall conform to the latest requirements of AWWA C509. Ductile iron resilient-seated gate valves and tapping valves shall conform to the latest requirements of AWWA C515. The valve seats shall be able to withstand 200 psi and the body shall withstand 400 psi.

2.4.2. CONSTRUCTION

Size:	4" to 36"
Joints:	Joints shall be provided with AWWA standard bell ends, flanged ends or mechanical joint bell ends as required for the type of pipe being used.
Gaskets:	Rubber.
Operation:	Open left (counter clockwise) w/ 2 inch operating nut.
Bolting:	All body bolts shall be stainless steel.
Stem & seals:	The stem shall be made of bronze and shall have two "O" rings to provide sealing.
Coating:	All valves shall be coated inside and out in accordance with the latest revision of AWWA C-550.

Acceptable manufacturers are American Flow, Clow, Mueller, U.S. Pipe or Waterous.

16" and larger valves shall be installed horizontally with bevel gear actuators.

*2.5. VALVE BOXES**2.5.1. GENERAL*

Valve boxes are required on all valves. All valve boxes shall be heavy-duty cast or ductile iron in accordance with ASTM A 48 30B material specification with a minimum tensile strength of 30,000 psi, have screw type adjustment, 5 1/4" shaft, and be furnished with heavy-duty cast or ductile iron bases and covers. Covers shall be made in the USA and cast with "WATER" on them. Valve boxes shall be three-piece type, adjustable from 62 to 82 inches in height, except that they shall in all cases be supplied and installed with a sufficient quantity of additional intermediate section(s) to allow the top of the installed box to be set at finished grade at mid-height of adjustment.

2.5.2. VALVE BOX ADAPTOR

Rubber valve box adaptors shall be installed for all valve boxes on all gate valves and butterfly valves. The adaptor shall be the Valve Box Adaptor II as manufactured by Adaptor, Inc. or as approved by the Engineer.

2.6. TAPPING SLEEVES AND VALVES

Valves shall be in accordance with the latest revision of AWWA C-509. The sleeves shall be mechanical joint with stainless steel bolts or stainless steel tapping sleeves with a stainless steel flange.

*2.7. HYDRANTS**2.7.1. GENERAL*

Hydrants shall be non-jacket types meeting the latest revision of AWWA C-502. All hydrants shall be equipped with a break-off traffic flange and shall be capable of being extended in 6" increments.

2.7.2. CONSTRUCTION

Main valve opening: 5" minimum.

Hydrant barrel: 7 3/8" minimum inside diameter.

Type of shut-off: Compression.

Inlet connection: 6" size- bell or mechanical joint type.

Nozzles: 2-2 1/2" hose nozzles; 1-4 1/2" pumper nozzle.

Nozzle threads: National Standard threads.

Bury depth: 8 feet 6 inches.

Operating & cap nuts: City of Fargo Standard (NST).

Direction to open: To the left (counter-clockwise).

Paint: City of Fargo Standard Red above ground line.

Bolts: All bolts below ground shall be stainless steel.

Hydrants shall be wrapped with polyethylene plastic film as per section 2.2.6.

POLYETHYLENE WRAP.

Acceptable manufacturers are Waterous WB67 Pacer and American Darling B62B-1.

2.8. HYDRANT MARKERS*2.8.1. GENERAL*

Hydrant markers shall be mounted on both sides of the post to face traffic (perpendicular to the curb) and shall be installed with each hydrant.

POST: Green U-channel- 2 lb. per foot & 9 feet long with 2 foot bury.

SIGN: 4" by 7" by 0.063" aluminum covered with Engineer Grade reflective sheeting, Red hydrant symbol on white background.

2.9. SERVICE CONNECTIONS

All service connections to PVC pipe shall be stainless steel, double bolt (minimum) service saddles. Service saddles shall have stainless steel washers between the nut and the plastic washer to equalize tightening stress. Rubber tapered gaskets shall be required to resist circumferential and longitudinal forces along with O-ring or flat gaskets for hydraulic seal. Saddle bolts shall be tightened to the manufacturers recommended tightness and verified with a torque wrench. Bolt tightness shall be rechecked with a torque wrench after the pipe tap is complete.

Approved saddle types:

Romac style 306

Ford style FS 300

Powerseal 3412AS

Cascade CSC2

2.10. YARD HYDRANTS*2.10.1. GENERAL*

Yard hydrants, where allowed by the Engineer, shall be brass ¾" frost proof type equipped with a brass vacuum breaker. The valve stem and plunger assembly shall be removable for inspection and repair without the need for digging up of the hydrant.

2.10.2. CONSTRUCTION

Hydrant barrel: 1" brass.

Inlet connection: ¾" NPT in brass casting.

Nozzle: heavy duty ¾" brass hose thread.

Bury depth: 7 feet.

Paint: Standard Red above ground line.

Acceptable manufacturers are Merrill Any Flow Brass Frost Proof or equal.

2.11. TRACER WIRE AND TRACER WIRE ACCESSORIES

2.11.1. GENERAL

All tracer wire and tracer wire accessories (connectors, splices, access points, and magnesium ground rods) shall be domestically manufactured in the USA. Tracer wire shall be installed along all water mains, water services, and sanitary sewer force mains unless otherwise noted in these plans. All system components, including tracer wire and tracer wire accessories must be compatible. Tracer wire and tracer wire accessories shall be considered incidental to other items.

2.11.2 TRACER WIRE

All tracer wire shall meet the following criteria:

- All tracer wire shall have HDPE insulation and color coded per APWA standards for specific utility being marked
- Must carry a radio signal to aid in locating buried underground utilities
- Certified to meet ASTM B170 specification for oxygen-free electrolytic copper
- Certified to meet ASTM B869 specification for 21% conductivity, hard drawn, copper-clad steel wire
- Certified to meet ASTM D1238 specification for polyethylene plastics extrusion materials
- The wire shall be identified by surface marking indicating manufacturer's identification, conductor size, and other appropriate information.

Tracer wire to be used for direct bury shall meet the following criteria:

- 12 AWG copper clad carbon steel core with HDPE coating (30 mil thickness) and minimum 450 lb. break load

Tracer wire to be used for directional drilling and boring shall meet the following criteria:

- 12 AWG copper clad carbon steel core with HDPE coating (45 mil thickness) and minimum 1,150 lb. break load

Tracer wire to be used for pipe bursting and slip lining shall meet the following criteria:

- 7 x 7 stranded copper clad steel with HDPE coating (50 mil thickness) and minimum 4,700 lb. break load

2.11.3 *TRACER WIRE CONNECTORS*

Tracer wire connectors shall be used to interconnect tracer wire at the intersection of mains and laterals. Non-locking, friction fit, twist on wire nuts, or taped connectors are prohibited.

Tracer wire connectors to be used for direct bury, directional drilling, and boring shall meet the following criteria:

- Pre-filled with dielectric silicon that never hardens.
- Waterproof and corrosion proof.
- Manufactured for the wire gauge being installed.
- Designed for direct bury and low voltage up to 50V.

Connectors used for direct bury, directional drilling, and boring shall be “DryConn Direct Bury Lug Aqua”, “Copperhead Mainline to Service Connector”, or approved equal.

Tracer wire connectors to be used for pipe bursting and slip lining shall meet the following criteria:

- ¼”- 20 slotted stainless steel set screw with 30 volt maximum and shall be protected from corrosion with a wax pad or other approved anti-corrosive methods.

Connectors used for pipe bursting and slip lining shall be “SnakeBite Pipe Burst Connector” or approved equal.

2.11.4 *TRACER WIRE SPLICES*

Tracer wire splices shall be used to join tracer wires at the end of a spool or when required to repair damaged tracer wire. End of spool tracer wire splices shall occur no more than once per 500 feet.

Tracer wire splices to be used for direct bury, directional drilling, and boring shall be “DryConn Direct Bury Lug Aqua”, “Copperhead Mainline to Service Connector”, “Copperhead SnakeBite Locking Connector”, or approved equal.

Tracer wire connectors to be used for pipe bursting and slip lining shall meet the following criteria:

- In-line splices for the 7x7 copper clad steel core tracer wire shall be made with a 30 volt maximum solid brass lug with a set screw locking mechanism. The brass lug shall be protected with a fast cure heat shrink that creates a weather resistant connection.

2.11.5 ACCESS POINTS

Tracer wire access points shall be “Copperhead Cobra Access Point”, “Rhino TriView Test Station”, or approved equal.

Tracer wire access points installed at hydrant locations shall meet the following criteria:

- Made of polypropylene material
- Direct connection point for utility locator transmitter
- Minimum of 2 terminal exterior connection points with a jumper
- Tracer wire protection conduit connection opening at the bottom with 1” MTP thread
- Blue in color

Tracer wire access points installed at hydrant locations shall be “Copperhead Cobra Access Point” or approved equal.

The mounting bracket for connecting tracer wire access points to a hydrant shall be either a $\frac{3}{4}$ ” HDPE flange or a stainless steel flange. To protect tracer wire from weed whips, mowers, etc., tracer wire shall be run through a tracer wire protection conduit. The tracer wire protection conduit shall be a minimum 2-foot long piece of 1” HDPE heavy-wall innerduct with MTP thread on the connection end and an angle-cut buried end.

Tracer wire access points installed at locations other than hydrants or curb stops shall meet the following criteria:

- Temperature stable from -40 degrees Fahrenheit to +150 degrees Fahrenheit
- Color coded per APWA standards for specific utility being marked

- Shall be 54" in length
- Shall have tracer wire terminal post
- Must have a minimum of 2 external terminals ¼" brass shall include a bolt, nut, washers and ring terminal
- TS-SHUNT/ Jumper between the two adjacent terminals shall be rust free
- Mounted to a "T" post or "U" Channel

Tracer wire access points installed at locations other than hydrants shall be "Rhino TriView Test Station" or approved equal.

2.11.6 MAGNESIUM GROUND ROD

Magnesium ground rods shall meet the following criteria:

- Shall be a 1.5 lb. drive-in magnesium ground rod
- HDPE cap mounted to top of rod
- Minimum of 12 foot factory installed 12 AWG copper clad carbon steel core tracer wire
- Magnesium ground rod tracer wire shall be 12 AWG copper clad carbon steel core with HDPE coating (30 mil thickness) and minimum 450 lb. break load
- Magnesium ground rod tracer wire coating shall be red in color

2.12. INSULATION

Insulation shall be in accordance with Section 1200 of these Specifications.

PART 3

CONSTRUCTION

3.1. GENERAL

Excavation, trenching, and backfill shall be done in accordance with Section 1000. Pipe and fittings shall be handled and laid in accordance with the latest revision of AWWA Standard C600. Pipe and fittings shall be laid in the location shown on the plans, the exact location being designated by the Engineer during construction. Before laying any pipe, it shall be cleaned of all foreign matter and kept clean thereafter. Open ends shall be protected at all times to prevent the entrance of dirt, trench water, animals or foreign material into the pipe. The bell and spigot shall be wiped clean and sufficient lubrication placed on the gasket and spigot before the pipe is pushed fully into the bell. Field cut spigot ends of push-on joints shall be beveled prior to being pushed into the bell. Every part of the pipe shall be bedded uniformly throughout its length. All handling, field cuts, polyethylene wrapping, and jointing shall be done as per the manufacturer's recommendation.

3.2. ALIGNMENT

The Engineering Department will provide line and grade for all water main. All water mains shall have a minimum cover of 7.5'. Grade shall be maintained by the Contractor using methods approved by the Engineer. Water mains installed parallel to sanitary sewer shall be laid 10 feet apart, distance shall be measured edge to edge. Where a water main crosses a sanitary sewer line, a minimum vertical distance of 18 inches shall be maintained between the outside of the water main and the outside of the sewer. Deflections from a straight line or grade, where permitted by the Engineer, shall not exceed the pipe manufacturer's recommendation.

3.3. THRUST BLOCKS

All fittings shall be braced by means of poured concrete or concrete thrust blocks. No wood thrust blocks will be allowed. Poured concrete shall be 3000 psi concrete poured against undisturbed earth. Care shall be taken not to cover up joints, bolts, flanges, and the fittings with concrete.

Thrust restraint at the joints may be used in lieu of concrete thrust blocking with the permission of the Engineer. Restraint devices for PVC pipe shall meet or exceed the requirements of ASTM F 1674-96 or the latest revision, Standard Test Method for Joint Restraint Products for Use with PVC Pipe.

3.4. SETTING HYDRANTS

All hydrants shall be vertically plumb and shall have their pumper nozzle facing and at right angles to the street. Each hydrant shall be set on a concrete block and blocked behind with concrete block(s) of sufficient size to prevent settling and horizontal movement. Hydrant bases shall be backfilled with at least 1/3 cubic yard of 1 1/4" crushed rock to facilitate drainage and covered with polyethylene plastic film. The 1 1/4" crushed rock shall extend to 6" above the weep hole. After backfilling the hydrant markers shall be installed 18 inches behind the hydrant.

3.5. CONNECTIONS TO EXISTING WATER MAINS

Connections between new and existing pipes shall use proper specials and fittings to suit the actual conditions encountered. Suitable facilities shall be provided for proper de-watering, drainage, and disposal of all water removed from the excavation or pipe without damage to adjacent property. Prior to the closure of existing water mains, the Contractor shall notify all affected water users.

3.6. WATER MAIN SHUTDOWNS

The Contractor shall coordinate water main shutdowns with the Engineer and the Mains and Hydrants Department. The Contractor is responsible for gate valve locations and property notification. The Mains and Hydrants Department will assist with cleaning and operating the valves if required.

Shutdowns in residential areas may not occur prior to 9:00 AM. Residential water users shall be notified of the outage by 7:00 PM the night before the planned shutdown.

The Contractor shall schedule outages to non-residential water users in such a manner as to minimize the impact of the outage to the user. Outage notifications to non-residential water users shall be per the direction of the Engineer, but in no case shall be given less than 2 working days prior to the shutdown.

Notifications shall be in writing and shall indicate the estimated duration of the shutdown. A sample shutoff notification form can be found on the City's website. If actual shutdown varies from the stated time by more than one hour, a second verbal notification is required.

The Contractor shall turn on all valves after the necessary water main connections have been made.

3.7. TEMPORARY WATER SERVICES

If the water to a property is to be out for more than 12 hours, the Contractor will be responsible for providing a temporary water service to the affected water users. All piping shall be rated for potable water use. Minimum pipe size shall be 1" diameter for up to 3 service connections, 2" diameter for 4 or more connections. The Contractor shall use larger pipes where necessary to provide adequate domestic service throughout the duration of the temporary connection. Valves shall be provided on temporary piping at intervals not to exceed 500 feet. The method of providing the temporary water service (which hydrant to use, direction to feed, etc.) shall be an option of the Contractor subject to the approval of the Engineer.

All temporary water mains and services shall be disinfected in accordance with section 1300.3.9. One water sample per block at the end of a service connection will be taken after the temporary water line is flushed. The sample shall show the absence of bacteria before connections are allowed. All mains and services shall be flushed prior to being put into service. No additional contract time will be allowed for failure to pass bacteria test.

3.8. SETTING VALVES

Valves will be installed where shown on the plans or as directed by the Engineer. Before installing the valve, care should be taken to ensure that all foreign material has been removed. The stuffing boxes shall be tightened and the valve opened and closed to see that all parts are in first class working order. Valves shall be set on block as shown in the details. The body of the valve shall be wrapped with polyethylene wrap, securely fastened to the pipe on both sides of the valve, as per ANSI/AWWA C105/A21.5. Valve and valve boxes must be plumb. The valve box adapter shall be installed on the valve and the valve box shall be placed directly over the operating nut, and the top of the box being brought flush with finish grade. The Valve box shall be wrapped with polyethylene plastic film as per section 2.2.6. *POLYETHYLENE WRAP*. The box shall be backfilled and thoroughly tamped around the box. After backfilling a wrench shall be dropped on the valve to ensure that it is operable. Prior to acceptance, the City Water Department will verify that each valve is easily operable.

3.9. DISINFECTION

All water mains shall be chlorinated as set forth by the latest revision of AWWA Standard C651. Sufficient chlorine tablets or powder shall be placed in each pipe to furnish a resultant solution of

50 to 100 parts per million of available chlorine. Generally required dosage to meet this standard is as follows:

<u>WATER MAIN SIZE</u>	<u>REQUIRED DOSAGE</u>
2"	1 LB. PER 10,000 FEET
4"	1 LB. PER 2,500 FEET
6"	1 LB. PER 1,100 FEET
8"	1 LB. PER 700 FEET
10"	1 LB. PER 350 FEET
12"	1 LB. PER 280 FEET
16"	1 LB. PER 160 FEET

The chlorinated water shall remain in the pipe line for at least 24 hours and shall have a residual chlorine content of at least 5 parts per million at that time. A bacteriological sample will be taken after the main is flushed and shall show the absence of bacteria before connections are allowed to the water main. Chlorine disinfection shall be included in the unit bid price for the pipe.

3.10. PRESSURE AND LEAKAGE TESTING

All water main and services shall be subjected to pressure and leakage testing. All services shall be pressure tested with the main. The Contractor shall furnish all pumping equipment, labor and gauges required for these tests and if any section of pipe does not meet these tests, the Contractor shall at his own expense locate and repair the defects and retest the line until it meets the requirements. The pipe shall be subjected to a hydrostatic test of 150 psi for a period of two hours. Each pressure test shall be limited to a maximum of 1,500 linear feet of water main. The pressure shall be held within 2 psi of this test pressure for the entire time and leakage shall not exceed the rate established by the following formula:

$$Q = (LD\sqrt{P})/148,000$$

In which:

Q= maximum permissible leakage rate in gallons per hour for the length of line being tested.

L= length of the line being tested in feet.

D= internal diameter of the pipe in inches.

P= average test pressure in psig.

In the event that the line contains more than one size of pipe, the allowable leakage for each size shall be calculated separately and then added to obtain the total allowable leakage allowed for the

lines being tested. Repairs shall be made by replacing the defective pipe or dismantling the faulty joint, cleaning, realigning the gland or gasket and reassembling the joint as per the original specification. Repair sleeves may only be used if approved by the Engineer and shall have all stainless steel parts. All cost of locating and repairing the leaks shall be borne by the Contractor.

3.11. BACTERIOLOGICAL TESTING

Bacteriological testing is required on all new and replaced water main before the water main is placed in service. The tests ensure that the water being introduced into the system has been properly disinfected and is free of contamination. Only the City inspector may do the testing procedure. Records are kept of the litmus test, the bacteriological tests, and the chain of custody during the sample submittal process.

All water samples for bacteriological testing shall be collected from a newly installed water service. If a project does not include newly installed water services, the Contractor shall supply all labor and materials necessary to collect the sample. The materials, location, and method for abandonment/removal of necessary materials shall be approved by the Engineer. Water samples may not be collected from a fire hydrant.

After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the new main. At least one set of samples shall be collected from every 1,200 feet of new water main. All samples shall be tested for bacteriological quality in accordance with *Standard Methods for the Examination of Water and Wastewater*, and show the absence of coliform organisms and the presence of a chlorine residual.

The basic procedure is as follows:

1. Insert litmus paper test strip in the discharge stream of the hydrant while it is being flushed. The color change will indicate that there is residual chlorine content.
2. Before the valves are opened, obtain a sterile sample of the disinfected main. This water sample will be taken after the completion of the pressure test. 100-ml samples will be taken with a chlorine neutralizer tablet in the container. The sample must be taken to the water plant immediately for testing. If this is not possible, the sample must be kept in a refrigerated container, however, the test must begin within 24 hours. Results will be available approximately 24 hours from the time the test is admitted.

3. A second sample is obtained from the same location at least 24 hours after the first sample. This sample indicates that the residual chlorine content is such that verification is obtained that the pipe, newly introduced water, and any debris are disinfected. As such, the sample must be obtained from water that has remained in the new pipe for at least 24 hours. Both samples must pass the test before the new water main may be opened and put in use in the distribution system.
4. When flushing the mains, care must be taken to ensure that flow is away from the existing mains. This may involve flushing ½ block in one direction until the water is clear, and then closing that valve and flushing from the other end of the block for a mid-block hydrant.

If the initial disinfecting fails to produce satisfactory results, the main shall be reflushed and re-sampled. If check samples also fail, the main shall be rechlorinated by the continuous feed or slug method until satisfactory results are obtained.

The Contractor should note that the testing tank may require sterilization in order to avoid contamination of the mains during the testing process. The pipe installation crews will need to ensure that the pipes are free of dirt, debris and other matter. It must be remembered that the final water quality test is not the primary means for certifying the sanitary condition of the main. The sanitary handling of materials, the construction practices, and the continual inspection of the work are the primary means for ensuring the sanitary condition of the water main.

The Contractor shall assist the inspector as necessary to obtain the samples. All costs for the disinfection and testing of water mains shall be incidental to the bid price for the water main.

3.12. TRACER WIRE SYSTEM

3.12.1. GENERAL

Tracer wire shall be installed below the spring line of pipes and fittings. Tracer wire shall be securely fastened to the water main pipe with tape or plastic ties at every pipe bell or at 20 foot intervals, whichever is less. In addition, tracer wire shall be secured within 1 foot of all underground utility appurtenances. The maximum mainline spacing for a tracer wire access point shall be no greater than 600 linear feet. End of spool tracer wire splices shall occur no more than once per 500 feet. All lateral tracer wires shall be a single wire, connected to the mainline tracer wire using an approved tracer wire connector. Looping or coiling of wire is not allowed.

Minimum requirements for the number of tracer wire lines are as follows:

- One wire shall be used for direct bury installations
- Two wires shall be used for directional drilling/ boring installations
- One 7x7 extreme strength copper clad steel core tracer wire shall be used for pipe bursting/ slip lining installations.

Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors and/or splicing kits. Taping and/or spray coating is not allowed. Mainline trace wire shall not be connected to existing conductive pipes.

All costs associated with the installation and testing of the tracer wire shall be considered incidental to other items.

3.12.2. TRACER WIRE CONNECTORS

Tracer wire connectors shall be used to interconnect tracer wire at the intersection of mains and laterals. Tracer wire connectors shall be installed in accordance with the manufacturer's installation instructions. The mainline tracer wire shall not be cut.

3.12.3. TRACER WIRE SPLICES

Tracer wire splices shall be used to join tracer wire at the end of a spool or when required to repair damaged tracer wire. End of spool tracer wire splices shall occur no more than once per 500 feet.

3.12.4. TRACER WIRE ACCESS POINT

At each hydrant, the tracer wire and the magnesium ground rod tracer wire shall be routed up the side of the hydrant, through the tracer wire protection conduit, and connected to the access point. The Contractor shall leave 2 feet of tracer wire and magnesium ground tracer wire slack in the tracer wire protection conduit.

At locations other than hydrants or curb stops, tracer wire and the magnesium ground rod tracer wire shall be ran into a "Rhino TriView Test Station" or approved equal access point. The access point shall be mounted to a "U" channel post. The Contractor shall leave 2 feet of tracer wire and magnesium ground tracer wire slack in the "Rhino TriView Test Station" or approved equal access point.

Tracer wire shall not be mounted to the lid of gate valves or other devices that are located within the pavement section.

3.12.5. TRACER WIRE MAGNESIUM GROUND RODS

Tracer wire must be properly grounded at all hydrants. Grounding of trace wire shall be achieved by use of a drive-in magnesium ground rod specifically manufactured for this purpose and shall be driven into virgin ground below the pipe bedding. The lateral tracer wire and the magnesium ground rod tracer wire shall be ran up the hydrant through the tracer wire protection conduit and connected to the access point. The Contractor shall leave 2 feet of tracer wire and magnesium ground rod tracer wire slack in the tracer wire protection conduit.

3.12.6. TRACER WIRE ELECTRICAL CONDUCTIVITY TEST

All new tracer wire installations shall be located using typical low frequency (512Hz) line tracing equipment furnished by the Contractor and witnessed by the Contractor and Engineer prior to acceptance of ownership.

This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.

Continuity testing in lieu of actual line tracing shall not be accepted. All areas failing the location test shall be corrected at the Contractor's expense. The wire shall be tested in accordance with the requirements of ASTM B-1, B-3, B-8 and D-1248.

3.12.7. ELECTRICAL CONDUCTIVITY TEST FOR DUCTILE IRON

The Contractor shall perform a conductivity test one week after completion of pressure testing of the water main on all ductile iron pipe water main. This shall be performed in a timely manner to ensure acceptable conductivity prior to further construction.

On water main reconstruction projects, the Contractor shall perform the conductivity test prior to service line reconnections to ensure main line isolation from house services.

The Engineer and Owner may require a 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 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 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-minute test period.

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.

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

After the test, the hydrant shall be shut off and cap loosened to allow hydrant drainage. Tighten cap after drainage.

3.13. FINAL INSPECTION

The Contractor and the City of Fargo representative will operate all main valves and inspect all stop boxes for access. This procedure will be accomplished after all clean up, etc. has been completed. This inspection will be made prior to the final payment for work performed. Any defects shall be promptly repaired by the Contractor at his cost.

PART 4
GUARANTEE, MEASUREMENT & PAYMENT

4.1. GUARANTEE

The guarantee shall be per the contract.

4.2. MEASUREMENT AND PAYMENT

4.2.1. GENERAL

The cost of excavation, trenching, and backfill shall be included as part of this specification.

4.2.2. WATER MAIN PIPE

Pipe will be measured by customary and conventional methods and paid for on a unit price basis for the actual length installed.

Measurement will be from the center of the fitting or valve to the center of the next fitting or valve. The unit price shall include the cost of the pipe, jointing material, tracer wire and tracer wire accessories, concrete thrust blocking or joint restraint and all other appurtenance costs except valves, hydrants, and fittings, completely installed in accordance with the Specifications.

4.2.3. FITTINGS

Unless otherwise noted on the plans, water main fittings will be measured by the pound without joint accessories or cement lining. The weight for fittings not listed in the tables below shall be in accordance with AWWA C153. The weight for fittings not listed in the tables below or in AWWA C153 shall be the actual weight of the fitting(s) furnished and installed based on acceptable documentation provided by the Contractor. The standard weight of water main fittings, for payment purposes, shall be as follows:

Bends, Caps, and Plugs							
Size	Fitting Weights, lbs. (AWWA C153)						
	Bends (degrees)				Caps	Plugs	Sleeves
	90	45	22.5	11.25			
4	25	22	18	16	9	10	20
6	39	32	31	30	15	16	29
8	57	46	46	42	22	26	45
10	89	70	64	58	32	36	61
12	108	86	80	67	42	46	76
14	210	160	136	93	66	75	128
16	264	202	172	148	92	95	159
20	400	305	310	245	125	135	236
24	565	405	412	315	166	175	306

Tees, Crosses, and Reducers									
Run	Branch	Fitting Weights, lbs. (AWWA C153)			Run	Branch	Fitting Weights, lbs. (AWWA C153)		
		Tee	Cross	Reducer			Tee	Cross	Reducer
Large	Small				Large	Small			
4	4	32	40		16	6	228	240	124
6	4	46	57	24	16	8	248	260	124
6	6	56	75		16	10	264	317	124
8	4	60	68	32	16	12	280	306	112
8	6	72	74	36	16	14	316		140
8	8	86	105		16	16	322	385	
10	4	78	112	46	20	6	315		
10	6	90	119	47	20	8	345	379	
10	8	105	124	50	20	10	370		220
10	10	120	145		20	12	395	413	205
12	4	94	119	58	20	14	440		200
12	6	110	126	58	20	16	465		200
12	8	125	149	57	20	20	535		
12	10	140	179	61	24	6	415		
12	12	160	213		24	8	445	481	
14	4	172			24	10	470		
14	6	182	200	100	24	12	500	529	305
14	8	206	228	100	24	14	550		306
14	10	228		100	24	16	580	576	320
14	12	234		100	24	20	660	1589	300
14	14	280	299		24	24	720		

4.2.4. VALVES

Valves will be paid for under the unit price bid per each complete in place. The unit price will include the valve, jointing material, valve box, valve box adaptor, concrete blocking, necessary extensions, and all other work necessary for a complete and workable valve installation.

4.2.5. HYDRANTS AND YARD HYDRANTS

Hydrants will be paid for under the unit price bid per each complete in place. The unit price will include the hydrant with hydrant marker, rock bedding, blocking, excess excavation and all other work necessary for a complete and workable hydrant installation.

4.2.6. POLYETHYLENE WRAP

Polyethylene wrap shall be included in the unit bid price for ductile iron pipe, fittings, hydrants, and valves. All material, labor, equipment and incidental costs necessary to install the plastic wrap shall be included.

4.2.7. DISINFECTION AND TESTING WATER MAINS

Disinfection and testing of water mains shall be incidental to the bid price for the water main. Payment will not be made for water main until such time as it has been successfully tested.

4.2.8. TAPPING SLEEVES AND VALVES

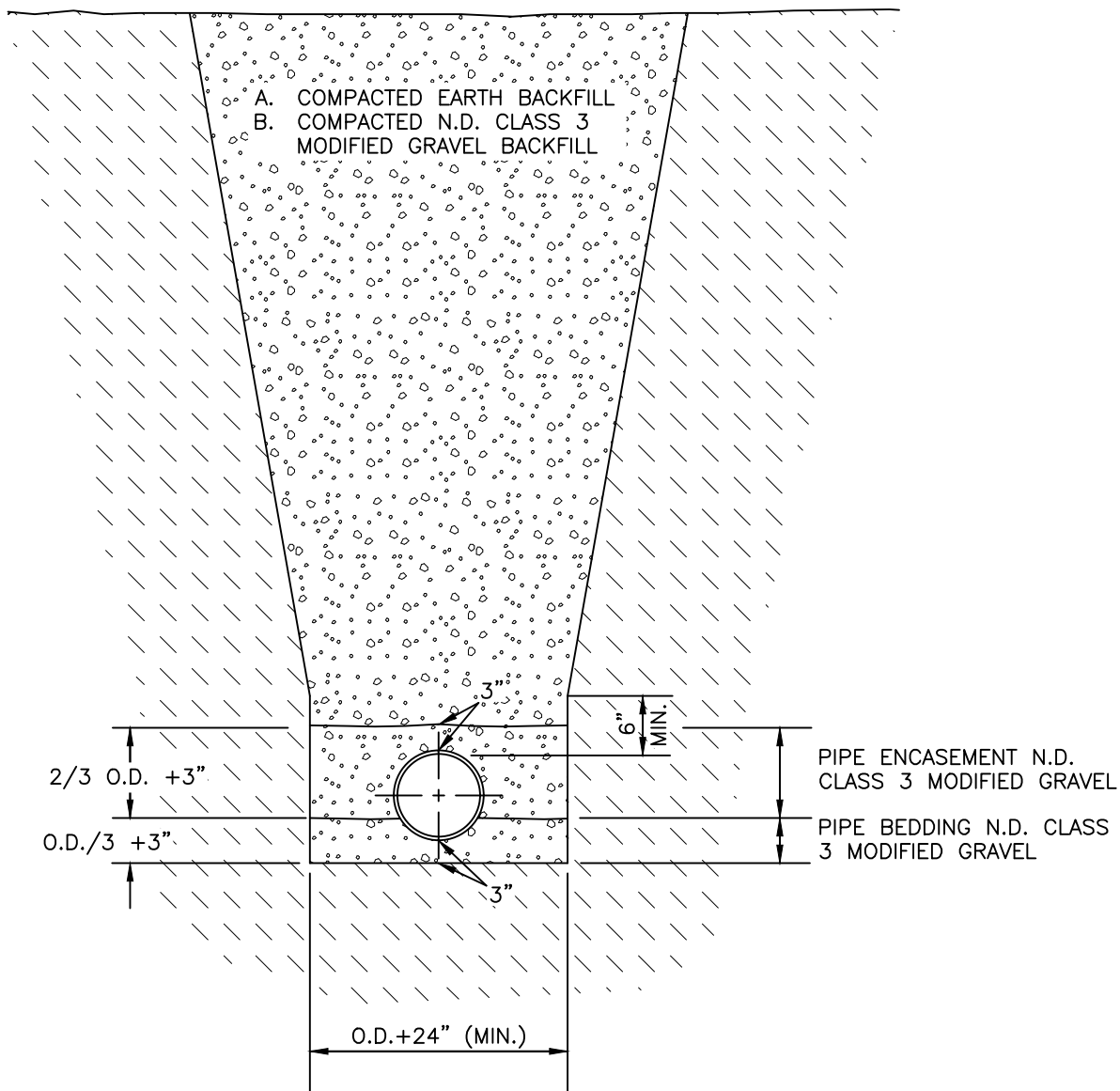
The unit bid price shall include the cost of furnishing and installing the tapping sleeve and valve. The City of Fargo Water Department will make the tap for 12" and smaller taps. On taps larger than 12", the Contractor shall make arrangements with other entities to make the tap. For connections made to the water main that are not made under city contract the Contractor will be billed for the connection by the City Water Department.

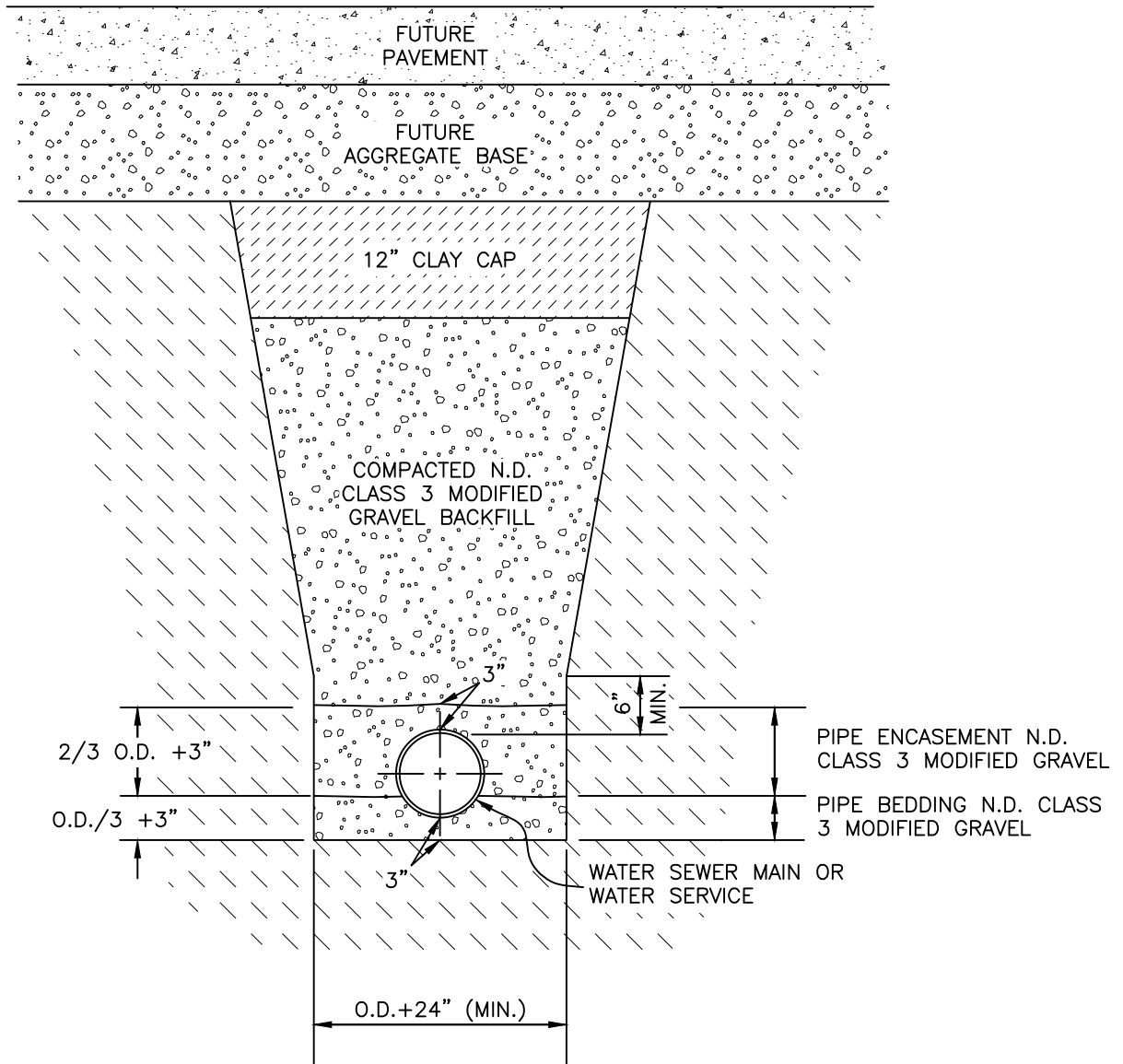
4.2.9. TRACER WIRE

The tracer wire system and electrical conductivity testing shall be considered incidental to water main construction.

4.2.10. OTHER COSTS

All other costs for work necessary to properly complete the work specified herein shall not be bid items; the costs shall be charged to other items unless a bid item is specifically included on the bid sheet.





NOTE:
THIS DETAIL APPLIES WHERE WATER MAIN IS INSTALLED UNDER FUTURE PAVING WITH EDGE DRAIN.

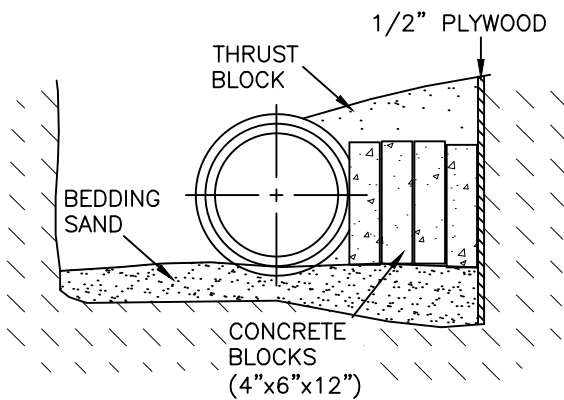
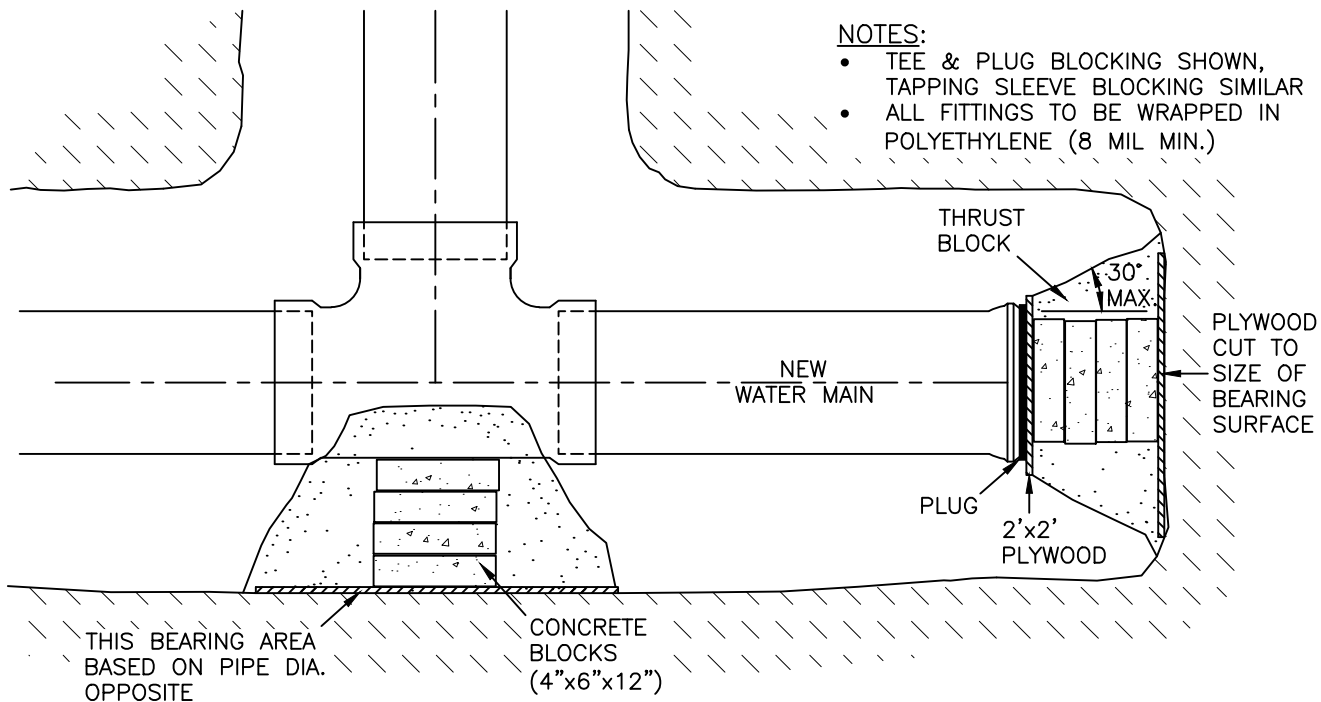
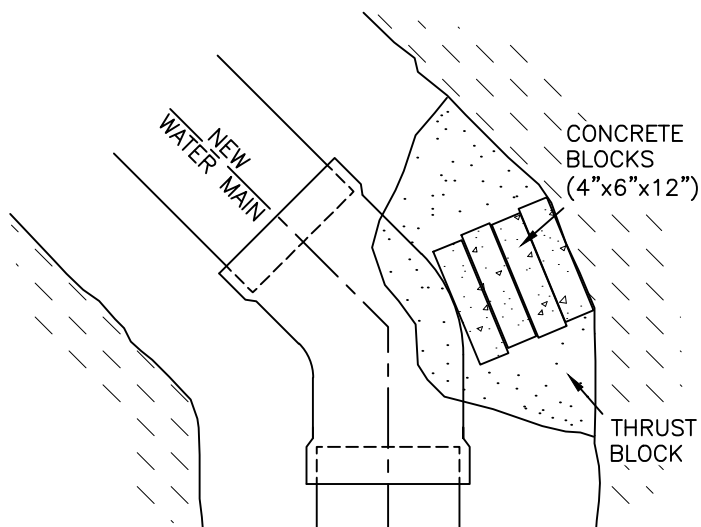


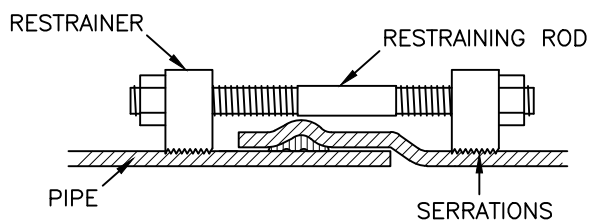
TABLE OF REQUIRED BEARING AREAS

PIPE SIZE	BEND ANGLE				TEE
	90°	45°	22-1/2°	11-1/4°	
4"	2' SQ.	2' SQ.	2' SQ.	2' SQ.	2' SQ.
6"	3' SQ.	2' SQ.	2' SQ.	2' SQ.	3' SQ.
8"	5' SQ.	3' SQ.	2' SQ.	2' SQ.	4' SQ.
10"	8' SQ.	4' SQ.	3' SQ.	2' SQ.	6' SQ.
12"	11' SQ.	6' SQ.	3' SQ.	2' SQ.	8' SQ.
16"	20' SQ.	11' SQ.	6' SQ.	4' SQ.	15' SQ.
18"	25' SQ.	14' SQ.	7' SQ.	4' SQ.	18' SQ.

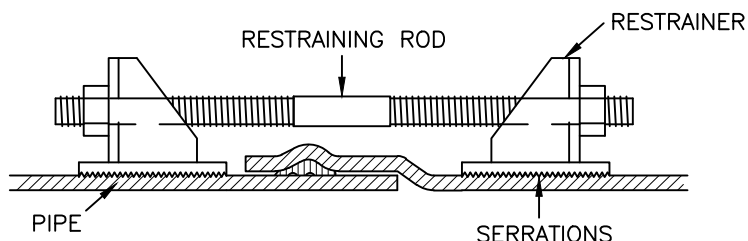
NOTES:

- CONCRETE BLOCKING TO BE POURED AGAINST UNDISTURBED EARTH. BELLS AND BOLTS TO BE KEPT FREE OF CONCRETE. CONCRETE IN PLACE TO BE INCLUDED IN PRICE BID FOR WATER MAIN.
- IF APPROVED BY THE ENGINEER, SOLID CONCRETE BLOCKS MAY BE USED FOR BLOCKING ON 8" DIA PIPE AND BELOW. 10" DIA. PIPE AND ABOVE WILL CONFORM TO CONCRETE POURED IN PLACE AREAS SHOWN ABOVE.

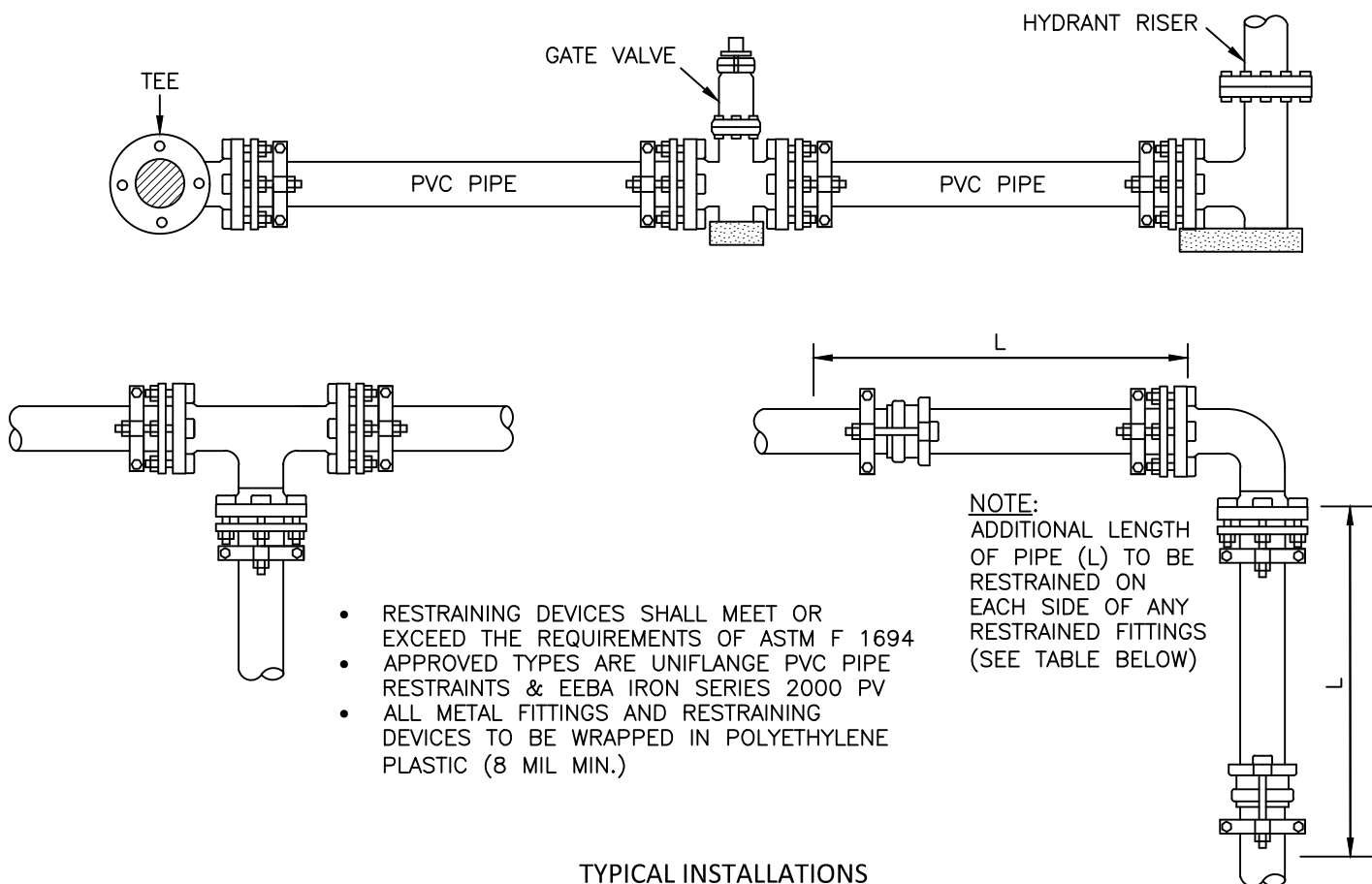




2" TO 12" DIA.



14" TO 36" DIA.



TYPICAL INSTALLATIONS

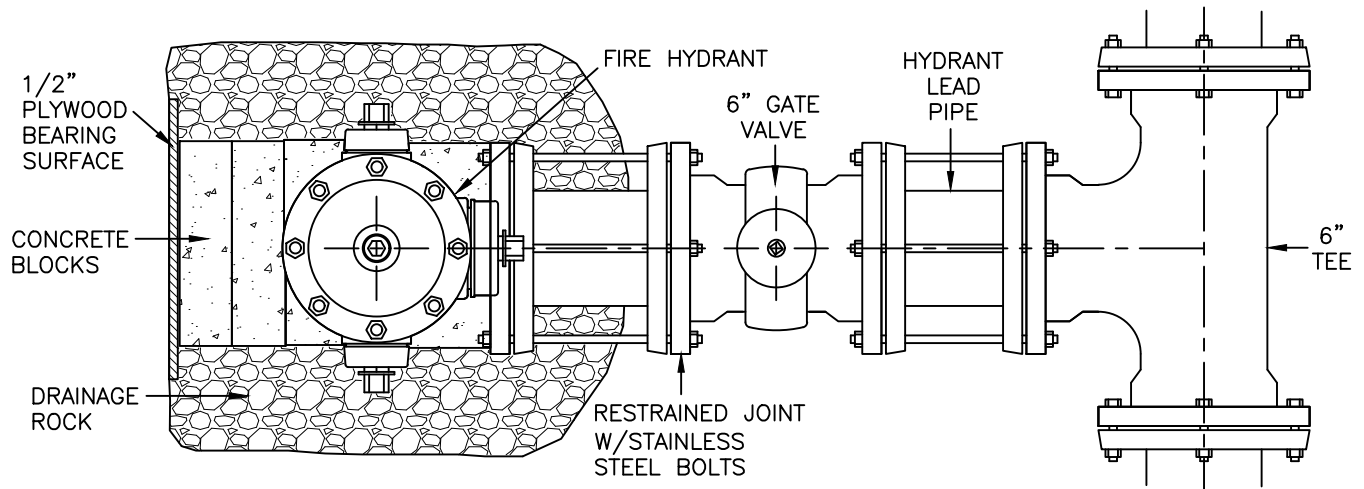
NOM. PIPE SIZE	90° BEND (L)	45° BEND (L)	22.5° BEND (L)	11.25° BEND (L)	SIZE ON SIZE TEE (L)*	VALVE/ DEAD-END (L)
6"	19'	8'	4'	2'	2'	35'
8"	25'	11'	5'	3'	13'	45'
10"	31'	13'	6'	3'	23'	55'
12"	36'	15'	8'	4'	33'	65'
16"	47'	20'	10'	5'	52'	84'

* RECOMMENDED RESTRAINED LENGTHS FOR TEES ARE FOR THE BRANCH OUTLET AND ASSUME A MINIMUM 10 FT. SECTION OF PIPE ATTACHED TO EACH SIDE OF THE RUN. RESTRAINT DEVICES ARE ALSO REQUIRED ON BOTH RUN JOINTS OF THE TEE ITSELF.

SIZE	45° VERT. OFFSET* (L)	22.5° VERT. OFFSET* (L)
6"	15'/8'	7'/4'
8"	19'/11'	9'/5'
10"	23'/13'	11'/6'
12"	27'/15'	13'/8'
16"	35'/20'	17'/10'

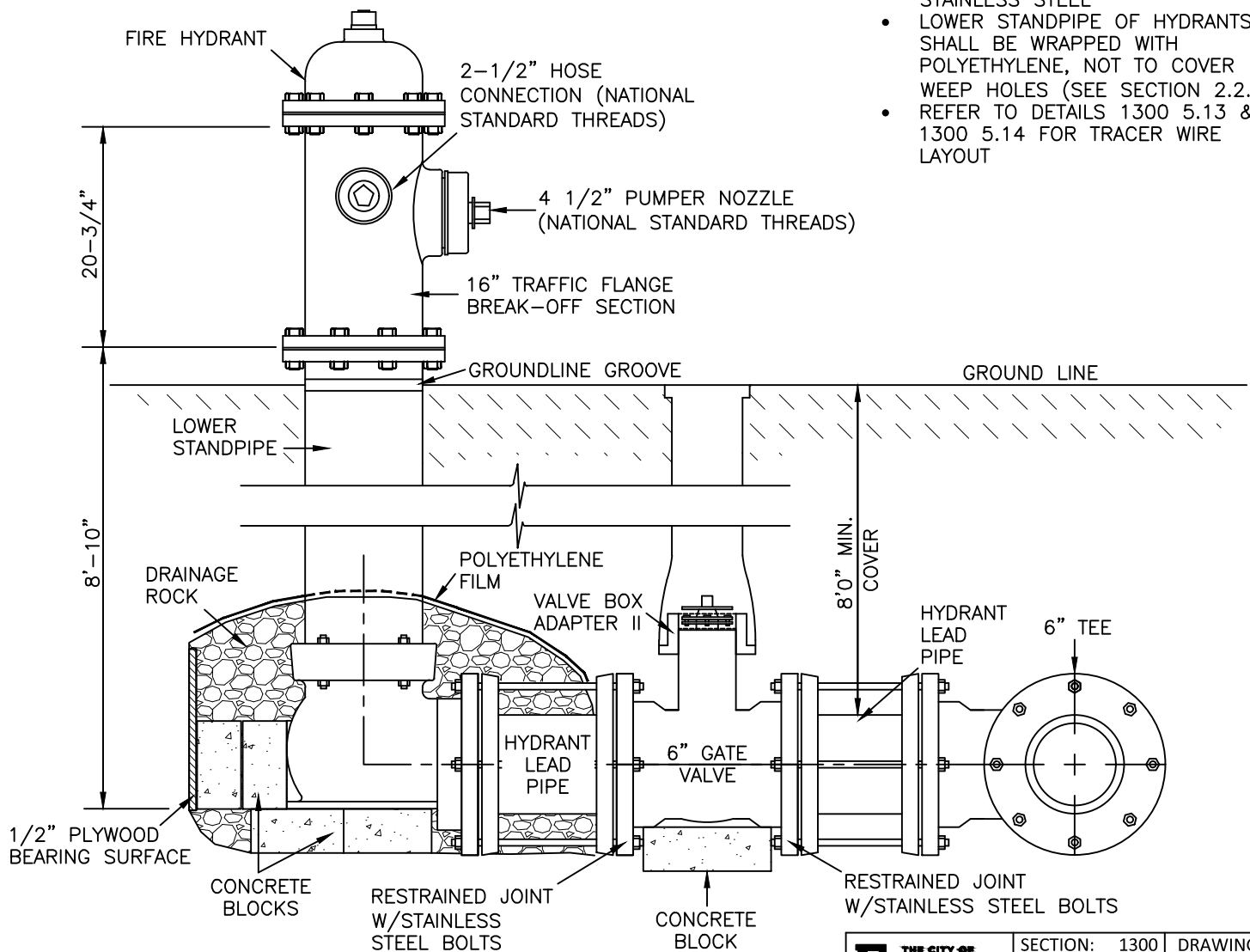
* FIRST NUMBER IS THE RECOMMENDED RESTRAINED LENGTH ON EACH SIDE OF THE DOWN BEND, THE SECOND NUMBER IS THE LENGTH FOR EACH SIDE OF THE UP BEND.

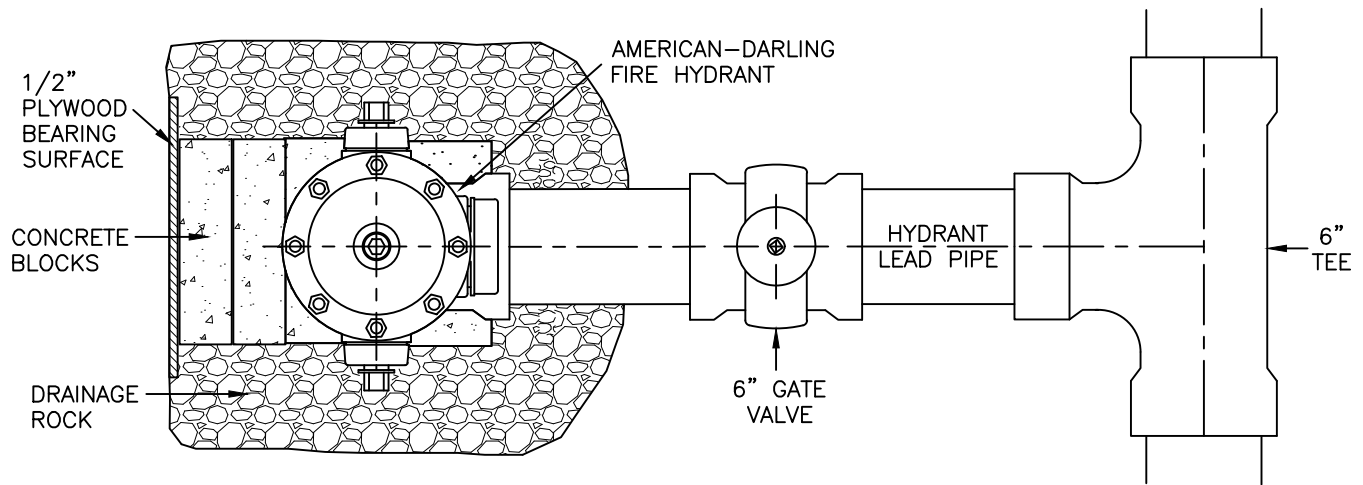
RESTRAINED LENGTHS OF PVC PIPE



NOTES:

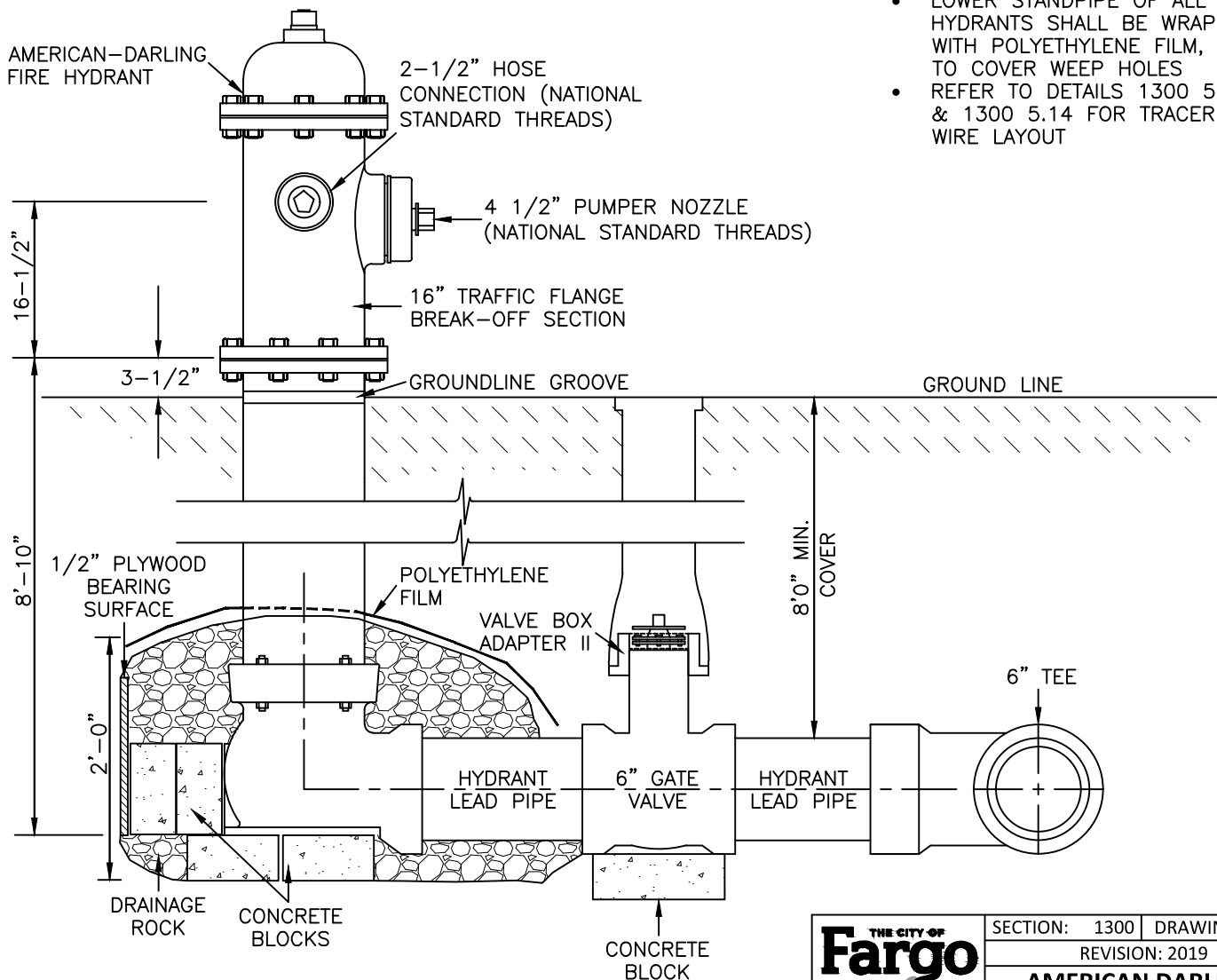
- OPERATING & CAP NUTS: CITY OF FARGO STANDARDS
- BOLTS BELOW GROUND SHALL BE STAINLESS STEEL
- LOWER STANDPIPE OF HYDRANTS SHALL BE WRAPPED WITH POLYETHYLENE, NOT TO COVER WEEP HOLES (SEE SECTION 2.2.6)
- REFER TO DETAILS 1300 5.13 & 1300 5.14 FOR TRACER WIRE LAYOUT

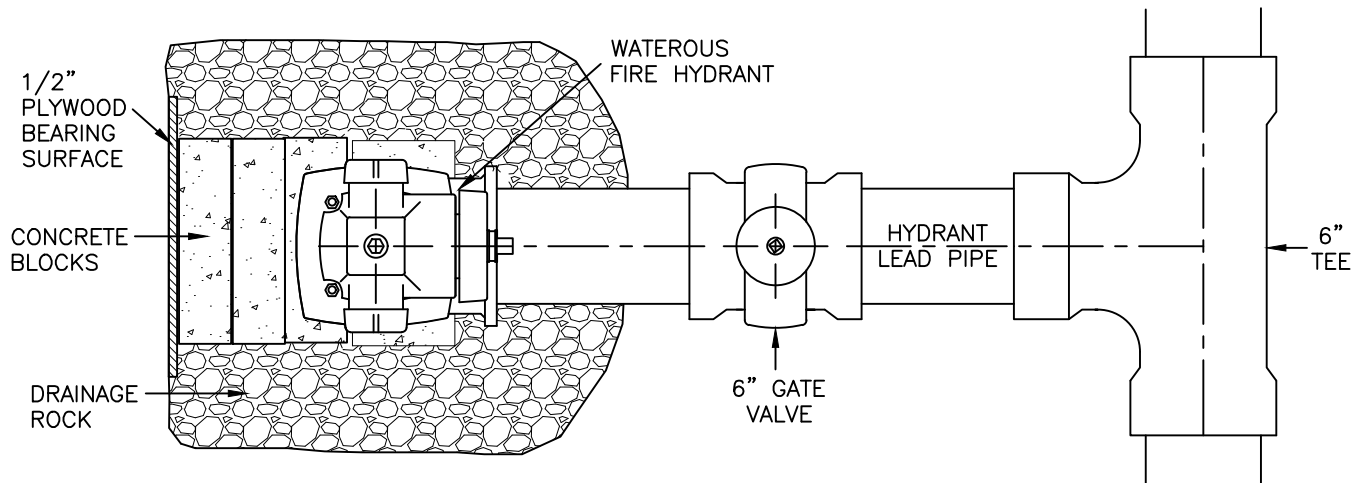




NOTES:

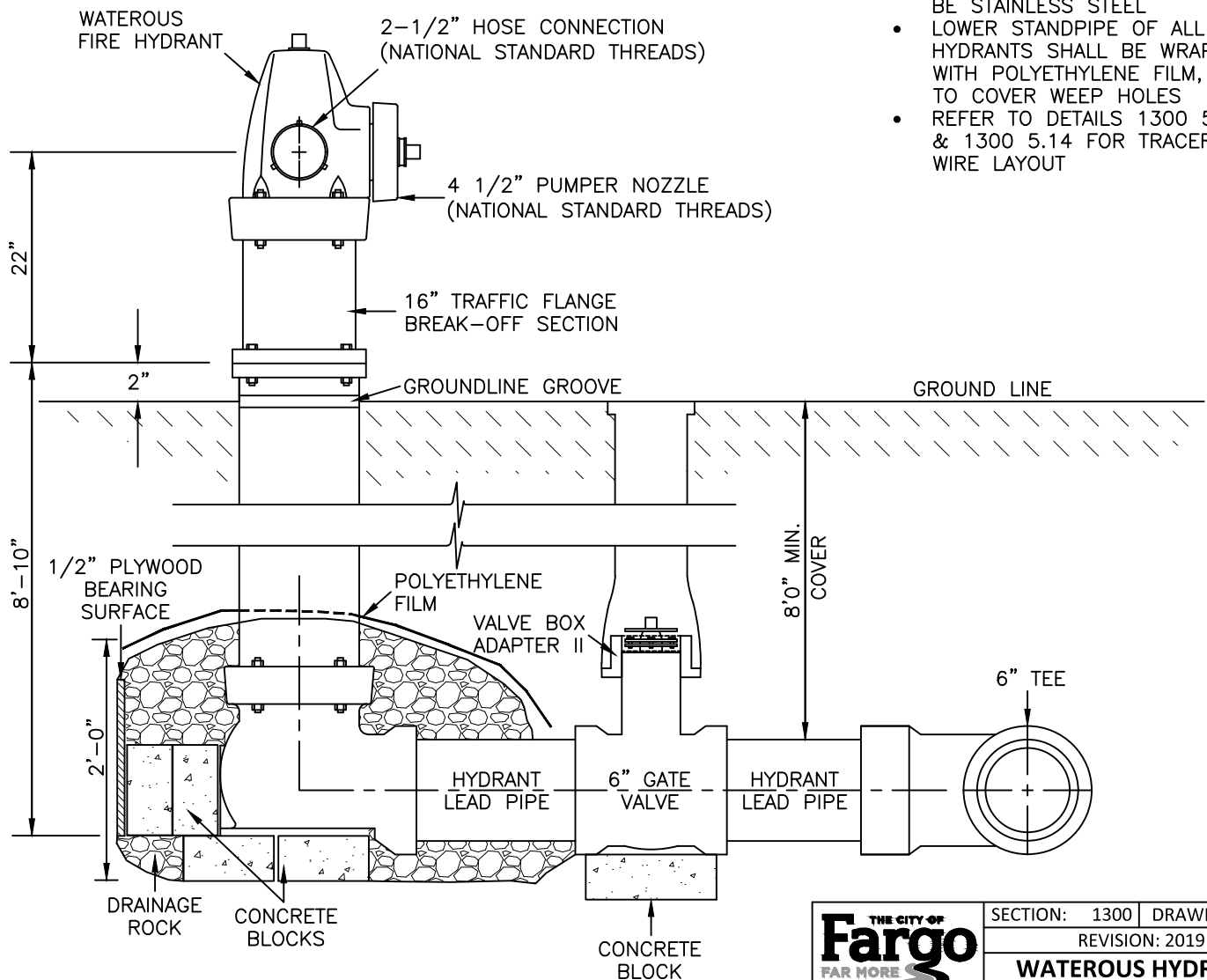
- OPERATING & CAP NUTS: CITY OF FARGO STANDARDS
- BOLTS BELOW GROUND SHALL BE STAINLESS STEEL
- LOWER STANDPIPE OF ALL HYDRANTS SHALL BE WRAPPED WITH POLYETHYLENE FILM, NOT TO COVER WEEP HOLES
- REFER TO DETAILS 1300 5.13 & 1300 5.14 FOR TRACER WIRE LAYOUT

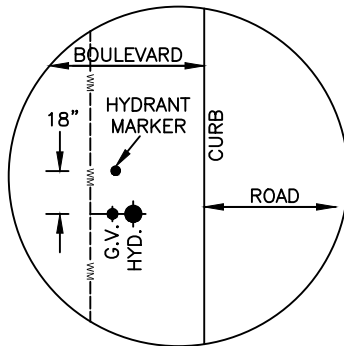




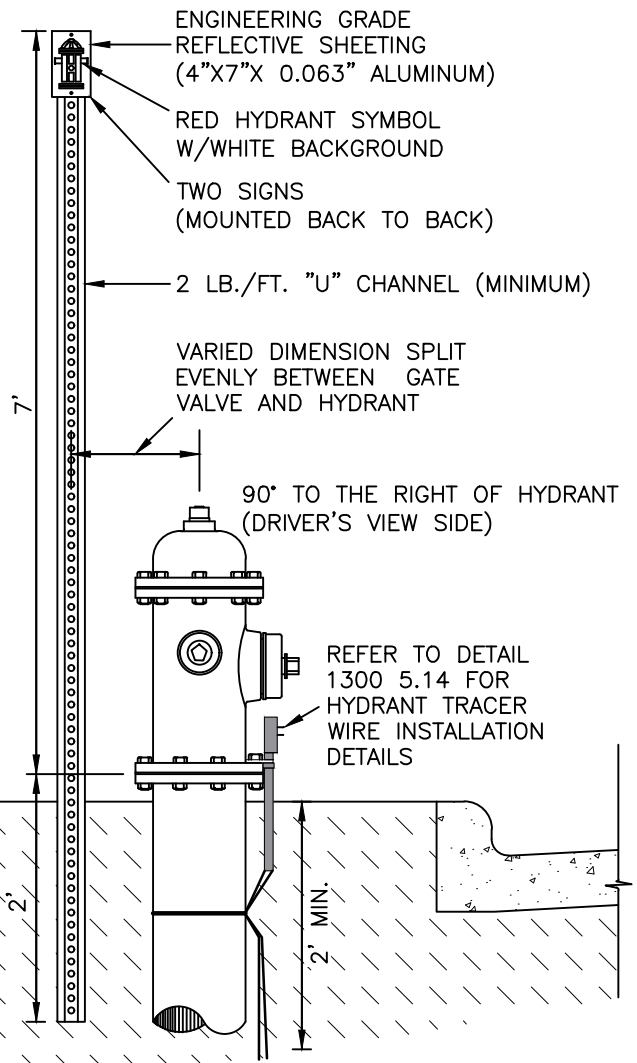
NOTES:

- OPERATING & CAP NUTS: CITY OF FARGO STANDARDS
- BOLTS BELOW GROUND SHALL BE STAINLESS STEEL
- LOWER STANDPIPE OF ALL HYDRANTS SHALL BE WRAPPED WITH POLYETHYLENE FILM, NOT TO COVER WEEP HOLES
- REFER TO DETAILS 1300 5.13 & 1300 5.14 FOR TRACER WIRE LAYOUT

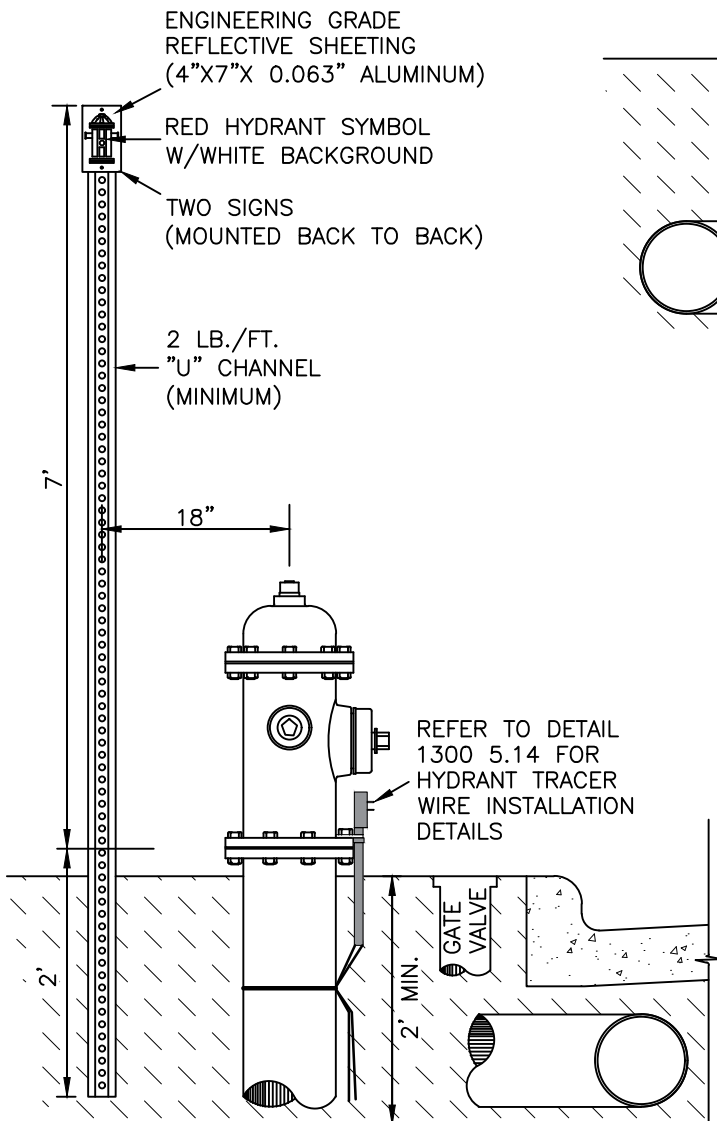




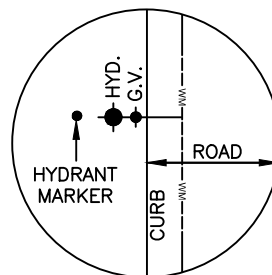
PLAN VIEW



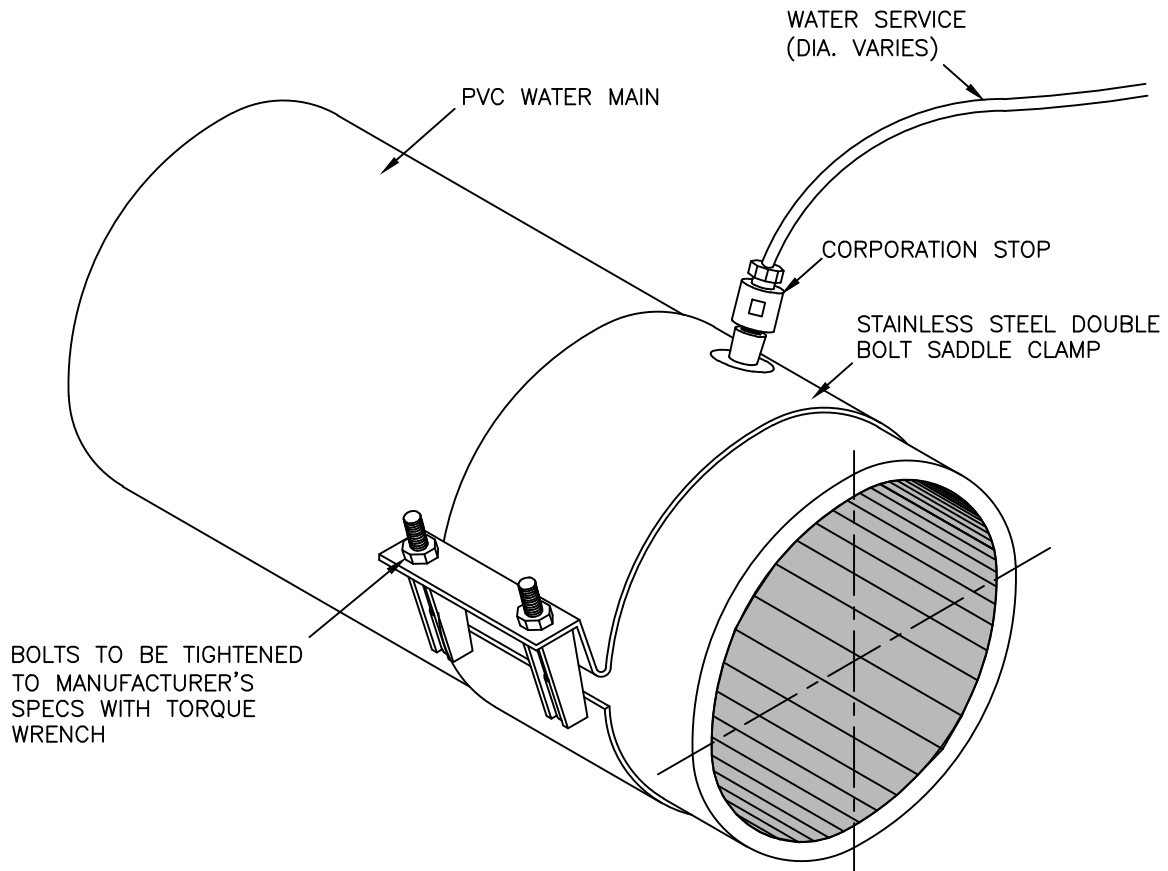
WATERMAIN IN BOULEVARD



WATERMAIN UNDER ROADWAY

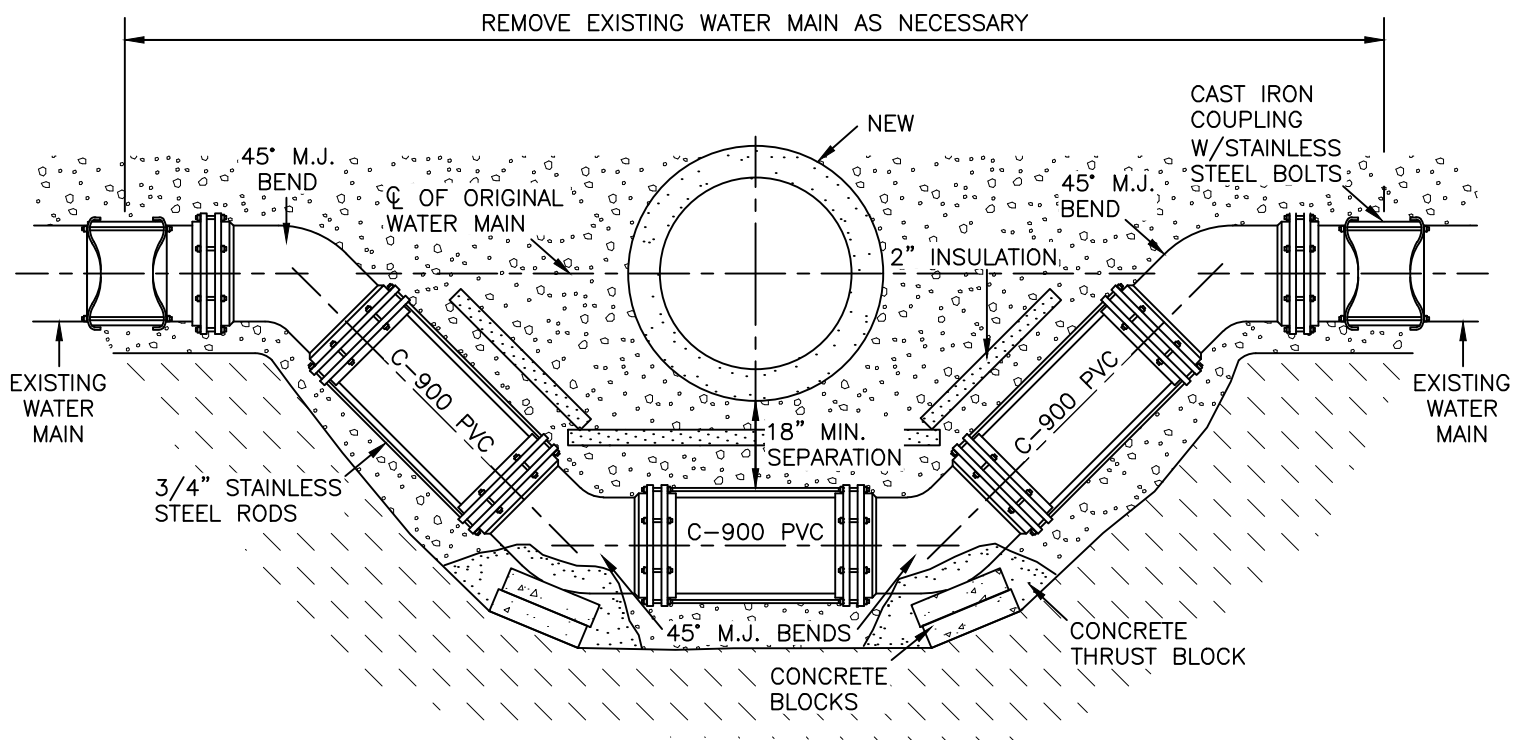


PLAN VIEW



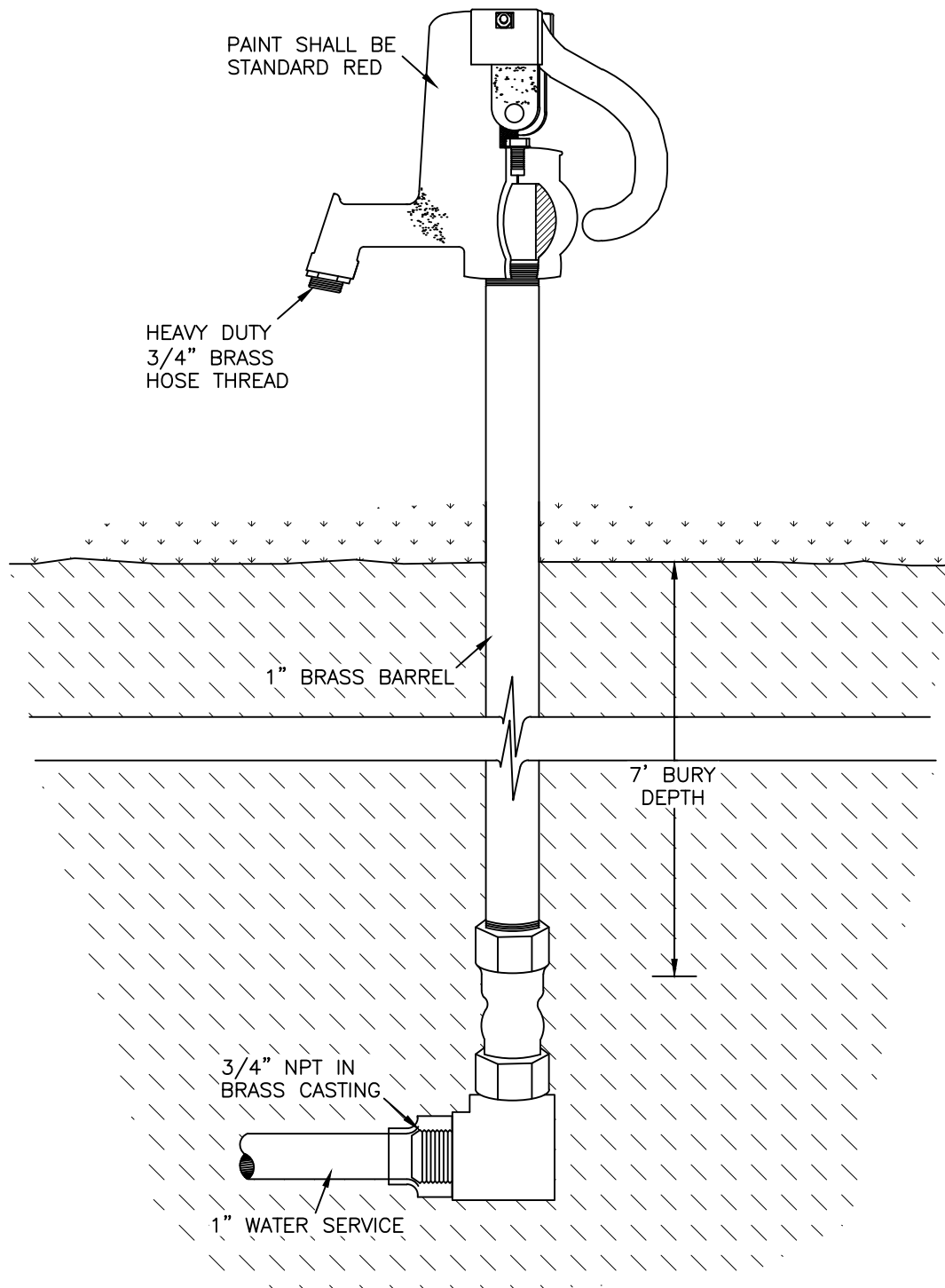
NOTES:

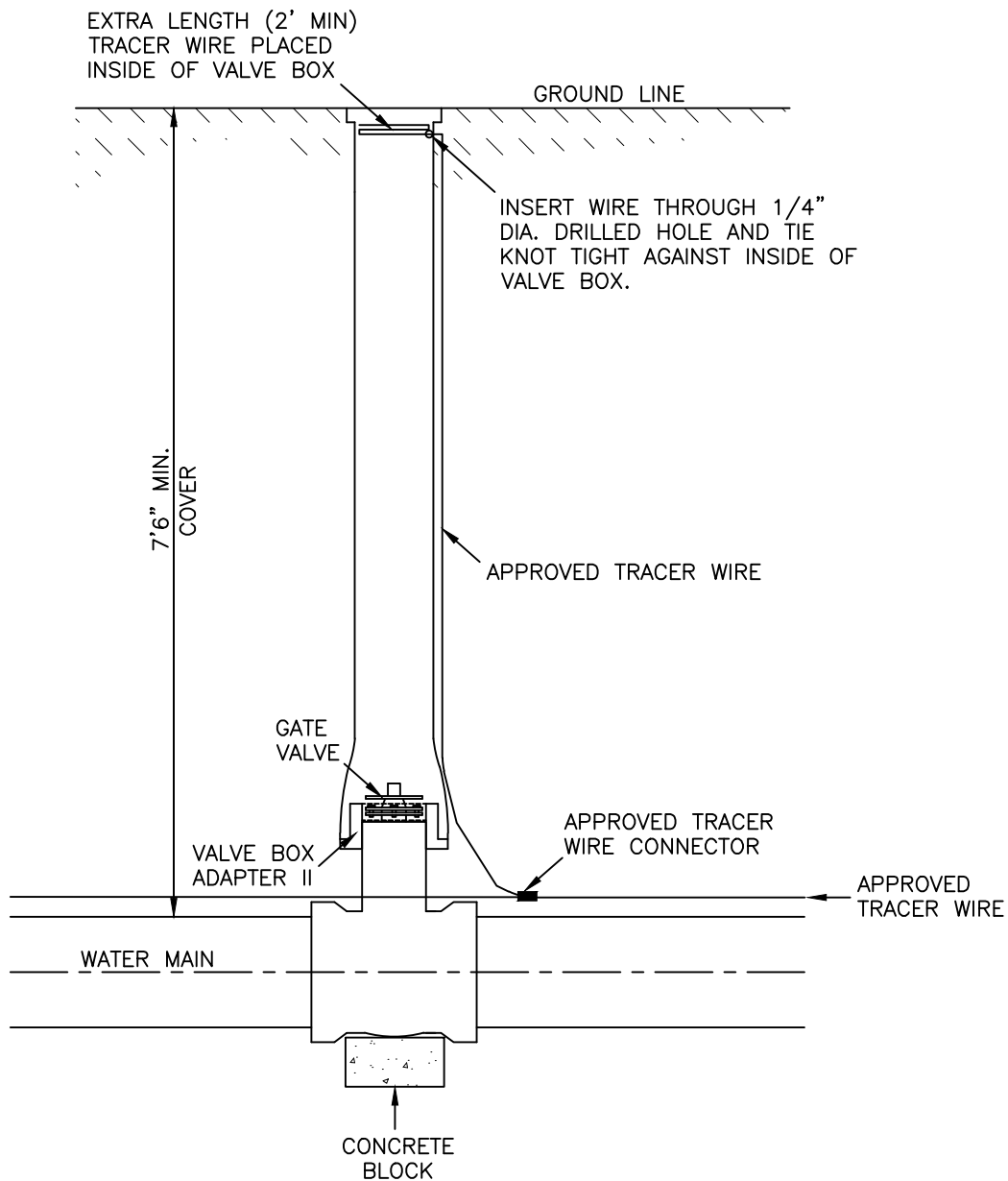
- THE CONTRACTOR WILL BE REQUIRED TO USE ALL STAINLESS STEEL SADDLE SERVICES. DIRECT TAPS WILL NOT BE PERMITTED.
- REFER TO DETAILS 1300 5.13 & 1300 5.14 FOR TRACER WIRE LAYOUT.



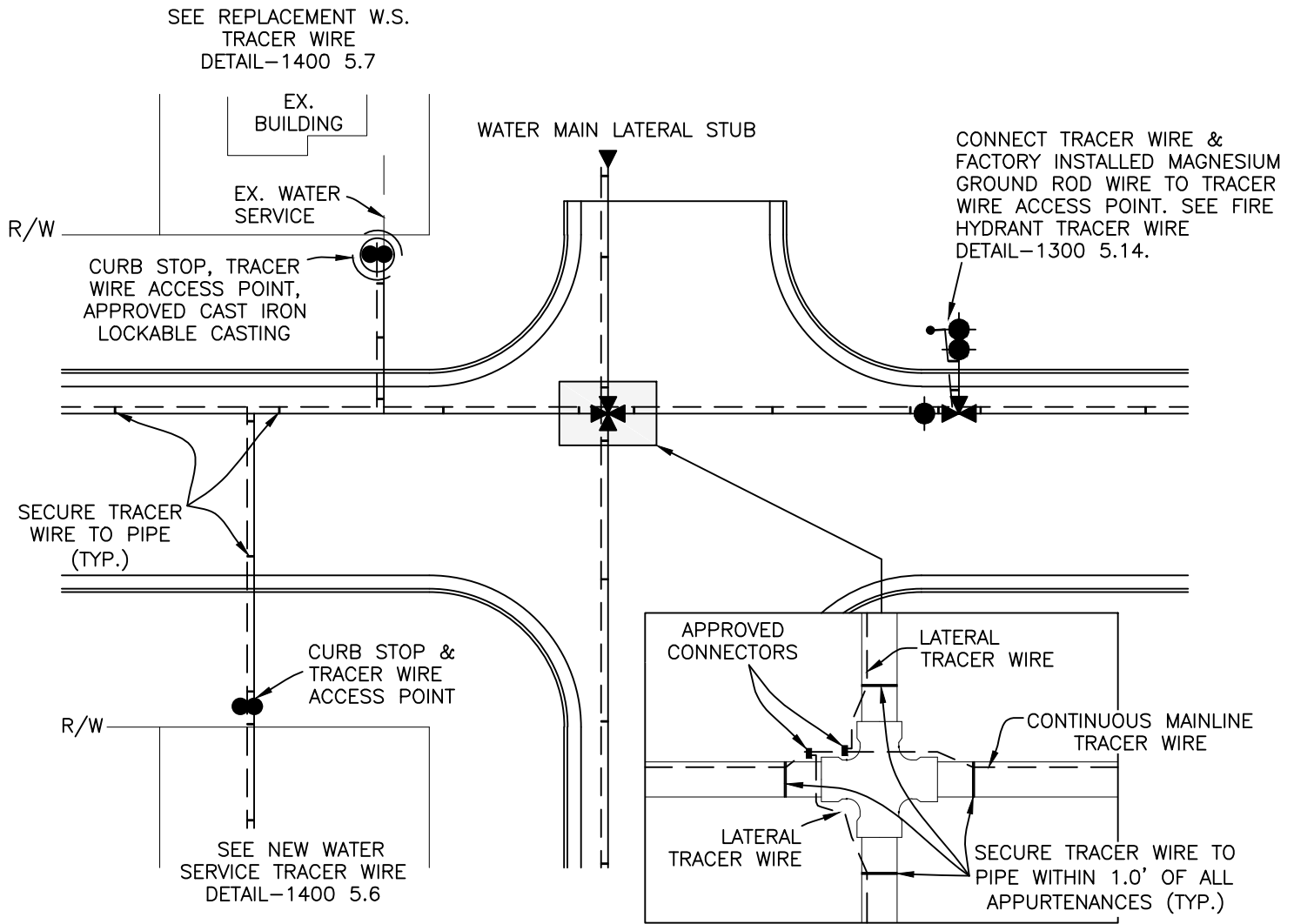
NOTES:

- ALL FITTINGS TO BE WRAPPED IN POLYETHYLENE PLASTIC (8 MIL MIN.)
- BELLS AND BOLTS TO BE KEPT FREE OF CONCRETE.
- ALL JOINTS TO HAVE RESTRAINING GLANDS WITH $\frac{3}{4}$ " STAINLESS RODS.



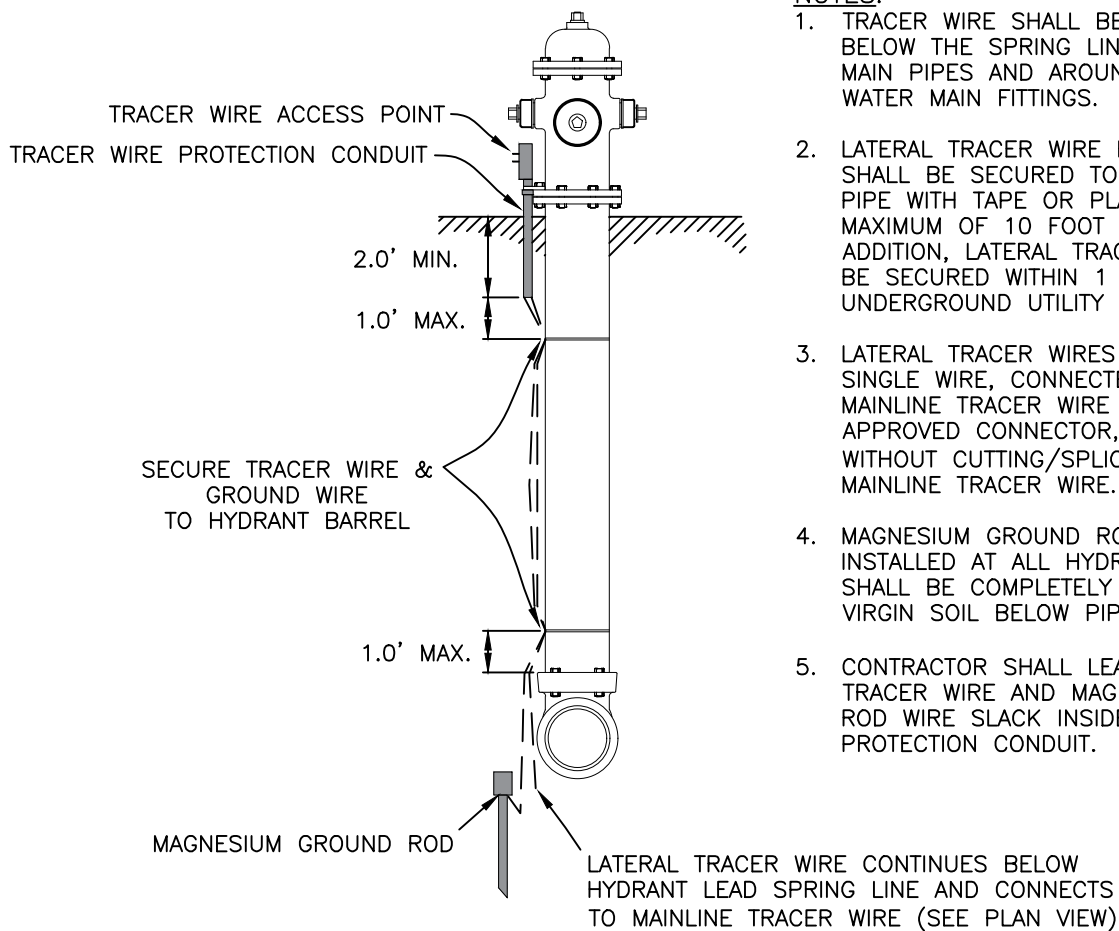


NOTE:
TRACER WIRE WILL NOT NORMALLY BE INSTALLED
VERTICALLY UP VALVE BOXES AS SHOWN. THIS
DETAIL APPLIES ONLY WHERE SPECIFICALLY
CALLED FOR ON THE PLANS OR AS DIRECTED
BY THE ENGINEER.



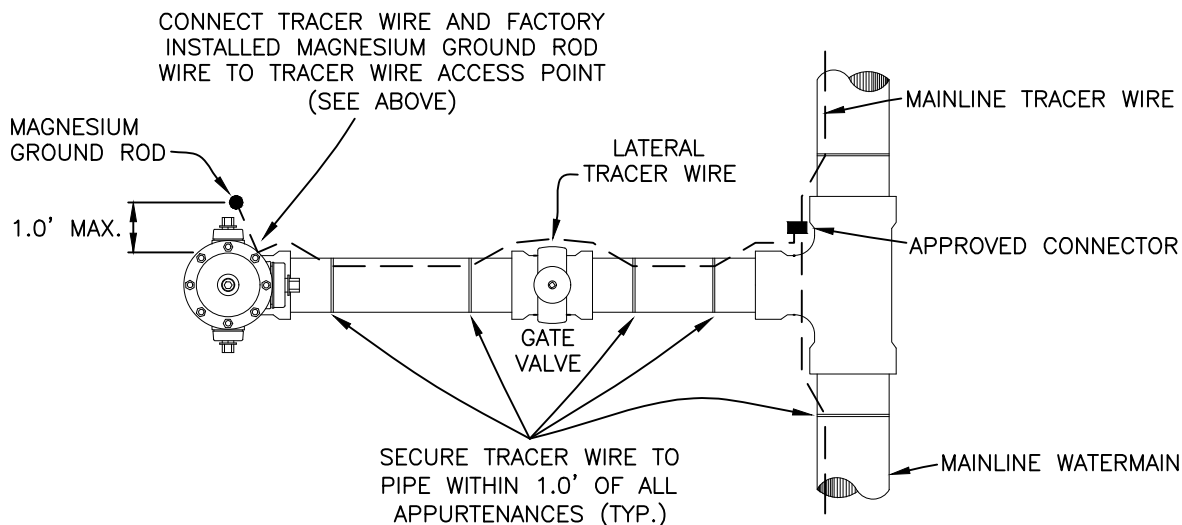
NOTES:

1. TRACER WIRE SHOWN AWAY FROM PIPE FOR CLARITY.
2. TRACER WIRE SHALL BE INSTALLED BELOW THE SPRING LINE OF WATER MAIN PIPES AND AROUND THE SIDE OF WATER MAIN FITTINGS.
3. MAINLINE TRACER WIRE SHALL BE SECURED TO THE MAINLINE PIPE WITH TAPE OR PLASTIC TIES AT EVERY PIPE BELL OR AT 20 FOOT INTERVALS, WHICHEVER IS LESS. IN ADDITION, MAINLINE TRACER WIRE SHALL BE SECURED WITHIN 1 FOOT OF ALL UNDERGROUND UTILITY APPURTENANCES.
4. LATERAL TRACER WIRE FOR WATER SERVICES SHALL BE SECURED TO THE WATER SERVICE PIPE WITH TAPE OR PLASTIC TIES AT A MAXIMUM OF 10 FOOT INTERVALS. IN ADDITION, LATERAL TRACER WIRE SHALL BE SECURED WITHIN 1 FOOT OF ALL UNDERGROUND UTILITY APPURTENANCES.
5. MAINLINE TRACER WIRE SHALL BE INSTALLED AS A SINGLE CONTINUOUS WIRE. SPLICES SHALL NOT OCCUR MORE FREQUENTLY THAN ONE PER 500 FEET.
6. LATERAL TRACER WIRES SHALL BE A SINGLE WIRE, CONNECTED TO THE MAINLINE TRACER WIRE USING AN APPROVED CONNECTOR, INSTALLED WITHOUT CUTTING/SPLICING THE MAINLINE TRACER WIRE.
7. MAGNESIUM GROUND RODS SHALL BE INSTALLED AT ALL HYDRANTS AND SHALL BE COMPLETELY DRIVEN INTO VIRGIN SOIL BELOW PIPE BEDDING.
8. ALL NEW CONSTRUCTION WATER SERVICES SHALL INCLUDE AN APPROVED TRACER WIRE ACCESS POINT.
9. WHEN CURB STOP BOX AND/OR TRACER WIRE ACCESS POINT ARE LOCATED IN A HARD SURFACED AREA THEY SHALL BE PLACED INSIDE AN APPROVED CAST IRON LOCKABLE CASTING.



HYDRANT - PROFILE VIEW
NOT TO SCALE

- NOTES:**
1. TRACER WIRE SHALL BE INSTALLED BELOW THE SPRING LINE OF WATER MAIN PIPES AND AROUND THE SIDE OF WATER MAIN FITTINGS.
 2. LATERAL TRACER WIRE FOR HYDRANTS SHALL BE SECURED TO THE WATER PIPE WITH TAPE OR PLASTIC TIES AT A MAXIMUM OF 10 FOOT INTERVALS. IN ADDITION, LATERAL TRACER WIRE SHALL BE SECURED WITHIN 1 FOOT OF ALL UNDERGROUND UTILITY APPURTENANCES.
 3. LATERAL TRACER WIRES SHALL BE A SINGLE WIRE, CONNECTED TO THE MAINLINE TRACER WIRE USING AN APPROVED CONNECTOR, INSTALLED WITHOUT CUTTING/SPlicing THE MAINLINE TRACER WIRE.
 4. MAGNESIUM GROUND RODS SHALL BE INSTALLED AT ALL HYDRANTS AND SHALL BE COMPLETELY DRIVEN INTO VIRGIN SOIL BELOW PIPE BEDDING.
 5. CONTRACTOR SHALL LEAVE 24" OF TRACER WIRE AND MAGNESIUM GROUND ROD WIRE SLACK INSIDE TRACER WIRE PROTECTION CONDUIT.



HYDRANT - PLAN VIEW
NOT TO SCALE