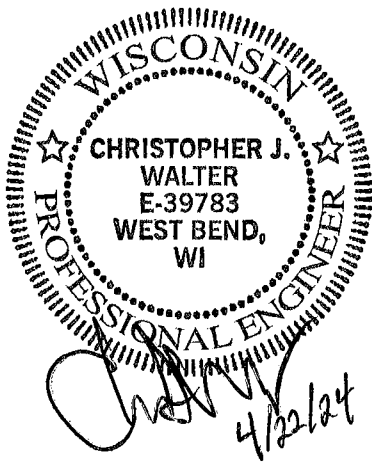


SPECIFICATIONS
FOR
WATER MAIN & SERVICE LATERAL MATERIALS
AND
THE INSTALLATION OF
WATER MAIN & APPURTENANCES
FOR
WAUKESHA WATER UTILITY
CITY OF WAUKESHA

April 22, 2024



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CHAPTER 1 – ADMINISTRATIVE PROCEDURES

1.0 Introduction

These instructions for Water Main and Service Lateral Materials and for the Installation of Water Main and Appurtenances establish a uniform standard for the design and construction of water main. These standards will promote consistent construction practices; and safeguard the interests of the Waukesha Water Utility by ensuring that all improvements are designed and constructed in conformance with sound engineering principles and accepted standards.

1.1 Title

This document shall be referred to as the "Specifications for Water Main and Service Lateral Materials and Installation of Water Main and Appurtenances for Waukesha Water Utility, City of Waukesha".

1.2 Jurisdiction

The review and approval of engineering designs, plans, and specifications by the Utility for water main improvements is not exclusive. Other public agencies have review jurisdiction, including but not limited to the City of Waukesha, the Wisconsin Department of Natural Resources, the Waukesha County Department of Public Works, the Wisconsin Department of Transportation, the Department of Industry, Labor, and Human Relations, the Public Service Commission of Wisconsin, and the Army Corps of Engineers. These specifications are not a substitute for the requirements of other public agencies having review jurisdiction.

The design engineer must conform not only to the requirements of the Utility, but to the legal requirements of all public agencies who may have review jurisdiction and issue permits or require bonds or other securities in order to construct public improvements. This manual does not relieve the design engineer of the responsibility to use acceptable engineering principles or to comply with all Federal, State, and Local laws and codes.

All water mains shall be designed and constructed to the standards established in these specifications and the manual of Standard Specifications for Sewer and Water Construction in Wisconsin. In the event of a discrepancy between the Utility specifications and the Standard Specifications for Sewer and Water Construction in Wisconsin, the Utility specifications will govern.

1.3 Definition of Terms

ASTM: American Society for Testing and Materials.

As-Built Drawings: Design plans reviewed in the field and revised to show actual construction dimensions and quantities. The plans shall specify the location of all improvements where installed and include a description of the item including the type, make, materials used and any unusual characteristics.

Bond: Any form of security approved as to form and amount by the city, including a cash deposit, surety bond, letter of credit, collateral, or other instrument of credit.

Building or Structure: Anything constructed or erected, the use of which requires more or less permanent location on ground or attached to something having permanent location on the ground. This does not include public utility fixtures and appurtenances.

Change Order: Utility's written approval on any changes, additions, or deletions to the approved contract documents.

City: The City of Waukesha, Wisconsin, and where appropriate, its Common Council, commissions, committees, and authorized officials.

Common Council: The aldermen and Mayor of the city.

Construction Site Best Management Practices Handbook: Refers to the manual of the same title, current edition, published by the Wisconsin Department of Natural Resources.

Contract Documents: Includes the notice to bidders, instructions to bidders, bid proposal, affidavit of organization and authority, listing of subcontractors, bid bond, contract, performance bond, detailed specifications, general specifications, standard specifications, state specifications, construction plans, special provisions, wage rates, agency permits, addenda, and notice to proceed. Also included are any contract change orders and agreements that are required to complete construction in an acceptable manner, including any authorized extensions, all of which constitute one instrument.

Contractor: An individual, company, firm, or other party or organization who contracts to construct all or a portion of a project.

Design Engineer: A qualified professional engineer registered in the State of Wisconsin responsible for the design and preparation of contract documents.

Developer: Any person, firm, corporation, agent, partnership, or entity that seeks to improve land in accordance with the city's development regulations.

Development: A man-made change to improved or unimproved real estate.

Developers Agreement: A legally binding Agreement for the development between the Water Commission and the Developer.

Easement: The area of land set aside or over or through which a liberty, privilege or advantage in land, distinct from ownership of the land, is granted to the public or some particular person or part of the public.

Inspector: An individual or firm appointed or employed by the Utility as the authorized representative of the Utility assigned to inspect construction and to ensure compliance with approved plans and specifications.

Erosion Control: Any method or means of controlling sediment or runoff from a construction site, as specified in the "Construction Site, Best Management Practices" Handbook, a Department of Natural Resources publication.

Gradient or Percent of Grade: The vertical rise in feet per 100 feet of horizontal distance. (A 1% grade is a rise of 1 foot in 100 feet, for example.)

General Specifications: General Specifications of the City of Waukesha, Engineering Division, Latest Edition

Manual: This document, entitled "Specifications for the Installation of Water Main and Appurtenances for Waukesha Water Utility of the City of Waukesha"

Owner: Any government, firm, association, partnership, private corporation, public or quasi-public corporation, or a combination of any of them, or other legal entity having sufficient proprietary interest in the land to be subdivided to commence and maintain proceedings to subdivide.

Parcel: A lot or tract of land.

Plans: The approved plans, profiles, typical cross sections, working drawings, supplemental drawings, or exact reproductions that show the location, character, dimensions, and details of the work to be done.

Punch List: A list of deficiencies requiring corrective action before final payment or acceptance of the project.

Right-of-Way (ROW): A public way dedicated to the public for its intended use.

Road or Roadway: The paved and shoulder areas or paved and curbed areas within the street ROW.

Standard Specifications: Refers to the Standard Specifications for Sewer and Water Construction in Wisconsin, current edition and its revisions, prepared by a committee of municipal engineers, consulting engineers, suppliers, and contractors for the purpose of suggesting standards for the design and construction of sanitary sewer, storm sewer, and water main.

State Specifications: Refers to the Standard Specifications for Highway and Structure Construction, State of Wisconsin, Department of Transportation, current edition and its supplements.

Subdivider: Any person, firm, corporation, agent, partnership, or other entity that divides or proposes to divide, by plat or certified survey, or re-plat land in any manner.

Subdivision: Subdivision is a division of a lot, parcel, or tract of land by the owner or the owner's agent for the purpose of sale or of building development where:

- The act of division creates five or more parcels, lots, or building sites of 1½ acres each or less; or
- Five or more parcels, lots, or building sites of 1½ acres each or less in area are created by successive divisions within a period of five years.

Utility: The City of Waukesha Water Utility and/or the designated representative of the City of Waukesha Water Utility, Waukesha, Wisconsin.

Utility Commission: The Waukesha Water Utility Commissioners of the City.

Water main: Buried pipe located in right-of-way or easement by which water is delivered to more than one customer.

Water system: Any aggregate of piping and appurtenances associated with furnishing public water supply to the customers of the Utility.

Wisconsin Administrative Code: The rules of administrative agencies having rule-making authority in Wisconsin, published in loose-leaf, continual revision system, as directed by Section 35.93 and Chapter 227 of the Wisconsin Statutes.

1.4 Construction Specification Requirements

The detailed construction specification requirements for all water main will be outlined in the contract documents. Technical specifications, as discussed in this document, are requirements of the Utility and must be adhered to in the preparation of engineering drawings. The design engineer must also follow the appropriate specific sections of the most recent editions, including but not limited to:

- Standard Specifications for Sewer and Water Construction in Wisconsin, Standard Specifications
- State Standard Specifications for Highway and Structure Construction in Wisconsin, State Specifications
- American Society for Testing and Materials, ASTM Standards
- American Water Works Association, AWWA Standards
- Manual of Uniform Traffic Control Devices, MUTCD Standards
- Construction Site Best Management Practices

1.5 Required Documents for Review Approval

The design engineer must submit the following documents to the Utility, along with a letter of transmittal listing the items being submitted and requesting review and approval of the project. The design engineer may supplement the documents with any additional data necessary to help the Utility review a proposed project. Should the design engineer want or need any document returned for his/her files, an additional set must be included and marked "for return to the design engineer."

The Utility requires that all engineering plans be neat and clean, readable, and well organized. Engineering plans shall be coordinated as follows: (Please note that PDF plans are generally acceptable, however hard copies must be provided upon request as outlined below)

- Title Sheet: Including location map, north arrow, legal description, project name, project number, city datum benchmarks, index of sheets, legend, developer's name, and engineer's seal and signature.
- Plan and Profile Sheets: Indicating all information specified in this manual
- Detail Sheets: Indicating all construction details, notes and specifications.

The design engineer must submit all documents for review and approval to the Utility in two parts. The first (preliminary) submittal shall be sent to the Utility for review and comment. The second shall be the revised plans submitted for approval. The following documents must be included in the first (preliminary) submittal:

- Engineering Plans 2 sets
- Construction Documents and Specifications 2 sets
- Design Computations 2 sets
- Plat of Subdivision (if applicable) 2 sets
- Soil Boring Report (if borings taken) 2 sets
- Preliminary Construction Cost Estimate 2 sets
- Miscellaneous Data (system plans, exhibits) 2 copies

After reviewing the first submittal, the Utility will send to the design engineer comments on any items that do not meet the city requirements or that require revisions, additions, or clarifications to the engineering plans and contract documents. The design engineer must then revise the engineering plans and make a second submittal to the Utility for review and approval purposes.

The second submittal shall include the following documents:

- Final Engineering Plans 2 sets
- Engineering Specifications 2 sets
- Detailed Cost Estimate 2 sets
- Revised Design Calculations 2 sets
- Permit Application As required by agency
- AutoCAD files in electronic format 1 copy

Once the final plans are revised, the Utility will request the signed plans for approvals. The design engineer is responsible for plan set reproduction for record copy, bidding, and construction purposes. The design engineer shall make all submittals to the other agencies not requiring a Utility signature. Wisconsin Department of Natural Resources Water Main extension permit will be filled out and submitted for approval to the Department of Natural Resources by the Owner or their design engineer. An Owner Letter will be provided by Waukesha Water Utility following approval of plans. Any other agency application that requires a city signature shall be prepared by the design engineer, delivered to the Utility, and sent to the agency by the Utility.

1.6 Plan Revision

Once the plans are approved, any deviations shall require a written change order signed by the Utility. Any revisions that occur because of field construction conditions must be reported to the Utility by the design engineer, developer, or engineering inspector immediately after they are discovered. Should the Utility consider the required changes to be major, the Utility shall issue a stop work order until revised drawings are submitted and approved.

1.7 Project Completion, Acceptance, Dedication, and Financial Reconciliation

Following project completion, the design engineer, developer, or contractor shall initiate the acceptance of those public improvements by notifying the Utility. The notification must be made in writing.

The Utility will conduct a final inspection, prepare a punch list of the deficiencies, and send it to the design engineer, the developer, and contractor. This inspection will not be started until all pavement, curb, gutter and sidewalk (where required) are installed and the water main is in an approvable state.

Final inspections are only scheduled between April 1st and October 15th of each year, unless otherwise approved by the Utility.

All public improvements should be in an approvable state when the final inspection is requested. If there are five unique deficiencies noted during the final inspection, the inspection may be terminated. A re-inspection will not be allowed for at least 10 days. All costs associated with the re-inspection will be the responsibility of the developer.

After receiving a punch list, the noted deficiencies shall be remedied to meet the Utility's requirements. If the deficiencies are not resolved within thirty (30) days, the list will become null and void, and a re-inspection by the Utility will be prepared.

When the items have been corrected, the Utility will provide a letter to design engineer, the developer, and contractor stating the deficiencies have been corrected.

The developer will then complete the dedication and financial reconciliation process as outlined in their Developers Agreement with the Utility.

1.8 Application of new or revised standards

When new or revised standards and/or specifications have been adopted by the Utility, work on public improvements not begun within 6 months of the date of the development agreement, plans or permit approval, shall be made to the new or revised standards and/or specifications.

CHAPTER 2 - APPROVALS, INTERPRETATIONS AND EXCEPTIONS

2.0 Approvals

No water supply improvements shall be constructed until the plans are formally approved by the Water Utility Commission and any other agency having jurisdiction.

2.1 Interpretation

The provisions of this manual are considered minimum requirements.

Where the conditions imposed by this manual differ from comparable conditions imposed by any other ordinance, law, resolution, rule, or regulation of any kind, the regulations that are more restrictive or that impose higher standards or requirements shall govern.

The Utility reserves the right to interpret and make determination with regard to all rules and regulations.

2.2 Exceptions and Variations

In cases where the design engineer can demonstrate, in writing, with engineering rationale and data that a provision of these regulations, if strictly adhered to, would cause unnecessary hardship because of topographical or other conditions particular to the site, and that a departure may be made without destroying the intent of such provision, the Utility may approve a variation or modification of the required standard or regulation.

CHAPTER 3 – GENERAL REQUIREMENTS

3.0 Introduction

All developments within the corporate limits or under the control of the Utility shall include provisions for the construction of water distribution facilities designed according to these specifications.

Water main and water service lateral construction consists of excavating the required trenches and tunnels; laying the required pipe, fittings, special castings, valves, valve boxes, hydrants, structures and appurtenances; at the locations and to the required lines and grades; backfilling and compacting the trenches; and restoring the site of the work; all as shown on the drawings and provided by the Contract.

The work consists essentially of the following items:

- Making the necessary excavations, preparing the necessary foundations, inspecting materials, laying pipe, doing the necessary bracing, pumping, backfilling, compacting, installing polyethylene encasement, installing tracer wire, etc.
- Furnishing all tools, equipment, and material (except such as are specifically listed herein) necessary for the laying in complete working order the mains and services described.
- Cutting pipes, making joints and all required connections, connecting bonding straps and/or tracer wire, providing concrete thrust blocking; setting and adjusting all valves, hydrants, and other appurtenances described in these Specifications.
- Making the tap, installation of corporation stops, laying of pipe, installation of curb stop and curb box or valve box, as required and all compaction and backfill necessary to complete the installation of services laterals for new water mains.
- Providing the ditch and trench shield for the Water Utility to make the tap, providing traffic control, setting the valve box, laying the pipe and all compaction and backfill necessary to complete pressure taps to existing water mains.
- Repairing any and all damage caused to sewers, gas, telephone, or power facilities, or any other obstructions encountered in the prosecution of the work.
- Testing and disinfecting the mains.
- Backfilling and compacting trenches, clearing roads and grounds of all rubbish and refuse caused by the above work, resurfacing all gravel or stone roadways and providing concrete and asphalt concrete street patches as directed.

All work done and materials used in connection with any water main extension installation, water main tapping, and the installation of service pipes and appurtenances from the water distribution system shall be in accordance with the requirements of the Waukesha Water Utility, American Water Works Association specifications, American Standards Association specifications, Standard Specifications, State Specifications, General Specifications and this Manual.

3.1 Equipment

Equipment and tools necessary for performing all parts of the work shall be satisfactory as to design, capacity, and mechanical condition for the purposes intended. Any equipment which is not maintained in full working order, or which as used by the Contractor is inadequate to obtain the results prescribed, shall be repaired, improved, replaced, or supplemented to obtain the progress and quality of work contemplated by the Contract.

3.2 Testing

Upon completion of the water main installation, the water main will undergo hydrostatic pressure testing and water quality bacteriological testing. The water main will also be tested for electrical conductivity through the tracer wire. The repair of all defective work will be at no additional cost to the Waukesha Water Utility.

3.3 Finishing Work and Maintenance

Maintain all trenches in an acceptable and safe condition suitable for traffic throughout the work. At the completion of the work, the condition of all trenches shall be satisfactory to the Engineer. Repair all concrete, asphalt, and gravel pavements; stone flagging or paving; sidewalks, curbs and gutters; culverts; fences; or other structures damaged or displaced during construction. Surfaces shall be rebuilt or re-laid properly to the original line and grade in accordance with pertinent parts of these Specifications, City of Waukesha Public Works Standard Specifications, or in the absence of applicable specifications, to original condition.

Maintain all repaired, restored, or replaced asphalt and gravel surfaces until final acceptance of the project by the Waukesha Water Utility. Repair, restore or replace all failures occurring during the guarantee period at no additional cost to the Waukesha Water Utility.

Prior to final acceptance by the Engineer, clean and grade the project area.

Unless otherwise provided, costs of the work included in this Article shall be included in the unit prices bid for the Contract items with which such work is associated. Final payment will be withheld until such work is completed in a manner satisfactory to the Engineer.

3.4 Repairs and Replacement

Unless noted otherwise herein, all pipe repairs shall be made by replacement of the defective pipe section with new pipe meeting these Specifications. Alignment, grade, bedding and backfilling shall conform to the requirements of these Specifications. Notify the Water Utility a minimum of twenty-four (24) hours prior to beginning any repair or replacement work, including the raising or facing of hydrants.

Make all field cuts of all types of pipe with an approved mechanical pipe cutter or with a power saw in order to make a straight, true cut without chipping and cracking the pipe. For joining the replacement sections, use approved fittings conforming to the requirements of these Specifications. In no case will concrete encasement of defective pipe be allowed. These repairs shall include total and complete restoration of any disturbed surface to original or better than original condition, regardless of improvements on lands where the repair is required.

CHAPTER 4 - MATERIALS

4.0 Introduction

Unless otherwise shown on the drawings or specified in the Contract, the materials furnished and installed in the work shall conform to the requirements specified herein for the type and class for material named. Inspect all materials when delivered to the job site. Materials found to have cracks, flaws, or other defects will be rejected, and shall be promptly removed from the site of the work.

Unless otherwise directed by the Engineer, all pipes and accessories furnished by the Contractor shall be unloaded, hauled, and distributed to the point of installation by the Contractor. Pipes and accessories furnished by the Waukesha Water Utility will be unloaded in an area designated by the Contractor and acceptable to the Waukesha Water Utility that is accessible and convenient to the job site. The Contractor shall distribute materials to the actual point of installation as part of the work. All pipe and fittings shall be protected from dirt, dust and contamination during storage on the job site. Handle the materials with care to avoid damage. Do not drop or bump materials against the ground, other stored pipes and accessories or any other objects on the ground.

Unless otherwise specified, references to various standard specifications and test methods shall be understood to mean the specifications or test method which is current on the date of advertisement for bids.

Prior to use, all proposed substitutions of equivalent material must be approved in writing by the Engineer. The Engineer reserves the right to reject any materials not meeting these Specifications as being defective.

4.1 Minimum Standard

All materials shall be NSF 61 certified, meet or exceed ANSI/AWWA standards and these specifications prepared by the Waukesha Water Utility.

4.2 Water Main

4.2.1 – Water Main – Installed using traditional trench methods

All water main 16" and larger shall be ductile iron pipe conforming to ANSI/AWWA C151/A21.51 – Latest Revision, (Thickness Class for 16" is Class 52, for 20" is Class 52 and for 24" is Class 52) cement mortar-lined, push-on joint and shall meet the requirements of Chapter 8.18.0 of the Standard Specifications.

All water main 12" and smaller shall be either ductile iron pipe conforming to ANSI/AWWA C151/A21.51 – Latest Revision, Thickness Class 52, cement mortar-lined, push-on joint and shall meet the requirements of Chapter 8.18.0 of the Standard Specifications, or shall be Polyvinyl Chloride (PVC) conforming to ANSI/AWWA C900 – Latest Revision, DR-18, push-on joint and shall meet the requirements of Chapter 8.20.0 of the Standard Specifications.

All new ductile iron pipe will require conductivity straps at all slip joints.

4.2.2 Water Main – HDPE Installed Using Directional Drilling

Pipes used in direction drilling application shall be high-density polyethylene (HDPE) pipe. Pipe 1/2-inches through 3-inches shall conform to AWWA C901 and the Specifications. Pipe and fittings 4-inches through 60-inches shall conform to AWWA C906 and these specifications.

Pipe shall have a nominal DIPS (ductile iron pipe size OD). The dimension ratio shall be verified by the Contractor based on the pipe pull strength and the pressure rating of the pipe supplied shall be PE4710 (DR 11) pressure class 200 for water main, in accordance with Table 5 of AWWA C906.

The pipe shall be homogenous throughout and free of visible cracks, holes, voids, foreign inclusions, or other deleterious defects and shall be identical in color, density, melt index, and other physical properties throughout.

Pipe shall have a minimum hydrostatic design basis (HDB) of 1,600-psi (11 MPa), as determined in accordance with ASTM D2837.

Pipes shall be marked in accordance with AWWA requirements (C901 Section 2.4 or C906 Section 3.1, as appropriate). AWWA C901 pipe (3/4-inch through 3-inches) shall be PE 4710 SDR 9, colored blue for water. AWWA C906 pipe (4-inches through 60-inches) shall be PE 4710 DR11, color coded as above with co-extruded equally spaced stripes of the same material as the pipe. Stripes printed on the pipe outside surface shall not be acceptable. The pipe shall be extruded from pre-compounded resin.

Sections of polyethylene pipe shall be joined into continuous lengths on the job site above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The butt fusion equipment used in the joining procedures shall be capable of meeting all conditions recommended by the pipe manufacturer. Butt fusion joining shall result in joint weld strength equal to or greater than the tensile strength of the pipe. Socket fusion shall not be used. Extrusion welding or hot gas welding of HDPE shall not be used. Flanges, unions, grooved-couplers, transition fittings, and some mechanical couplers may be used to connect HDPE pipe mechanically without butt-fusion only where shown in the Drawings.

HDPE Connections: Mechanical joint connections between ductile iron pipe or fittings and HDPE pipe or fittings shall use ductile iron mechanical joint glands conforming to AWWA C111 and AWWA C153. Mechanical joints shall be fully thrust restrained. Gaskets, bolts, and hexagonal nuts shall be standard rubber gaskets conforming to AWWA C111. Follower gland shall match class 350 compact fittings. HDPE pipe stiffeners shall be constructed of stainless steel and shall be flanged on one end to prevent over-insertion into the receiving pipe.

Use the following procedure to butt fused HDPE pipe. If a procedure noted below contradicts manufacturer's recommendations, follow the manufacturer's recommendation.

- Maintain the proper temperature of the heater plate as recommended by the pipe manufacturer. Check it with a tempilstik or pyrometer for correct surface temperature.

- Clean pipe ends inside and outside with a clean cotton cloth to remove dirt, water, grease, and other foreign materials.
- Square (face) the pipe ends using the facing tools on the fusion machine. Remove all burrs, chips, and fillings before joining pipe or fittings.
- Check the line-up of pipe ends in the fusion machine to see that pipe ends meet squarely and completely over the entire surface to be fused. The clamps shall be tight so that the pipe does not slip during the fusion process.
- Insert the clean heater plate between the aligned ends and bring the ends firmly in contact with the plate but do not apply pressure while achieving the melt pattern. Allow the pipe ends to heat and soften. Softening depths shall be per the manufacturer's recommendation.
- Carefully move the pipe ends away from the heater plate and remove the plate (if the softened material sticks to the heater plate, discontinue the joint, clean heater plate, square pipe ends, and start over).
- The melted ends shall be connected rapidly but not slammed together. Apply enough pressure to form a double rollback bead to the body of the pipe around the entire circumference of the pipe about 1/8-inch (3.175-mm) to 3/16-inch (4.763-mm) wide. Pressure is necessary to cause the heated material to flow together.
- Allow the joint to cool and solidify properly. Remove the pipe from the clamps and inspect the joint appearance.

Flanged Joints

- Flange adapters shall be pressure rated the same as the pipe. Flange adapters shall be heat fused to the pipe as outlined in the heat fusion section.
- Gaskets shall be used between the polyethylene flange adapters when recommended by the HDPE pipe manufacturer. Sufficient torque shall be applied evenly to the bolts to prevent leaks. After initial installation and tightening of flanged connections, allow the connections to set for a few hours then conduct a final tightening of the bolts.
- Lubricate nuts and bolts with oil or graphite prior to installation.
- Check operation of valves connected to molded stub end flange adapters. Insert polyethylene spacer if recommended by pipe manufacturer for clearance.

Mechanical Joints

- Wipe the socket and the plain end clean. Lubrication and additional cleaning should be provided by brushing both the gasket and plain end with an approved pipe lubricant just prior to slipping the gasket onto the plain end for joint assembly. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
- Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.

- Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand tighten nuts. Make deflection after assembly but before tightening bolts.
- Tighten the bolts to the normal range of bolt torque as indicated in AWWA C-600 while maintaining approximately the same distance between the gland and the face of the flange at all points around the socket.
- When connection is being made to HDPE pipe or fittings use a welded flange to connect to fittings.

Installation of High-Density Polyethylene Pipe

- All high-density polyethylene (HDPE) pipe shall be handled, stored, assembled, and installed in accordance with AWWA C906, manufacturer's recommendations, and these Specifications. HDPE pipe shall be installed using directional drilling method of construction.

4.2.3 Fusible Polyvinyl Chloride Pressure Pipe – Installed using directional drilling

Fusible polyvinylchloride pipe shall conform to AWWA C900, AWWA C905, ASTM D2241 or ASTM D1785 for standard dimensions, as applicable. Testing shall be in accordance with the referenced AWWA standards for all pipe types.

Fusible polyvinylchloride pipe shall be extruded with plain ends. The ends shall be square to the pipe and free of any bevel or chamfer. There shall be no bell or gasket of any kind incorporated into the pipe.

Fusible polyvinylchloride pipe shall be manufactured in a standard 40' nominal length, or custom lengths as specified.

Fusible polyvinylchloride pipe shall be blue in color for potable water use.

Pipe shall be marked as follows:

- Nominal pipe size
- PVC
- Dimension Ratio, Standard Dimension Ratio, or Schedule
- AWWA pressure class, or standard pressure rating for non-AWWA pipe, as applicable
- AWWA standard designation number, or pipe type for non-AWWA pipe, as applicable
- NSF-61 mark verifying suitability for potable water service
- Extrusion production-record code
- Trademark or trade name
- Cell Classification 12454 and/or PVC material code 1120 may also be included

Pipe shall be homogeneous throughout and be free of visible cracks, holes, foreign material, blisters, or other visible deleterious faults. All joints shall be rubber gasket joints conforming to ANSI/AWWA C111/A21.11 – Latest Revision.

4.3 Fittings

All 3” through 48” fittings shall conform to ANSI/AWWA C110/A21.10 – Latest Revision and compact fittings shall conform to ANSI/AWWA C153/A21.53 – Latest Revision. They shall be cement lined in accordance with ANSI/AWWA C104/A21.4 – Latest Revision. All fittings shall be mechanical joint fittings.

4.4 Mechanical Joint Restraints

Allowable Mechanical Joint Restraints are as follows:

- a. Ductile Iron Mechanical Joint Restraints: EBAA Iron Inc. – MEGALUG® Series 1100
- b. Ductile Iron Mechanical Joint Restraints: Romac Industries Inc. – Romagrip™

4.5 Restrained Push-On Joints

Allowable Restrained push-on joints are as follows:

- a. AMERICAN Flex Ring
- b. McWane, Inc. TR Flex
- c. United States Pipe and Foundry Company
 - i. TR Flex
 - ii. HDSS

4.6 Gaskets

Gaskets shall conform to the requirements of American National Standard for Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings (ANSI/AWWA C111/A21.11 - latest revision).

Allowable Gaskets:

- a. AMERICAN
- b. Garlock Packing Company
- c. John Crane, Inc.
- d. McWane, Inc.
- e. Specifications Rubber Products, Inc.
- f. United States Pipe and Foundry Company
- g. U.S. Rubber Company

Gasket Requirements:

1. Plain rubber gaskets.
2. Restrained-joint locking gaskets.
 - i. Use restrained joint locking gaskets when electing to or are otherwise required to meet thrust-restraint requirements by means of restrained-joint pipe.
 - ii. Restrained-joint locking gaskets must be certified as compliant for use with the furnished pipe material by the pipe manufacturer.
3. Nitrile or Fluorocarbon gaskets are required if water mains are in or near contaminated soils.

4.7 Magnesium Anode

Magnesium Anodes shall be high potential magnesium anode ingots with packaged backfill. Anode ingot shall meet or exceed ASTM B843, GRADE M1C for high-potential magnesium anodes. A #12 solid copper lead wire (10'-black is standard) is silver soldered to the ingot core, and this connection is sealed with tar. The magnesium ingots are then packaged in a cotton bag with a backfill mixture consisting of 75% gypsum, 20% bentonite, and 5% sodium sulphate. The packaged anode assembly is sealed in a plastic or paper outer wrap (this must be removed prior to installation) to protect it from moisture and abrasion during shipment and storage.

Work consists of installing prepackaged magnesium anodes, to cathodically protect a portion of new or existing cast or ductile iron water main, copper water services or hydrant branch pipe, as required in the Contract Documents and as directed by the Project Manager.

A 32# bagged magnesium anode will be used for all ductile iron water mains and a 5# bagged magnesium anode will be used on copper services.

4.8 Tracer Wire and Tracer Wire Access Box

The tracer wire shall be a minimum of twelve (12) gauge solid core copper electric wire with blue PVC coating and rated for wet conditions, or #12 AWG HS-CCS high-strength copper clad steel conductor (HS-CCS), insulated with a 30 mil, high-density, high molecular weight polyethylene (HDPE) insulation, and rated for direct burial use at 30 volts. HS-CCS conductor must be 21% conductivity for locating purposes, with minimum break load of 380 pounds.

Stranded or braided tracer wire is unacceptable.

The tracer wire access box shall have a magnetic metal cover to aid in locating. Some manufactures examples are: Bingham & Taylor Tracer Wire Box, Copperhead Tracer Wire Box, or an approved equivalent. Though the box cover does not have to be labeled, it is preferred that it say, "Tracer Wire." It cannot be labeled "Electric."

4.9 Valves

All 6" through 12" valves shall be Resilient Wedge (R/W) gate valves conforming to ANSI/AWWA C509 – Latest Revision, shall be interior and exterior epoxy coated ANSI/AWWA C515 – Latest Revision, ANSI/AWWA C550 – Latest Revision and shall meet the following specifications:

Features:

- Valves to have non-rising stem.
- Provided with an arrow externally cast on the operating nut showing direction of closing.
- All gate valves 6" and larger shall be designed for an input torque of 400 foot-pounds without distortion of any kind.
- All bonnet bolts shall be 304 stainless steel.
- 2" square operating nut.
- The operating nut attaching nut or bolt shall be 304 stainless steel.

Approved Equals:

- Kennedy series 8571 C509, 7571 C515
- Mueller series A-2362 C509, 2361 C515
- Clow series F6100
- AFC series 2500 (Waterous)

All valves 16" and larger shall be rubber seated butterfly valves conforming to ANSI/AWWA C504 – Latest Revision.

Approved Equals:

- Kennedy series B4500
- Mueller series B-3211-20

4.10 Valve Boxes

All valve boxes shall be street duty rated cast iron three-piece **manufactured in USA or Canada only**, screw type, 5 ¼" shaft. They shall be valve box size "DD" with a #6 base, Tyler Series 6860, East Jordan, or an approved equal. All components of an approved equal shall be interchangeable with the Tyler series 6860. The cover shall be of stay-put design, with the word "WATER" embossed on the cover. Screw-type risers or long throat risers shall be used to accommodate final lift of asphalt if boxes cannot be turned to final grade – **no inserts will be allowed.**

4.11 Hydrants

All hydrants shall be Clow Eddy F-2640 or Waterous Pacer WB67-250 (16" Upper Standpipe) and conform to NSF-61 and ANSI/AWWA C502 – Latest Revision and shall meet the following specifications:

- A minimum 5-inch valve opening.
- One (1) – 5" Storz pumper nozzle connection
- (Cap removal must be by Storz wrench, hand removal of cap not allowed)
- Two (2) – 2½" nozzles with National Standard threads.
- The hydrant operating and cap nuts shall be 1¼" pentagon.
- Break flange construction.
- The direction of operation shall be CLOCKWISE TO OPEN.
- The word open and an arrow showing that the hydrant opens right shall be embossed on every hydrant and painted black.
- The hydrant shall have a 6'6" bury length unless noted on the Engineering Plans.
- The distance from the final grade line to the centerline of the lowest nozzle shall fall between 18 and 24 inches.
- Hydrant extensions, if used, shall be compatible with hydrant barrel and stem sections and shall be installed at the top of the barrel section with no modifications to the barrel.

- The front nozzle must be a minimum of twenty-four inches (24”) behind the back of curb or as shown on the plans.
- The hydrant shall have a six (6) inch mechanical joint bottom connection.
- All buried nuts and bolts used to assemble the hydrant shall be 304 stainless steel or Cor-Blue T-Bolts as manufactured by NSS Industries or better.
- The top section of the Hydrant shall be painted with high visibility SAFETY yellow paint, with the embossed arrow painted black. Painting shall be in accordance with section 4.13 of ANSI/AWWA C502 – Latest Revision. The top coat of paint shall be applied over base coat of primer.
- All external repair parts that are part of the top section of the hydrant, such as the operating nut and breakaway assembly, shall also be painted as described above.
- No chains shall be attached to the caps.
- All hydrant leads shall be six (6) inch, Class 52, ductile iron pipe.

4.12 Hydrant Flag

5 foot long highly reflective fiberglass marker, red and white, corrosion and UV resistant, Pollardwater Part No. 4934856, or equal as approved.

4.13 Casing Pipe

Casing pipe requirements shall conform to the requirements of Chapter 4.13.0 and File No. 49 of the Standard Specifications.

4.14 Casing Spacers

Casing spacers (all sizes) shall be Cascade series CCS stainless steel with vinyl runners or an approved equivalent.

4.15 Air Release Assemblies (where approved for use by the Utility)

Air-release assemblies shall be constructed in accordance with File No. 42, or File No. 43, if a dead end main, of the Standard Specifications. Copper tubing shall be 1 inch diameter for all mains less or equal to 16-inch diameter, and 2 inch diameter for mains 18-inch and larger.

4.16 Check Valve, Coupling Adapter, 1” Corporations and Manhole (where approved)

The Contractor shall furnish and install a pipe diameter check valve, a coupling adapter and two pipe diameters by 1” tapping saddles and 1” corporations and 5-foot diameter manhole, including compacted granular backfill.

The check valve shall be an APCO Series 100 Rubber Flapper Swing Check Valve or pre-approved equal, conforming to AWWA C508, minimum 150 psi and NSF61. The flapper shall be Buna-N having an O-ring seating edge and be informally reinforced with steel. Connect Check Valve to pipe, on one side, with Smith-Blair 912 Flanged Coupling Adapter or pre-approved equal.

Install 8”x1” tapping saddle and 1” corporation so that the corporation is on the top of the pipe.

Manhole construction shall conform to Detail Drawing on plans. The manhole sections including the risers, flat slab top, base section and adjusting rings shall be precast reinforced concrete and shall

conform to ASTM C478. Lengths of manhole risers shall be furnished in such a combination as to conveniently make up depth of the manhole. A maximum of two handling holes per length of riser will be permitted. All chimney joints, including frame-chimney joint and all barrel section lifting holes shall be sealed with a premixed, high-strength, non-shrink cementitious grout. Manhole bottom shall have an 18-inch-diameter sump hole with a solid concrete bottom, offset from pipe centerline.

All joints between manhole pipe sections and top shall be tongue and groove conforming to ASTM C443. Manhole joints shall be sealed with circular O-ring conforming to ASTM C443 or bituminous jointing material equal to EZ-Stick, Kent Seal butyl rubber gasket or butyl rubber rope. Manhole steps shall be Neenah Type R-1981-N or equal, set into precast manhole sections and shall be aligned vertically in the manhole.

Manhole connection for water main piping shall be made with flexible watertight connectors, Kor-N-Seal, Link-Seal, A-Lok or equal. All clamps, bolts, etc. of pipe to manhole seals shall be stainless steel. If Link-Seal connectors are used, the bolt heads shall be placed on the inside of the manholes. Manhole frame and cover shall be Neenah Type R 1550 or equal, self-sealing type "B" lid with concealed pick holes.

4.17 Tapping Sleeves

Approved Equals: Smith-Blair model 663

Body: Full circumference band. Type 304 stainless steel

Flange: AWWA C207 Class D ANSI 150 lb drilling, 18-8 type 304 stainless steel flange.

Test Plug: Provide ¾" NPT stainless steel per ASTM A 240, type 304, with standard square head for pressure testing before tap is made.

Gasket: Nitrile (Buna N) compounded to resist oil, hydrocarbon fluids and water, and suitable to temperatures up to 180F.

Bolts and Nuts: Type 304 stainless steel heavy hex nuts, stud bolts & washers. Nuts and stud shall have factory applied anti galling coating

4.18 Tapping Saddles

Approved Equals:

- Smith Blair model 317
- Romac 202SN

Body: Epoxy Coated Ductile Iron Body with type 304 Stainless Steel double bands and bolts

Gasket: Grade 60 Buna N compounded to resist oil, acids, hydrocarbon fluids, and water.

Bolts and Nuts: Type 304 stainless steel heavy hex nuts, stud bolts & washers. Nuts and studs shall have factory applied anti galling coating.

4.19 Pipe Repair Clamps

Approved Equals:

2" in size

- EZ- Max

4"-12" in size for up to 100 psi working pressure

- Smith Blair model 261
- Romac Style SS1

16"-24" in size for up to 100 psi working pressure

- Smith Blair model 263
- Romac Style SS3

6"- 24" For over 100 psi main pressure

- Smith Blair model 268

Minimum Lengths of Repair Clamps:

- 6" diameter - minimum 12' long
- 8" diameter - minimum 15" long
- 12" diameter - minimum 20" long
- 16" diameter - minimum 30" long
- 20" diameter - minimum 30" long
- 24" diameter - minimum 30" long

4.20 Packaged Anodes

Approved Equals:

- EEI Packaged Anode - Anode Type 32D5

4.21 Service Laterals (See FIGURE 1A & 1B)

All water laterals shall be a minimum of 1" in diameter for Type "K" Copper or a minimum of 1¼" Polyethylene (PE) Pressure Pipe and Tubing, CTS (Copper Tubing Size) rated for 250 PSI, SDR-9. A larger diameter may be required.

Type "K" Copper Tubing service laterals, 1" to 2" in size, shall conform to ASTM B88 – Standard Specification for Seamless Copper Water Tube, suitable for underground installation, in sizes and length specified on the design plans.

OR

Polyethylene (PE 4710) Pressure Pipe and Tubing, CTS (Copper Tubing Size) rated for 250 PSI service laterals, 1" to 2" in size, shall conform to ANSI/AWWA C901 – Latest Revision in sizes and length specified on the design plans. Polyethylene tubing shall conform to the outside diameter dimensions of Type K Copper.

The PE tubing shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other defects. It shall be uniform in color, opacity, density and other physical properties. Surfaces of the product shall be free from scratches, gouges, bloom and color imperfections.

The PE tubing shall be permanently identified as PE 4710 water service tubing and the markings shall also include manufacturer's brand name or trademark and production record code, nominal

size, NSF logo, pressure class (PC 200), AWWA designation number (AWWA C901-02) and date of manufacture. SDR 9 200 PSI tubing (CTS-OD) will be color coded with a blue stripe and marked with the word “Tubing” and the dimension ratio.

A stainless-steel stiffener is required on the inside of the PE tubing at all connections.

Per federal requirements, all applicable fittings shall have “NL” included on each model to indicate “No Lead”.

All service laterals 4” and larger required for fire protection shall be rated for a Pressure Class 200 PSI and use either Polyvinyl Chloride (PVC) (DR-14) conforming to ANSI/AWWA C900 – Latest Revision or Ductile Iron Pipe (Class 52). Four inch (4”) valves are not allowed in the water main system, a six inch (6”) valve would be required at the connection to the water main with six (6”) pipe in the right-of-way and then reduce down to the four inch (4”) service lateral at the property line.

4.22 Curb Boxes

Approved Equals:

- Mueller H-10334 with a 30” long stationary rod and tracer wire attachment point.
- A.Y. McDonald series 5607ALRTWW

Extension type curb box with arch pattern base for ¾” - 1” and CB7 for 1-1/4” to 2” curb valves and stops. With the following specifications:

- 72” when fully extended
- Cast iron box
- Cast iron cap with brass pentagon plug, with tracer wire attachment point
- Upper section 1”
- 30” long stationary rod

4.23 Brass Fittings

Underground service material, line valves, and fittings shall comply with ANSI/AWWA C800 – Latest Revision and NSF-61 no-lead standard.

4.24 Straight Couplings – Compression ¾”-2” with tracer wire attachment

Approved Equals:

- Mueller type H-15403 must include tracer wire attachment point
- Ford C-44-XX-TW-Q must include tracer wire attachment point
- A.Y. McDonald series 4758 must include tracer wire attachment point

4.25 Corporation Stops ¾”-2” with tracer wire attachment

Approved Equals:

- Mueller type B-25008 must include tracer wire attachment point
- Ford type FB1000-X-TW-Q must include tracer wire attachment point
- A.Y. McDonald series 74701BQA must include tracer wire attachment point

4.26 Curb Stops – Compression copper to copper (C-C) with tracer wire attachment

Approved Equals:

- Mueller type H-15209 must include tracer wire attachment point
- Ford B44-XXX-TW-Q must include tracer wire attachment point
- A.Y. McDonald series 6100Q must include tracer wire attachment point

4.27 Curb Stops – Compression copper to iron (C-I) with tracer wire attachment

Approved Equals:

- Mueller type H-15172 must include tracer wire attachment point
- Ford series B41-XXX-TW-Q must include tracer wire attachment point
- A.Y. McDonald series 6102Q must include tracer wire attachment point

4.28 Copperhorns for 5/8” to 1” Water Meters

Copperhorns shall comply with ANSI/AWWA C-800, have a brass body with copper arms and swivel connections manufactured by Ford in the following sizes:

- No. 1 copperhorn for a 5/8” water meter, provide with union nuts
- No. 3 copperhorn for a 3/4” water meter, provide with union nuts
- No. 4 copperhorn for a 1” water meter, provided with union nuts

4.29 Meter Setters for 1½” to 2” Water Meters

Approved Equals:

1½” meter setter with ¼” lockable bypass

- Ford VV76-12B-11-66
- A.Y. McDonald 20B612WWFF665

2” meter setter with ¼” lockable bypass

- Ford VV77-12B-11-77
- A.Y. McDonald 20B712WWFF775

4.30 Meter Resetters for 1½” to 2” Water Meters

Approved Equals:

1½” meter setter with ¼” lockable bypass

- Ford VV46-13B
- A.Y. McDonald 18B612WW

2” meter setter with ¼” lockable bypass

- Ford VV47-12B
- A.Y. McDonald 18B712WW

4.31 Water Main Lining

Cured-in-Place Pipe (CIPP) Lining shall be Sanexen AQUAPIPE or approved equal

- Required to meet ASTM F-1216
- Design must be sealed by a Professional Engineer licensed in Wisconsin
- Design life shall be minimum of 50 years with a Flexural Strength of 10,000 psi
- Wisconsin DNR permit approval is required and design calculations must be submitted by the design engineer

CHAPTER 5 - DESIGN REQUIREMENTS

5.0 General

- All engineering plans and specifications shall be designed, prepared, stamped, and signed by a qualified professional engineer registered in the State of Wisconsin.
- The design engineer shall prepare final engineering drawings based on the requirements outlined in this document, the Utility standards, city ordinances, and the municipal code.
- Except as specified in this manual, all work performed, and materials supplied shall conform to the Standard Specifications.
- As a minimum, the distribution system shall include a system of water mains and service lines between a connection or connections to the existing distribution system at locations approved by the Utility, and at the boundary line of each individual parcel within the development.
- Extensions to the distribution system shall be a complete network extension or part of a complete network extension and shall include primary feeders, secondary feeders, and distribution mains conforming in general to the existing distribution system pattern.
- Any water main extension project shall include extending the water main the full length of the property.
- For water main protection, a minimum vertical separation distance (edge to edge) where water mains cross over sewers shall be 6" and where water mains cross under sewers the distance shall be 18". The minimum horizontal separation shall be 8' between sanitary sewer and storm sewer. The plans shall include a method of backfilling between the pipes that will provide adequate structural support for the water main. Whenever a storm sewer 24" in diameter or greater will cross over a water main, whether existing or proposed, the mains shall be properly supported, and a detail included as part of the construction plans.

5.1 Water Main

- Distribution mains shall form a grid to supply water to the local fire hydrants and service lines. Distribution mains shall have a minimum diameter as follows:

<u>Type of Development</u>	<u>Minimum Main Size</u>
Residential cul-de-sac 6 homes or less	6"
Residential cul-de-sac greater than 6 homes	8"
Residential	8"
Commercial	12"
Industrial	12"

- Primary mains are those mains forming the arterial system of the Utility and in the case of construction within a development, are further defined as mains 12" except when a diameter larger than 12" is required to meet local fire protection needs.

- Secondary feeders shall be sized and shall be looped with spacing as required for fire flows and shall have a minimum diameter of 8".
- The above size and criteria may be deviated from if the design engineer can demonstrate through a detailed hydraulic analysis of the water system that adequate fire flows are attainable.
- All water mains shall be looped or constructed with the intention to loop unless approved by the Utility.
- The proposed extension shall be arranged so that the effect of a break in a secondary feeder or distribution main will be kept to a minimum.
- All mains shall be provided with a means of flushing to remove air, dirt and debris.
- Required Fire Flow:

<u>Land Use</u>	<u>Range of Needed Fire Flows (gpm)</u>
Single Family	
Over 100 feet Building Separation	500
31 to 100 feet Building Separation	750
11 to 30 feet Building Separation	1000
10 feet or less Building Separation	1500
Multiple Family Residential Complexes	2000 to 3000+
Average Density Commercial	1500 to 2500+
High Value Commercial	2500 to 3500+
Light Industrial	2000 to 3500+
Heavy Industrial	2500 to 3500+
Other Commercial, Industrial & Government Buildings	Up to 12,000

- Head losses in relation to velocity in water mains shall be computed using the Hazen-Williams formula: $V = 1.318 C_{HW} R_h^{0.63} S^{0.54}$
 Where,
 V = velocity in feet per second
 C = 120
 R = the hydraulic radius (A/P_{wetted})
 S = the hydraulic gradient (hf/L)
- Water mains located outside the ROW must be centered in a 30' wide permanent water main or public utility easement. If the water main is located in the same easement as another utility, then the easement shall be increased to 50 feet.
- All water mains located inside the ROW but less than 10' from the lot line must have a 10' easement along the lot line.
- Casing pipe requirements shall conform to the requirements of Chapter 4.13.0 and File No. 49 of the Standard Specifications

5.2 Valves

- Valves shall be located so as to effectively isolate portions of the system with minimum loss of service.
- Valves shall be located at all intersections, at the property lines extended, and at spacing of 500' to 800' between intersections and/or adjacent to fire hydrants.

- Tees shall be installed with two valves and crosses shall be installed with three valves, unless otherwise required by the Utility.
- If a water main is passing along a side yard, valves are required at both ends and service connections are not permitted unless approved by the Utility.
- Four (4") inch valves are not allowed in the water main system.

5.3 Hydrants (See FIGURE 2)

- Hydrants shall be placed 2½ feet behind the back of curb, such that the front nozzle must be a minimum of twenty-four inches (24") behind the back of curb.
- All hydrants shall be located per the following requirements:
 - Near all roadway intersections.
 - At property line intersections in mid-block, to satisfy the maximum intervals listed below.
 - At the end of all cul-de-sacs, at property line intersections.
 - At a 500' maximum interval for residential areas.
 - At a 400' maximum interval for commercial and industrial areas.
 - As near to all high points of the system as possible.
 - Additional fire hydrants, as required, per the State or local fire or plumbing codes.
- Hydrants shall have an auxiliary isolating valve that shall be a 6" mechanical joint resilient wedge gate valve.
- An anchoring tee shall be used to attach the hydrant lead to all water mains. The auxiliary valve shall be directly attached to the anchoring tee.
- All hydrants shall have a 6'6" bury length unless noted on the Utility Plans.
- All hydrant leads shall be ductile iron pipe and shall be noted on the Utility Plans or Details.

5.4 Service Laterals (See FIGURE 1A & 1B)

- In general, a water service shall be installed for each building or buildable lot. Water services shall consist of a corporation stop, service line, curb stop and curb box with a stationary rod.
- All new water laterals shall be a minimum of 1" in diameter for Type "K" Copper or a minimum of 1¼" Polyethylene PE 4710 (SDR 9) Pressure Pipe and Tubing, CTS (Copper Tubing Size) rated for 200 PSI. A larger diameter may be required.
- Curb Box Placement
 - Where there is curb and sidewalk, the curb box shall be located between the back of curb and the sidewalk edge closest to the back of curb.
 - Where there is no sidewalk or the sidewalk abuts the back of curb, the curb box must be in the Utility easement or street right of way and be within 3 feet of sidewalk or back of curb.
 - Where the water service resides in a Utility easement where there will be no pavement, the curb box shall be placed 5 feet from the water main.
 - Where the box is placed in future or existing street pavement, the curb box shall be installed in a valve box.

- An anchoring tee shall be used to attach all 6” and 8” service laterals to all water mains. The auxiliary valve shall be directly attached to the anchoring tee. The use of tapping sleeves will be reviewed on a case by case basis.
- There shall be no division of water services for the extension and independent meeting of the supply to an adjoining lot or parcel of land.
- The contractor will need to install a 5-pound anode bag to each copper service lateral. The water utility will provide the anodes. The connection shall be made on the fitting end that connects to the copper pipe, in the tracer wire attachment nut.

CHAPTER 6

Construction Requirements

6.0 General

All water main construction shall comply with ANSI/AWWA C600 – Latest Revision, the Standard Specifications and these this Manual.

A list of all acceptable pipe materials, fire hydrants, resilient wedge gate valves, butterfly valves, tapping saddles, service lateral materials, and all other appurtenances are listed in these Specifications, Chapter 4 – Materials. Deviations from this list will be considered if specifications for the variance are submitted to the Utility for review two weeks prior to the start of the Utility installation.

The Contractor shall furnish and place a temporary 2"x6" wood post, marked with blue paint at the curb box of each water service and at a valve box where a water service valve lies outside the road right-of-way in an easement. Any deviation from approved plans or specifications affecting the performance or installation of the water main and services shall be approved, in writing, by the Utility before such changes are made.

Revised plans or specifications shall be submitted well in advance of any construction work that will be affected by changes to permit sufficient time for review and approval.

6.1 Trench Excavation

All excavation shall be in accordance with the Wisconsin Administrative Code for “Trench, Excavation, and Tunnel Construction” and any additional requirements included in the Contract Documents.

Unless otherwise provided in the Contract or permitted by the Engineer, complete the work of constructing water mains and appurtenances in open trenches and in a manner to protect the pipe and appurtenances from unusual stresses. When provided in the Contract or permitted by the Engineer in writing, the construction of mains may be installed by tunneling and/or jacking in lieu of open trenching. Details of construction shall be developed by the Contractor and submitted to the Engineer prior to beginning the work of tunneling and/or pipe jacking.

Contractor shall take full responsibility for the means and methods of installing pipe by tunneling and/or pipe jacking. The length and grade of the tunnel shall meet the requirements of the project and shall be reviewed by the Engineer. The Engineer may require the use of a casing. After the installation of the water main, the remaining space in the tunnel shall be backfilled with sand or like material properly compacted, so as to minimize subsequent settlement of the material over the tunnel.

Excavate trenches in conformity with the required alignment and grades as shown on the drawings and as laid out in the field by the Engineer. It shall be understood that the elevations for water mains as shown on the drawings are subject to revisions as may be necessary to fit field conditions. The Engineer reserves the right to adjust the profile grades from those shown on the

plan. No adjustment in compensation will be made for grade adjustments of two (2) feet or less above or below the elevations shown on the drawings.

Remove all vegetation along the trench line to the width of the proposed trench before beginning excavation. The materials excavated from the trench shall be deposited on the sides of the trenches and excavations, beyond the reach of slides, or transported to spoil banks.

Surplus material shall be considered to include vegetation from the trench line, excavated rock or cobbles and boulders larger than six (6) inches in diameter, and all other material from excavation not needed or suitable for backfilling trenches. Unless otherwise specified, surplus material shall be the property of the Contractor, and shall be disposed of at no additional cost to the Utility.

For water main construction, the width of the trench shall be such as to leave a clear space of not less than six (6) inches nor more than twelve (12) inches between the earth wall or the supporting sheeting or bracing where such is used and the sides of the pipe. The trench width established by this pipe clearance, measured at the spring line, shall be applicable to that portion of the trench from one (1) foot above the top of the pipe to the bottom of the trench. On streets opened to traffic, on restricted easements and in such other locations as noted by the Engineer, the width of the trench at the ground surface shall be limited to the outside diameter of the pipe plus two (2) feet, plus the amount necessary for sheeting or bracing. The Engineer reserves the right to limit the extent of excavation depending on the nature of the soil and other conditions.

For normal trench dewatering, per DNR, the contractor may NOT pump into the adjacent storm sewer. The trench water must be pumped into a truck and hauled off site or pumped into the sanitary sewer if permission is received from Waukesha City Engineering – call 262-524-3600 for approval.

6.1.1 Rock Excavation

Rock excavation shall include all hard solid rock in ledges, bedded deposits, unstratified masses, conglomerate deposits or any other material so firmly cemented as to present all the characteristics of solid rock. If determined by the Engineer that such material is so hard or so firmly cemented that it is not practical to excavate and remove such material with a power shovel, it shall be thoroughly and continuously drilled and blasted prior to removal. Power shovels as referred to above shall be taken to apply to a modern track mounted power shovel or backhoe of not less than three-quarter (3/4) cubic yard manufacturer's rated capacity, having adequate power and being in good running condition in the hands of an experienced operator.

Rock excavation shall also include all rock boulders necessary to be removed having a volume of one cubic yard (27 cubic feet) or more. Rock excavation shall not apply to plain or asphalt-bound bases or surface courses of macadam, gravel or broken stone.

When rock excavation is necessary, all rock shall be removed to provide a clearance below and on each side of all pipe, valves and fittings of at least 6 inches for nominal pipe sizes 24-IN or smaller (and 9 inches for nominal pipe sizes 30-IN or larger). When rock excavation is complete, refill this portion of the trench with select fill and mechanically compact the select fill prior to laying the pipe. In every case, the pipe shall have a uniform bearing along its entire length and

never shall be laid directly on rock. The width of rock excavation shall be limited to the outside diameter of the pipe plus two (2) feet.

6.1.2 Excavation in Poor Soils

If, in the opinion of the Engineer, an artificial foundation is necessary because of the nature of the excavated material, excavate to a point a minimum of six (6) inches below the bottom of the pipe. Any work involved in forming a satisfactory foundation at depths of six (6) inches or less below the bottom of pipe will be considered as incidental to the work. Excavate to such depth as directed by the Engineer. Refill this portion of the trench with select fill and mechanically compact the select fill prior to laying the pipe. Limit the width of the trench excavation to the outside diameter of the pipe plus two (2) feet, plus the amount necessary for sheeting and/or bracing.

6.2 Sheeting, Bracing and Shoring

Unless otherwise specified, provide all the sheeting or bracing needed to protect the work, existing property, utilities, pavement, etc., and to provide safe working conditions in the trench. Such sheeting and bracing shall be according to the Contractor's design and shall comply with the "Wisconsin Administrative Code." Removal of any sheeting or bracing from the trench shall be accomplished in such a manner as to fulfill the above requirements. Sheeting and bracing shall be removed, unless specific permission is given by the Engineer in writing to leave it in place. All costs of sheeting, shoring and bracing are considered to be incidental to the work.

When a contractor is working in the area where existing water mains are present, additional care must be taken to ensure that the existing mains are properly and adequately supported during construction to avoid damage or breakage.

6.3 Water Main Installation

All water mains and their installation shall conform to all appropriate requirements of Part IV of the Standard Specifications.

Lay the pipe to the line and grade as shown on the approved drawings. Lay all pipes with a minimum of six (6) feet and a maximum of seven (7) feet of cover from final grade unless otherwise shown on the drawings or ordered by the Engineer. Any variance from the approved drawings or from the amount of cover to be placed must be authorized in writing by the Engineer prior to construction.

Construct bedding or foundation for water mains and water services to minimize settlement of the pipes and to avert excessive pressure on the pipes in order to avoid rupture, leakage or deformation of the pipes. Before laying the pipe, grade the bottom of the trench so that the pipe lays on a flat surface and has uniform bearing along its entire length.

Inspect all pipe and fittings for damage and cleanliness prior to lowering into the trench. Any and all costs due to the repair of damaged valves and hydrants caused by sand or silt in the pipe will be assessed to the Contractor. Never roll or push the pipe into the trench from the bank. Always lower the pipe into the trench using mechanical equipment.

After the pipe is laid, deposit bedding material around the pipe to an elevation of at least one (1') foot above the top of the pipe. Suitable bedding materials include, sand, limestone screenings, washed gravel and crushed stone. This portion of the backfill is considered to be part of the required bedding for the installation of water mains and is incidental to the cost of the work.

6.4 Slip Joints

Assembly of the joint shall be in accordance with ANSI/AWWA C600 – Latest Revision, including:

Thoroughly clean the bell socket of the pipe and the plain end of the mating pipe. For Ductile Iron Pipe also clean the groove before the rubber gasket is installed. Using a clean gasket of the proper design for the joint to be assembled, make a small loop in the gasket and insert it in the bell socket, making sure the gasket faces the correct direction and that it is properly seated.

Apply lubricant to the gasket and plain end of the pipe in accordance with ANSI/AWWA C111/A21.11 - Latest Revision. Only use lubricant supplied by the pipe manufacturer.

Be sure that the plain end of the pipe is beveled, as square or sharp edges may damage or dislodge the gasket and cause a leak. Push the plain end into the bell of the pipe, keeping the joint straight while pushing. Deflect the pipe as required only after the joint is assembled. Field locking gaskets may be required in some locations.

6.5 Mechanical Joints

Assembly of the joint shall be in accordance with ANSI/AWWA C600 – Latest Revision, including:

Thoroughly clean the socket of the fitting and the plain end of the mating pipe. Using a clean gasket of the proper design for the joint to be assembled, apply lubricant to the gasket and the plain end of the pipe in accordance with ANSI/AWWA C111/A21.11 - Latest Revision. Only use lubricant supplied by the pipe manufacturer.

All mechanical joints shall be made using MEGALUG® Series 1100 or equal mechanical joint restraints and Cor-blue nuts and T-bolts or corrosion-resistant equivalents, as approved by the Engineer, tighten bolts to the manufacturer's specifications.

All nuts and bolts must comply with AWWA C111/A21.11. - Latest Revision. Bolts shall be of sufficient length such that a minimum of ½" of threads are exposed beyond the end of the nut when tightened.

Tighten the bolts to the normal range of bolt torque in accordance with AWWA C600 - Latest Revision.

6.6 Magnesium Anodes

Spacing and size of magnesium anodes will be as specified in Contract Documents. Each anode shall be placed in a horizontal position parallel with the pipe, with centerline axis of the anode below the bottom of the water pipe. The centerline axis of the anode shall also be placed at least 2 feet from the exterior wall of the water pipe. Care shall be taken to ensure that the cloth bag is

not damaged and no backfill lost during installation. Each anode shall be centered in the cloth bag. It may be necessary to re-center the anode in the cloth bag by rolling it on the ground prior to installation. Each prepackaged anode shall be lowered into the trench using a sling or rope. The anode shall not be lowered, transported, handled or lifted by the lead wire. The anode lead wire shall be long enough to reach from the pipe to the anode without a splice. The anode lead wire shall be attached to the pipe using the thermite weld process.

For new ductile iron water main construction, a 32# magnesium anode shall be installed, the wire connection shall be made to the conductivity strap or the wire will need to be cad welded to the pipe, if a strap is not available. A 5# magnesium anode shall be installed to each existing copper service, the wire shall be connected to the fitting end that connects to the copper pipe, in the tracer wire attachment nut.

For existing cast iron and ductile iron water main, a 32# magnesium anode shall be installed at every pipe joint or every other pipe joint, on existing cast and ductile iron water main pipe to cathodically protect both pipes on either side of the joint. Two or more anodes will be installed at pipe joint locations, with one or more anodes connected to each pipe on either side of the joint, the wire will need to be cad welded to the pipe.

6.7 Tracer Wire.

A continuous tracer wire shall be installed with all water pipe, including PVC and Ductile Iron water mains, hydrant leads and water services (both copper and PE pipe). The tracer wire shall be installed in such a manner as to be able to properly trace all water mains, hydrant leads and water services without loss or deterioration of signal. The tracer wire system must pass a conductivity test before final acceptance of the water main installation is accepted by the Waukesha Water Utility. **All tracer wire ends must be grounded.**

At the point of connection between either cast or ductile iron water mains, with any new water main, the tracer wire shall be properly connected to the iron pipe with either a cad weld or a conductivity clamp. All tracer wire connections to the iron pipe shall be sealed with a mastic type sealer for underground use.

The tracer wire shall be placed along the entire length of the pipe and taped at a minimum of every ten (10) feet to the top of the pipe. The tracer wire shall be kept taut during backfill, so the wire does not slide down along the side of the water main. The tracer wire shall be protected from damage during water main installation. No breaks or cuts in the tracer wire or tracer wire insulation will be permitted. To avoid underground splices, whenever possible, the tracer wire shall be continuous and without splices from fire hydrant to fire hydrant.

Example; if there is fifty feet (50') of tracer wire on a spool at the hydrant, this spool of Tracer Wire should be terminated, and a new spool of tracer wire should be started. The remaining fifty feet (50') of wire can be used for water service laterals.

At the fire hydrant, no spliced in tracer wire connections shall be allowed. The main line tracer wire shall follow and be secured to the hydrant lead up to and back from the hydrant head and then continue along the water main. The tracer wire shall be brought up along the back or side of the fire hydrant, **through a two-inch PVC conduit that is a minimum of three feet long and**

shall be installed at the time of the hydrant installation. The tracer wire shall be encased in a tracer wire access box with a minimum of eighteen inches of excess tracer wire at the termination point. The top of the tracer wire access box is to be flush with the hydrant break flange and the side of the tracer wire access box shall be two to four inches from the side of the hydrant break flange. The tracer wire access box shall not be taped to any part of the hydrant. The tracer wire and the two-inch PVC conduit shall not be placed inside of the polyethylene encasement which is around the hydrant lead and barrel. If the tracer wire is not terminated, because the spool has more than fifty feet (50') of wire remaining, the tracer wire shall not be cut for connection at the cap – strip a section of coating away from the wire and make a loop in the wire and connect to one of the connection screws. (See FIGURE 2)

For all new developments with PE (CTS) piping, the water service tracer wire **shall not** be spliced into the water main tracer wire. The water service tracer wire shall be connected to the tracer wire attachments on the corporation, the curb stop, the curb box cover and to a grounding rod (minimum of 2 feet long). The water service tracer wire shall be taped to the water service every five feet. (See FIGURE 1A & 1B)

All tracer wire splices shall have the wire end looped a minimum of four (4) times, the joint must be soldered, and the connection shall be covered with a waterproof wrap that is approved for underground wire splices. (See FIGURE 3)

A tracer wire will be required for all water main replacements. Existing water laterals will not require a tracer wire, so there will be no spliced in connections allowed.

For transmission water mains, when there is not a practical location to bring the tracer wire to the surface, a valve box top section, may be used at approximately 500' intervals for access to the tracer wire. The valve box top section should be filled with sand to a maximum of one foot from the top. The tracer wire should not be spliced, bring the tracer wire to the surface with a minimum of 18" of excess wire at each valve box.

6.8 Polyethylene Encasement

Whenever Ductile Iron pipe is installed, the Contractor shall encase pipe in eight (8) mil polyethylene. The polyethylene shall be furnished in either tube-form for pipe and pipe-shaped appurtenances and flat sheet or split-tube form for odd-shaped appurtenances. Installation shall be by a method described in accordance with ANSI/AWWA C105/A21.5 - Latest Revision.

All joints shall be lapped and taped sufficiently to prevent the soil from coming in contact with the pipe. Tape shall be thermoplastic material with a pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene. Tape shall have a minimum thickness of 8 mils, and a minimum width of 1.5 inches.

The Contractor shall take care in placing the polyethylene and in backfilling to prevent tearing and puncturing the wrapping and shall conform to the requirements of Chapter 4.4.4 of the Standard Specifications. Repair holes or tears smaller than 1 inch in size with tape. Repair holes or tears larger than 1 inch in any dimension by taping another piece of polyethylene over the hole with

continuous tape around the entire perimeter of the patch piece. Extend the patch over the hole by a minimum of 6 inches in every direction.

Dig bell holes and slide polyethylene encasement over the adjacent pipe providing a minimum of 1 foot of overlap of the spigot side of the joint from the bell side. Where polyethylene encased pipe is being installed connects to a pipe that is not wrapped (including existing pipe), extend the wrap a minimum of 3 feet onto the previously uncovered pipe for both layers of polyethylene encasement. This includes lines which may be wrapped in polyethylene or dielectric PVC tape or plastic pipe.

Tape joint overlaps and at 3-foot intervals along the barrel of the pipe (2-foot intervals when installed below the water table). Tightly secure polyethylene encasement using two to three circumferential passes of adhesive tape on the pipe to polyethylene encasement connection and the overlap polyethylene encasement to polyethylene encasement connection for both layers.

When connecting to or tapping into existing or new polyethylene encased pipe, wrap two or three layers of tape completely around the pipe at the connection/tap location. Mount the tapping machine on the taped area and make the tap directly through the tape and polywrap. Install the corporation stop and inspect the area for damage, repair prior to backfilling, as necessary.

Remove and replace, or satisfactorily repair, any defective or inferior work that is found on polyethylene encasement with proper material and workmanship and without extra compensation from the Owner.

All cast-iron fittings and valves shall be completely wrapped with eight (8) mil polyethylene wrap to protect them from corrosion. If the fitting or valve cannot be wrapped practically in a tube, a double wrap of flat sheet or split tube shall be used. The wrap shall extend approximately 18 inches beyond all joints. All seams shall be taped securely.

Valve boxes, curb boxes, and the bottom of hydrants shall not be wrapped with polyethylene wrap.

6.9 Sterilizing the Pipe

All disinfection materials, procedures and requirements shall be per ANSI/AWWA C651 – Latest Revision, except as modified herein. Throughout construction constantly keep in mind that these pipelines are to be used to convey water for drinking purposes. Special care shall be taken to prevent dirt, mud, muddy water or other foreign matter from entering the pipe or fittings during installation. The Engineer reserves the right to require that the pipe and fittings be swabbed clean prior to lowering into the trench, if the proper care has not been taken.

The Contractor shall furnish and install a watertight plug for all open ends of pipe and fittings whenever the work is temporarily stopped. Plug the pipes during work breaks, as well as overnight. Failure to properly plug and protect the pipe during construction may result in additional costs to the Contractor for all work and materials necessary for cleaning pipes and fittings contaminated during construction.

The Contractor shall deposit the following amounts of HTH in each eighteen-foot (18') length of pipe:

4" pipe - 1 ounce	6" pipe - 2 ounces	8" pipe - 3 ounces
12" pipe - 6½ ounces	16" pipe - 11.4 ounces	

The Contractor shall deposit the following amounts of HTH in each twenty-foot (20') length of pipe:

4" pipe - 1½ ounce	6" pipe - 2 ounces	8" pipe - 3½ ounces
12" pipe - 7½ ounces	16" pipe - 13 ounces	

Hypochlorite tablets will not be allowed.

The final connection between the existing water main and new water main must be less than 20 feet (20'). Unless otherwise authorized by the Engineer, not more than 20-feet of pipe or fittings may be swabbed cleaned prior to lowering into the trench. When swabbing is permitted, disinfect the subject material by swabbing or soaking thoroughly all contact surfaces with a concentrated (1 percent available chlorine or greater) chlorine solution. The solution may be prepared by adding 2 oz of Calcium Hypochlorite (HTH or approved equal - 65% available chlorine) or 26 oz household bleach (5 percent available chlorine) to 1 gallon of water. Applicators (rags, mops, brushes, sprayers) must be clean and cannot be used for other purposes. Proper personal protection, such as rubber gloves, goggles, and potentially respiratory protection should be worn when performing this work.

When the water is turned on, only enough water shall be permitted to enter the pipe to fill the line with water. The chlorinated water shall remain in the pipeline until such time as the Engineer directs that it be flushed out. The Water Utility will collect or direct the Contractor to perform bacterial testing of the water before the newly laid line can be placed into service. The newly laid line must not be put in service until the water is pronounced safe by the Water Utility. Refer to section 6.18 Testing and Inspection for the requirements needed to flush and test water mains.

6.10 Fitting Installation

All fittings and their installation shall conform to all appropriate requirements of Part IV of the Standard Specifications.

All fittings shall be mechanical joint with each joint being made with an approved MEGALUG® per section 6.6 of these specifications.

All ductile iron fittings shall be wrapped with polyethylene wrap meeting the requirements of Chapter 8.21.0 of the Standard Specifications. Installation of the wrap shall conform to Section 4.4.4 of the Standard Specifications; specifically, if a fitting cannot be wrapped in a tube, a double wrap of flat sheet or split tube shall be used.

In general, 11.25° bend shall not be utilized.

6.11 Valve Installation

All valves and their installation shall conform to all appropriate requirements of Part IV of the Standard Specifications.

Prior to installation, inspect all valves for cracks, handling damages, direction of opening, number of turns to open, freedom of operation and cleanliness of valve ports, especially seating surfaces. Check all nuts and bolts on the valve bonnet and packing gland to be tightened to manufacturer's specifications, before the valve is lowered into the ditch.

All valve joints shall be made with an approved MEGALUG® per section 6.6 of these specifications. To prevent foreign material from entering the valve and causing damage, always install valves in the closed position. Adjust valves following installation so they will work easily and properly.

All valves shall be wrapped with polyethylene wrap meeting the requirements of Chapter 8.21.0 of the Standard Specifications. Installation of the wrap shall conform to Section 4.4.4 of the Standard Specifications; specifically, if a fitting cannot be wrapped in a tube, a double wrap of flat sheet or split tube shall be used.

Any valve nut that needs to be placed deeper than ten feet (10.0') below finished grade, the Contractor shall install a valve extension on the nut as approved by the owner. The top of the valve nut extension shall be between 4' and 5' from the finished grade. If a valve nut extension is necessary due to the contractor installing pipe deeper than on the plans, the contractor is responsible for all associated material and labor.

A three-piece valve box and valve box adapter is required for every valve. The valve box shall not transmit shock or stress to the valve and shall be centered over the operating nut of the valve. The valve box cover shall be set ½" below the binder grade for asphalt and shall be flush with the surface of the final asphalt lift or concrete pavements. No ramping will be allowed. Reset any valve boxes that have shifted at any time throughout construction until formal acceptance of the project by the Water Utility, so they are plumb and centered over the valve at final acceptance; thus, allowing the proper operation and functionality of every valve. **Valve Boxes shall not be wrapped with polyethylene wrap.**

6.12 Hydrant Installation (See FIGURE 2)

All hydrants and their installation shall conform to all appropriate requirements of Part IV of the Standard Specifications.

An anchoring tee shall be used to attach the hydrant lead to all water mains. The auxiliary valve shall be directly attached to the anchoring tee.

All hydrant leads shall be six (6) inch, class 52, ductile iron pipe.

The hydrants are to be secured in place during shipping, in such a manner as to prevent damage to the hydrant components or coatings during shipment. The Water Utility Inspector will make note on the daily inspection report form as to the condition of the paint of each hydrant at time of delivery.

Prior to installation, inspect all hydrants for cracks, handling damages (including any defects in the coating (paint)), freedom and direction of hydrant operation. Check all nuts and bolts on the hydrant flanges to be tightened to manufacturer's specifications, before the hydrant is lowered into the ditch.

The Contractor is responsible for installing the hydrant without any defects in the coating (paint). At the time of the Water Utility deficiency inspection, the hydrant coating (paint) must be free from all defects including scratches, chips or rust. If there are any defects found in the coating (paint), the Contractor shall repaint the hydrant(s) per the following Hydrant Repainting Specification.

HYDRANT REPAINTING SPECIFICATION

1. Surface Preparation

- Each hydrant to be painted shall be prepared for painting by using a blast clean specification – SSPC SP-6.
- Contractor shall protect the area surrounding the hydrant and property from damage during sandblasting.
- Contractor shall contain and collect all sand blasting waste material and properly dispose of the waste.

2. First Coat of Primer

- Primer shall be Tnemec Series 90-97 or approved equal.
- Primer shall be applied per manufacture recommendation.
- Primer shall be applied to 2.5 to 3.0 mils dry thickness.

3. Second Coat

- Second coat shall be Tnemec Series 73-SC09 or approved equal.
- Second coat shall be applied per manufacture recommendation.
- Second coat shall be applied to 3.5 to 4.0 mils dry thickness.

4. Final Coat

- Final coat shall be Tnemec Series 73-SC09 or approved equal.
- Final coat shall be applied per manufacture recommendation.
- Final coat shall be applied to 1.5 mils dry thickness.

The Water Utility Inspector shall be present when all hydrants are set, when any hydrant extension is installed and when hydrants are disassembled for adjustment or maintenance. The Water Utility Inspector shall inspect the hydrant setting before backfilling. The Contractor shall be responsible for the proper operation of all hydrants on the project until the Water Utility formally accepts the water mains and the warranty period has expired.

Install hydrants at the locations and grade shown on the drawings. The Water Utility Inspector must authorize in writing any variation from the locations or grades shown on the drawings.

Install a 4-IN x 8-IN x 16-IN solid concrete masonry unit, laid flat, in the excavation to provide a firm base for the hydrant. Set the hydrant in a truly vertical position and securely brace it until backfilling is complete. With the three-nozzle hydrant, the small nozzles shall be parallel with the curb and the pumper nozzle shall be perpendicular to the curb. The hydrant nozzle elevations shall be located 18” to 24” above finished grade or top of curb. The center of the hydrant shall be a minimum of 2.5’ behind the back of the curb. Break away flange and break away shaft coupling shall be positioned just above finished grade.

Restrain the full length of all hydrant leads from the tee on the water main to the hydrant, including the hydrant valve and any associated fittings, with mechanical joint restraints – MEGALUG® Series 1100 or equal. Install the required MEGALUG® restraints and concrete thrust blocking to fully secure the hydrant. A concrete thrust block shall conform to Section 6.14 of this specification and shall be used to restrain both the tee and the hydrant.

Where a hydrant is set in soil that allows drainage, the space around the lower portion of the hydrant from below the hydrant to at least six inches above the drain holes and to at least a distance of 1 foot around the base elbow shall be backfilled with a minimum of one cubic yard of #2 washed stone. When placing the stone, special care shall be taken to have the drain holes open for drainage. Whenever a hydrant is set in clay, rock or other impervious soil, a drainage pit two (2) feet in diameter and three (3) feet deep shall be excavated below the hydrant base and filled with compacted #2 washed stone.

Cover the washed stone with six (6)-mil polyethylene or suitable geotextile fabric to prevent loose dirt from filling in the voids in the stones. Place a wooden block or a brick under the hydrant lead to prevent the hydrant from leaning after being set. Fill the remainder of the excavation with the excavated material and compact it evenly in 12-inch lifts, so that the pressure of the backfill on the stem is equally distributed.

All ductile iron pipe and fittings shall be wrapped with polyethylene wrap meeting the requirements of Chapter 8.21.0 of the Standard Specifications. Installation of the wrap shall conform to Section 4.4.4 of the Standard Specifications; specifically, if a fitting cannot be wrapped in a tube, a double wrap of flat sheet or split tube shall be used. The wrap shall also be cut at the drain holes.

Temporarily cover new hydrants during construction with polyethylene bags, securely fastened in place, until after the water main has been tested and placed in service.

Hydrants shall all be installed with a hydrant flag that meets these material specifications.

6.13 Casing Pipe Installation

Determine actual installation means, methods, techniques and equipment used to install pipe casing.

Casing pipe requirements shall conform to the requirements of Chapter 4.13.0, Chapter 6.2.3 and File No. 49 of the Standard Specifications.

The full circumference of the steel casing joints shall be a continuous weld.

The water main shall be pushed into the casing pipe using stainless steel casing spacers installed per the manufactures recommended procedures. Any water main pipe joints shall be mechanically restrained.

The annular space between the water main and the casing pipe shall not be filled with any material unless otherwise noted on the Approved Plans. The ends of the casing pipe shall be sealed with a minimum 1/8" thick synthetic rubber end seal and secured to the casing pipe and the water main pipe with stainless steel banding straps.

If the annular space is to be filled, silica sand or a flowing material approved by the Water Utility to support the water main pipe shall be used. The ends of the casing pipe shall be securely and permanently sealed to outside of carrier pipe with approved joint material against encroachment of outside elements and a 12" thick concrete or brick bulkhead is required on each end of the casing.

6.14 Thrust Blocks

In addition to mechanical joint restraints, thrust blocking shall be constructed to prevent movement of lines under pressure behind all bends, hydrants, tees, caps, plugs and fittings. The thrust blocking shall be Portland cement concrete, a minimum of 12" thick, or solid concrete blocking placed between the appurtenance and the undisturbed wall of the trench. Thrust blocks should be installed in accordance with Section 4.3.13 of the Standard Specifications.

6.15 Trench Backfill

The bedding and cover for all water pipe shall be sand, crushed stone chips or crushed stone screening conforming to the requirements in Section 8.43.2 and 8.43.3 of the current Standard Specifications. The minimum depth of the bedding shall be 4-inches deep, with a minimum depth of 6-inches deep for trenches through bedrock. The minimum depth of cover over the water main pipe will be 6-inches deep.

The backfill material shall be per Section 8.43.4 or when allowed; Section 8.43.5 of the current Standard Specifications unless directed by the Engineer. Slurry shall be used, as required.

Excavation backfill shall be mechanically compacted in lifts not to exceed 12 inches. Compact each lift according to Section 2.6.14 (b) of the current Standard Specifications. Any deficiency in quantity of backfill material (caused by shrinkage or settlement) shall be supplied at no additional cost to the owner. No flushing of trenches shall be allowed.

6.16 Connections to Existing Water Mains

There are three (3) types of connections to existing mains:

- i. A plug-removal connection will be a connection which only requires the Contractor to remove a lead, slip, or mechanical joint plug from the existing fitting or the end of a water main.
- ii. A cutting in connection will be a connection which requires the Contractor to install a new fitting in an existing water main. The Contractor shall also furnish, at no extra cost to the Utility, all labor and help necessary to notify properly all water takers before a

main is shut off, and also all labor necessary to shut off the necessary valves, open hydrants, etc.

- iii. A pressurized tap will be a connection when the main is tapped under pressure and a tapping valve installed. The Contractor shall furnish the ditch necessary to make the tap per the following Water Utility policy, and the Water Utility will make the tap unless otherwise directed by the Engineer. Prepare a suitable work area in the ditch for the Water Utility personnel to perform the live-tap, with trench shoring that meets OSHA requirements. Expose the water main across the full width of the ditch. Provide at least 1-foot of clear space around the circumference of the exposed water main. Locate and identify the proposed tap location in the ditch and adjust as necessary to maintain a distance of at least 18-inches from the nearest joint. Provide at least a 4-foot-wide clear working area, extending at least 6-feet perpendicular from the main at the location of the live-tap. Traffic control measures must be in place per the Manual on Uniform Traffic Control Devices (MUTCD) requirements. The contractor may also be required to provide a means to lower the tapping machine into the trench work area.

All tap connections to the City's water distribution system shall be made under full water main pressure unless otherwise approved by the Utility at locations approved by the Utility.

6.17 Water Service Lines and Connections (See FIGURE 1A & 1B)

All services connected to PVC water main shall require a tapping saddle. All services 1¼" and larger connected to Ductile Iron Pipe shall require a tapping saddle. A direct tap, for 1" services connected to Ductile Iron Pipe, will be allowed with a proper tap machine. A tapping saddle for 1" services would also be allowed on Ductile Iron Pipe.

A minimum of 6' of cover shall be maintained on all water laterals, including the area through a drainage ditch. If installation of less than 6 feet is approved by the Engineer, then 2-inch polystyrene insulation board is required to be installed.

The corporation stop shall be tapped at a 45° angle on the upper half of the main and located on the side of main to which the service is to be extended. A vertical loop of piping shall be installed to minimize the potential for pulling the service line from the corporation stop. Lay service laterals perpendicular to the water main.

All copper service lines shall have sand for bedding and cover material.

Curb boxes shall not be wrapped with polyethylene wrap.

Prior to installation, all Polyethylene (PE) Pressure Pipe and Tubing shall be inspected for cuts, punctures or excessive abrasion which may have resulted from shipping, storage or handling damage. If tubing is cut to a depth greater than 10% of its wall thickness or kinked, the damaged portion shall be removed, discarded and replaced. Pipe cutters designed for cutting plastic pipes are recommended. Avoid dragging pipe over rough terrain or having it come in contact with sharp objects which may cut or puncture the product. Never allow PE pipe to come in contact with fire, excessive heat or chemicals harmful to the pipe.

Trench bottoms shall be free of rocks or sharp objects. The bedding and cover for PE pipe shall be sand, crushed stone chips or crushed stone screening conforming to the requirements in Section 8.43.2 and 8.43.3 of the current Standard Specifications. Backfill shall be uniform and free of rocks, sharp or heavy objects. PE pipe or tubing may be curved to avoid obstacles; however bends in PE pipe/tubing should not occur closer than 10 diameters from any fitting or valve. Minimum radius of curvature for any bends shall be no less than 30 diameters or the coil radius when bending with the coil. Bending of coiled pipe against the coil shall not go beyond straight.

PE pipe expands and contracts when exposed to temperature changes. Allowances for this should be made during installation. Normally PE pipe will “snake” itself in the trench enough to provide sufficient slack. An extra six inches (6”) per 100 feet of pipe per 45° F temperature change will compensate for thermal contraction in normal underground installations.

To aid in fitting installation, the pipe may be softened by immersing in hot water. Do not heat the pipe with other types of heat sources. Do not use any lubricants other than water. The use of pipe joint compounds, pipe sealing compounds, pipe dope and detergent type lubricants is not acceptable.

CAUTION: Potable water service PE pipe or tubing installation is prohibited in areas of known chemical contamination of the soil or where there is a high risk of potential chemical spills. PE pipe should not be used in areas known to be contaminated with organic solvents or petroleum distillates. PE pipe or tubing should not be used in soil near hazardous waste disposal sites or underground chemical or petroleum storage tanks.

A stainless-steel stiffener is required on the inside of the PE tubing at all connections.

Following installation of service lateral, open the corporation stop and the curb stop and flush out the service lateral. Once flushed out, close the curb stop and peen over the end of a copper service lateral or tape the end of the PE tubing.

Any existing water lateral to be removed shall be removed at the water main.

An anchoring tee shall be used to attach all 6” and 8” service laterals to newly installed water mains. The use of tapping sleeves for existing mains will be reviewed on a case by case basis. The auxiliary valve shall be directly attached to the anchoring tee.

6.18 Testing and Inspection

a. Inspection

An inspector shall be on the job site for the unloading of all materials and during the construction of the water main and laterals, including the filling, flushing and pressure testing of the water main. The contractor responsible for the construction of the water mains and laterals is also responsible for notifying the Utility of construction start-up. Notification shall be 3 normal business days prior to construction start-up. Contractor shall supply material certification sheets prior to construction.

b. **Tests.**

i. All water main and laterals shall be tested in full accordance with the requirements of Chapter 4.15.0 and Chapter 4.16.0 and Section 5.5.18 of the Standard Specifications.

ii. **Electrical Conductivity**

Upon completion of installation the water main and laterals shall be tested through the tracer wire for conductivity by the Water Utility. If there is no electrical conductivity, the Contractor shall check and repair tracing wire at their cost, until there is electrical conductivity through the length of main or laterals.

iii. **Flushing**

A minimum of twenty-four (24) hours after the water main has been filled; flush out the super chlorinated water from the water main. The super chlorinated water must be neutralized and flushed using a fire hose or other approved direct conveyance device into a tanker, into the sanitary sewer (with prior City Engineering Approval Required) or onto a neutralizer to keep the environment safe. Only the super chlorinated water should be flushed per the aforementioned methods. Once the super chlorinated water has been flushed, additional flushing methods should be used. These flushing methods must use the appropriate number of hoses or other direct conveyance devices to reach the minimum water flow rate of two and half (2½') feet per second of water flow in the main as required for proper flushing. The water must be discharged in such a manner as to not promote erosion of the area or movement of site materials off site or into the storm sewer system. This may require discharge directly into an established storm sewer inlet, or conveyance to a clean and paved surface to utilize the existing curbs and storm sewer system. It may be necessary to remove the inlet protection used during construction during the periods when flushing is occurring; these protections must be properly replaced when flushing has ended. Depending on the situation, it may also be necessary to stub up a temporary storm sewer inlet at flushing points, if the distance to an established storm sewer system is too great.

The required prior approval request from City Engineering (262-524-3600) to discharge super chlorinated water into the sanitary sewer must meet the following conditions:

- a. The suitable discharge point and the maximum flow rate will be specified.
- b. Only one discharge point may be used at a time (no flushing multiple locations at the same time).
- c. Hard flushing is not allowed to be discharged to the sanitary sewer and shall be done in a manner which will not cause erosion issues or debris from entering the storm or sanitary sewers.
- d. The downstream lines shall be monitored for surcharging (the contractor is responsible for any damage and/or backups related to this work).
- e. Appropriate traffic control measures shall be in place.

iv. **Hydrostatic Tests**

After the super chlorinated water has been flushed, the water main can then be pressure tested/leakage tested per the requirements of Chapter 4.15.0 of the Standard

Specifications for the two-hour combination leak/pressure test at 150 psi. If the pressure test does not pass, the Contractor shall inspect each joint and repair all the leaks. Once the pressure test has passed, a final minimum flushing should be done to remove any water used during the pressure test and to make sure the super chlorinated water has been removed. All valves must be in the full open position including hydrant lead valves.

v. **Bacteriological Tests**

Upon completion of the water main and the hydrostatic test, the Utility will collect samples not less than 24 hours after the final flushing for making bacterial tests. Disinfection sampling shall be performed per the requirements of Chapter 4.16.0 of the Standard Specifications, AWWA C651 and Wisconsin Department of Natural Resources NR 811. The newly installed water main system shall not be put into service until the water is pronounced safe by the Waukesha Water Utility.

The Waukesha Water Utility will perform the testing Monday through Thursday. If the contractor's schedule requires the testing be completed on a Friday, an independent testing lab may take the samples and analyze them, **but the Waukesha Water Utility must be present during the sampling process**. If the sample is not "safe" then the chlorination and flushing processes must be completed again.

After two (2) failed bacteriological tests on a given segment of tested water main, the Contractor or Developer is responsible for paying the labor time for Waukesha Water Utility to perform subsequent tests until a safe sample is obtained.

6.19 Erosion Control

The Contractor shall follow the DNR approved erosion control plan and all applicable DNR erosion control technical standards.

The Contractor shall also fill out the DNR's Construction Site Inspection Report weekly or after precipitation events. During the period of any construction or maintenance, the Contractor will be obligated to keep the work area neat and orderly and not create any unsightly conditions.

The Contractor is obligated to remove all their materials and equipment from the site after completion of all work. Erosion control devices shall be removed from the site after the site has been restored sufficiently stabilized and erosion control is no longer necessary.

Erosion control may include the following but is not limited to: Dust Control (regular watering of the site is required to regulate dust produced by construction and per the Owner's request), Silt Fence - delivered, installed and maintained (this item shall include the cost of any spreaders necessary to reinforce silt fences around inlets and for the cost of removal), the cost of Straw Bales, if required, will include being delivered, installed and maintained and all Filter Fabric Inlet Protection installed and maintained. Filter fabric must be kept clean or be replaced on a regular basis. Fine dust produced by saw cutting operations must be removed from the filter fabric in catch basins as well.

CHAPTER 7

Landscaping

7.0 Introduction

All proposed installations, regardless of their size, shall conform to the landscaping requirements as set forth in this chapter. These requirements shall apply to all street's ROWs, pedestrian ways, drainage ways, green spaces, and all other unpaved areas that will become the City property.

7.1 Grass

- a. All seed or sod shall be placed on 3 inches of topsoil.
- b. All unpaved areas that will be dedicated to the city shall be planted with the appropriate grass mix and type as set forth in the plans and specifications for the project or development.
- c. The standard for grass mixes shall be those set in the State Specifications.
- d. Before any maintenance bond release is recommended by the Utility, all unpaved areas must support a vigorous and healthy mat of grass.
- e. Provisions shall be made to assure proper grass growth.
- f. The Utility may require sod installation.
- g. Sod shall conform to the requirements of the State Specifications.

7.2 Construction Requirements

- a. Seed tags for all seed bags shall be submitted to the Utility inspector.
- b. Permanent seed shall not be placed after November 1.
- c. Sod shall be staked on any slope greater than 4:1.

CHAPTER 8

Plan Standards

8.0 Introduction

The Utility requires uniform plans for ease of recordkeeping and understanding. The following standards govern most plan submittals to the Utility. Any specialized submittal requirements may be discussed with the Utility. Survey should be done using Wisconsin State Plane Coordinate System, Wisconsin Southern Zone, North America Datum 1927 (NAD 27), and must adhere to the Cadastral Mapping Guide, as prepared by the Southeastern Wisconsin Regional Planning Commission (SEWRPC), July 1997.

8.1 General Plan Standards

- a. All final engineering plans submitted shall be on 22" x 34" paper, unless 11"x 17" is approved by the owner. An electronic file of the plans shall also be provided.
- b. All submitted engineering plans shall include a plan view of the entire new water system.
- c. Final specifications shall be submitted in an electronic file format.
- d. All public improvement plans shall be prepared on 22" x 34" paper.
- e. All plans must be clear, legible, and prepared in a professional manner.
- f. All documents shall be drawn to scale, which will permit all necessary information to be plainly shown, legible, and easily understood. Utility plans shall be drawn to 1"=40' horizontal and 1"=4' vertical.
- g. All benchmarks shall be noted on the plans.
- h. All proposed public improvement construction materials shall be indicated on the drawings.
- i. All required drawings shall be bound and submitted in one set. The Utility will not review partial sets.
- j. All elevations are to be based on the City datum, with a note to convert to MSL add 780.558.
- k. All elevations shall be described to the nearest 1/100 of a foot unless otherwise noted.
- l. All distances shall be described to the nearest 1/100 of a foot unless otherwise noted.
- m. Slopes shall be indicated in percentages to the nearest 0.00%.
- n. Stationing along the roadway centerline shall be shown at 100' intervals with tick marks at ½ stations, including cul-de-sacs.
- o. Stationing shall be referenced to a survey monument.
- p. A symbol legend shall be shown.
- q. Any revision made after the Utility has signed the plan set shall be clouded or otherwise indicated as a revision with the revision number indicated.
- r. Revisions shall be numbered in the title block revision section.
- s. The plan and profile sections shall be aligned vertically, with the profile at the bottom of the drawing.
- t. Plan sheet size shall be 22" x 34".
- u. A proposed established street grade with the appropriate five-line profile will have to be created if one does not exist.
- v. The design engineer's name, address, phone number, fax number, e-mail address, signature, and graphical company logo shall be placed just above the title block.
- w. All text shall be read from the bottom or right side.
- x. The computer file name and time of plot shall be printed up the left side of all plan sheets.

- y. Identify all obstructions/appurtenances located within the project limits, including but not limited to trees, signs, utilities, fences, and light poles.
- z. Title block shall contain the following:
 - i. A seal and signature of a professional engineer or surveyor registered in the State of Wisconsin.
 - ii. Scale the work is drawn in.
 - iii. Placed in lower right corner and conform to the Utility's standards.
 - iv. Drawing date and any revisions in the lower portion of the engineer's seal block.
 - aa. Plan View
 - i. All easement locations, type, and size.
 - ii. Subdivision boundary lines.
 - iii. ROW lines and width.
 - iv. All lot lines.
 - v. All underground utilities, proposed or existing, (sanitary, storm, water, gas, electric, telephone, and television cable.)
 - vi. The design engineer shall certify in the title block, left side, that all utilities have been investigated and show them on the drawing.
 - vii. Identify the following for all properties:
 - 1) Owner's name
 - 2) Address
 - 3) Tax Key Number
 - 4) Subdivision, block, and lot numbers
 - 5) CSM number
 - 6) Frontage distance
 - viii. All curb flange and back or edge of pavement lines.
 - ix. All adjoining and inclusive roadways and their names.
 - x. A north arrow.
 - xi. An estimate of quantities.
 - xii. Driveways and type
 - ab. Profile View
 - a. Show proposed established street grade.
 - b. Show existing and proposed ground elevations over proposed facility.
 - c. Existing and proposed centerline grade shall be drawn and labeled.
 - d. All existing or proposed utility crossings such as sanitary, gas, and telephone shall be drawn with the name, diameter, invert elevation, and station indicated, including other than city public utilities.

8.2 Water Main Plan

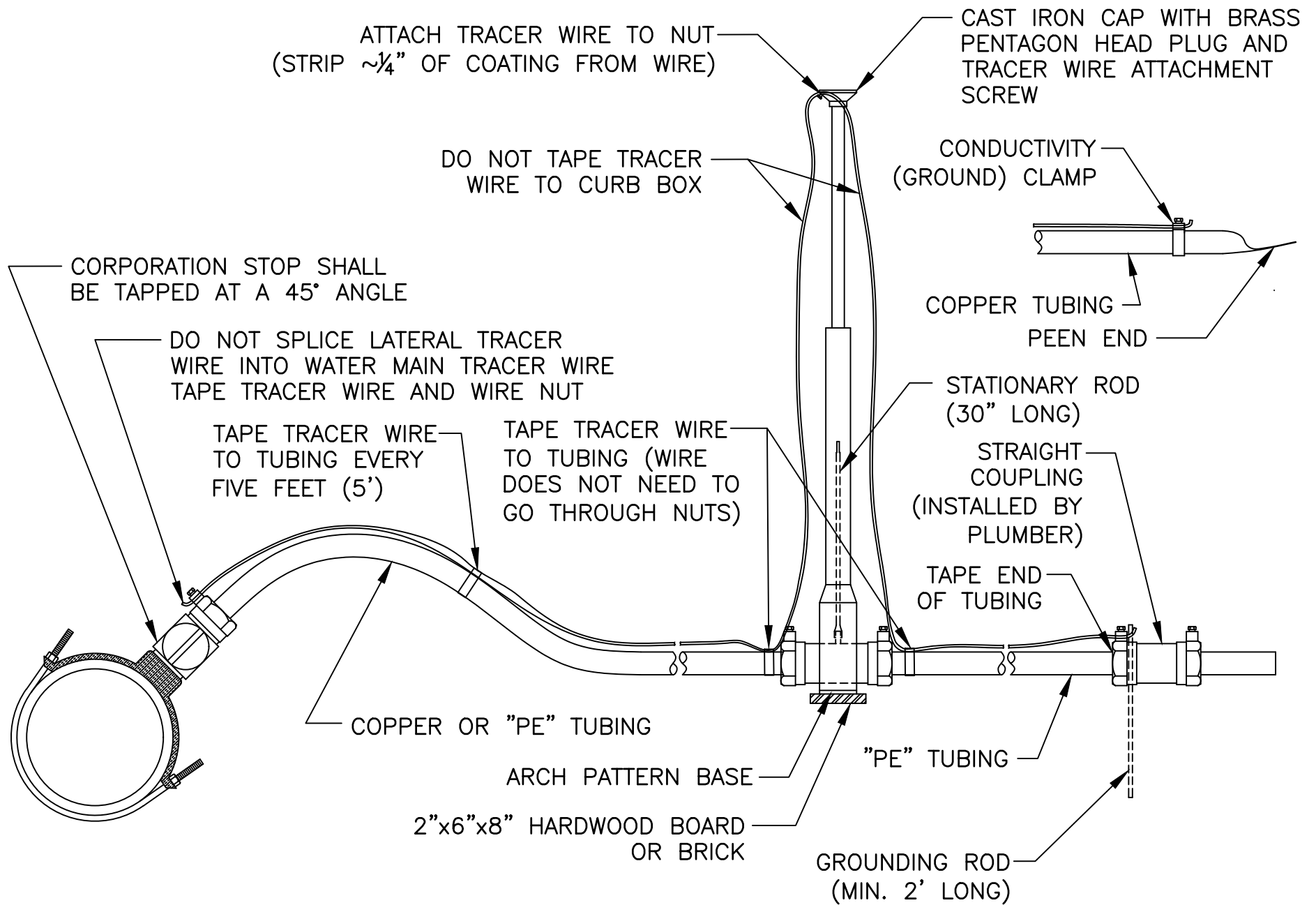
- a. Plan View
 - i. Proposed or existing sanitary and storm sewer main and lateral locations.
 - ii. The location and elevation of all proposed water main and appurtenances.
 - iii. Dimensions showing offset from ROW or centerline to the water main, and separation between the water main and the sanitary sewer and other utilities.
 - iv. Labeled appurtenances (i.e. hydrants, gate valves, and bends.)
 - v. Length, size, and material of each water lateral.
 - vi. Size of water main.

- vii. Size of proposed sanitary sewer, with horizontal separation called out.
- viii. A note warning that underground utilities should be staked out by Diggers Hotline.
- ix. All culvert locations.
- x. All areas to be insulated over water main.
- xi. Material and size of any existing water main to be tied into.
- xii. All required standard notes or other additional statements.
- xiii. Pump house and well location.
- xiv. All obstructions located within the project limits, including but not limited to trees, signs, utilities, fences, light poles, and structures.
- xv. A drawing scale of 1"=40' horizontal and 1"=4' vertical shall be used.
- b. Profile View
 - i. Water main pipe to be drawn with two solid lines indicating arch and flow line of pipe.
 - ii. Existing and proposed surface profiles over the water main.
 - iii. The proposed water main and appurtenances.
 - iv. Labels and elevations of appurtenances.
 - v. Distances between appurtenances.
 - vi. Slope of water main and elevations at break points.
 - vii. The proposed sanitary or storm sewer and its size (dashed.) with vertical separation clearly noted in the view.
 - viii. Culverts and their inverts and sizes.
 - ix. Limits of gravel, spoil, and/or slurry backfill.
 - x. Material and size of any existing water main to be tied into.
 - xi. Stationing of any areas to be insulated.
 - xii. Hydrant nozzle and hydrant tee elevations.
 - xiii. Material choices of new water main, if appropriate.

8.3 As-Built Record Drawings

- a. General
 - i. The Utility shall be provided with electronic files of all as-builts. These files shall be compatible with the Utility's current AutoCAD version.
 - ii. All as-builts shall be submitted on 22" x 34" paper if also submitted as a hard copy.
 - iii. All as-builts shall be submitted in a geodatabase format to be used with integration into our format for integration with the Utility's GIS software.
- b. Water Main Record Drawings
 - i. Shall be drafted at the same scale as sewer as-builts. One-inch equals 40 feet, one inch equals 50 feet.
 - ii. Shall indicate ties to all above ground improvements, including valves, hydrants, and stop boxes.
 - iii. Main type and size.
 - iv. Lateral type and size.
 - v. Hydrant type and size.
 - vi. Fitting type and size.
 - vii. Lateral lengths and location.

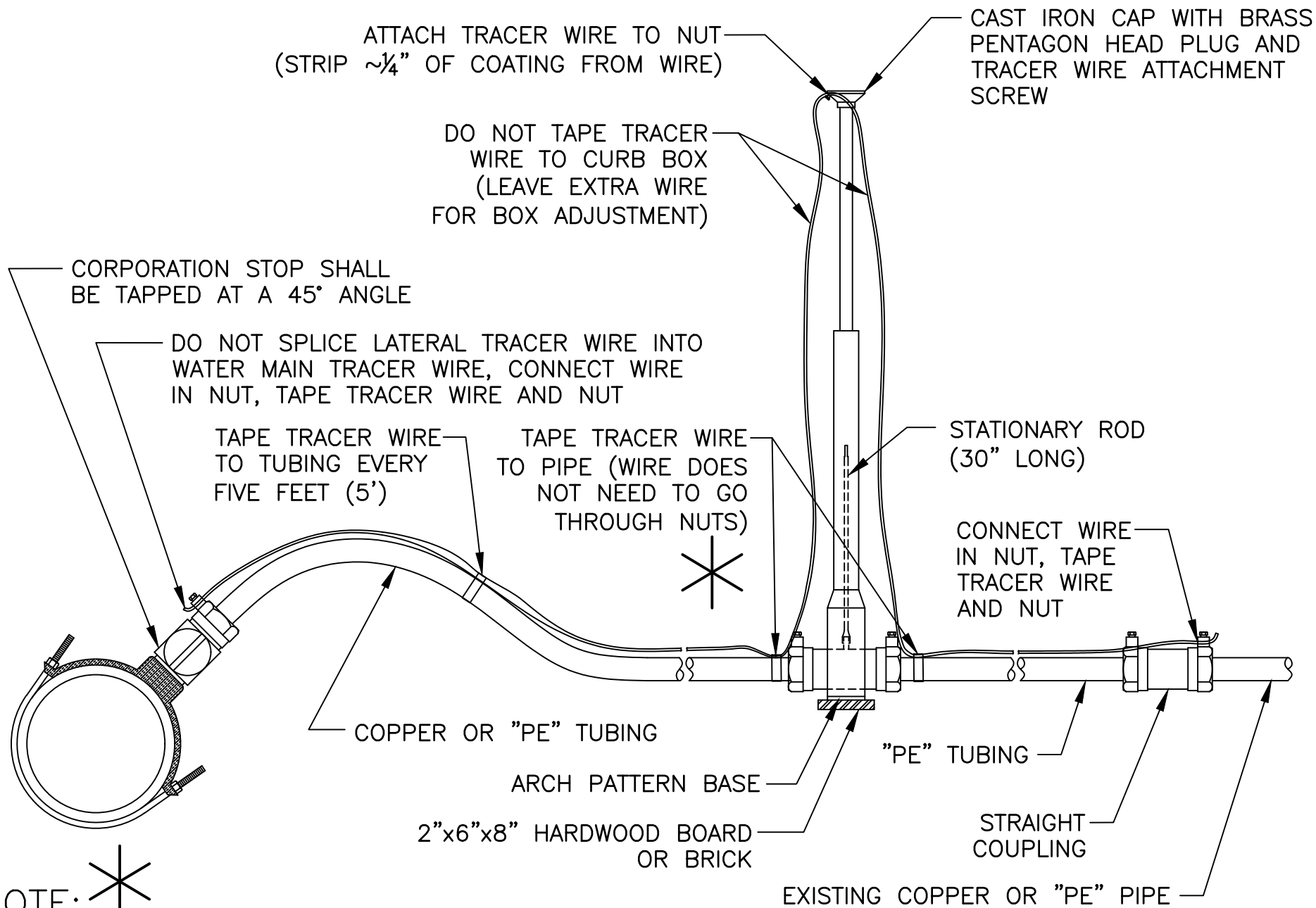
- viii. Name of contractor and date construction was complete.
- ix. Subdivision lot numbers, consistent with final plat.
- x. Street names.
- xi. Edge of pavement and ROW.
- xii. Existing sanitary sewer, dashed.
- xiii. Existing storm sewer, dashed.
- xiv. Inspector's name and firm.
- xv. Adjoining file numbers.
- xvi. Location of mainline off of ROW, centerline, or another utility.
- xvii. Show all easements and widths.



NEW WATER SERVICE LATERALS

COPPER TUBING 1" TO 2" (TYPE "K") OR
POLYETHYLENE (PE) TUBING $1\frac{1}{4}$ " TO 2" (CTS)

FIGURE 1A



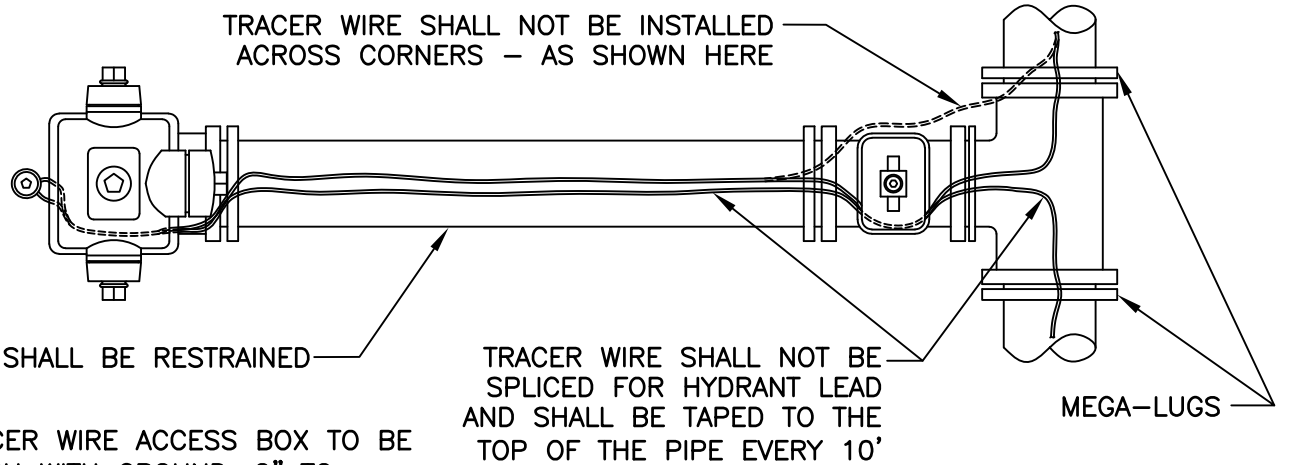
NOTE: *

IF THE CURB STOP IS ATTACHED TO
THE EXISTING COPPER PIPE, THEN
THE TRACER WIRE NEEDS TO BE
CONNECTED TO THE C.S. NUT THAT
IS CONNECTED TO THE COPPER PIPE.

EXISTING WATER SERVICE LATERALS

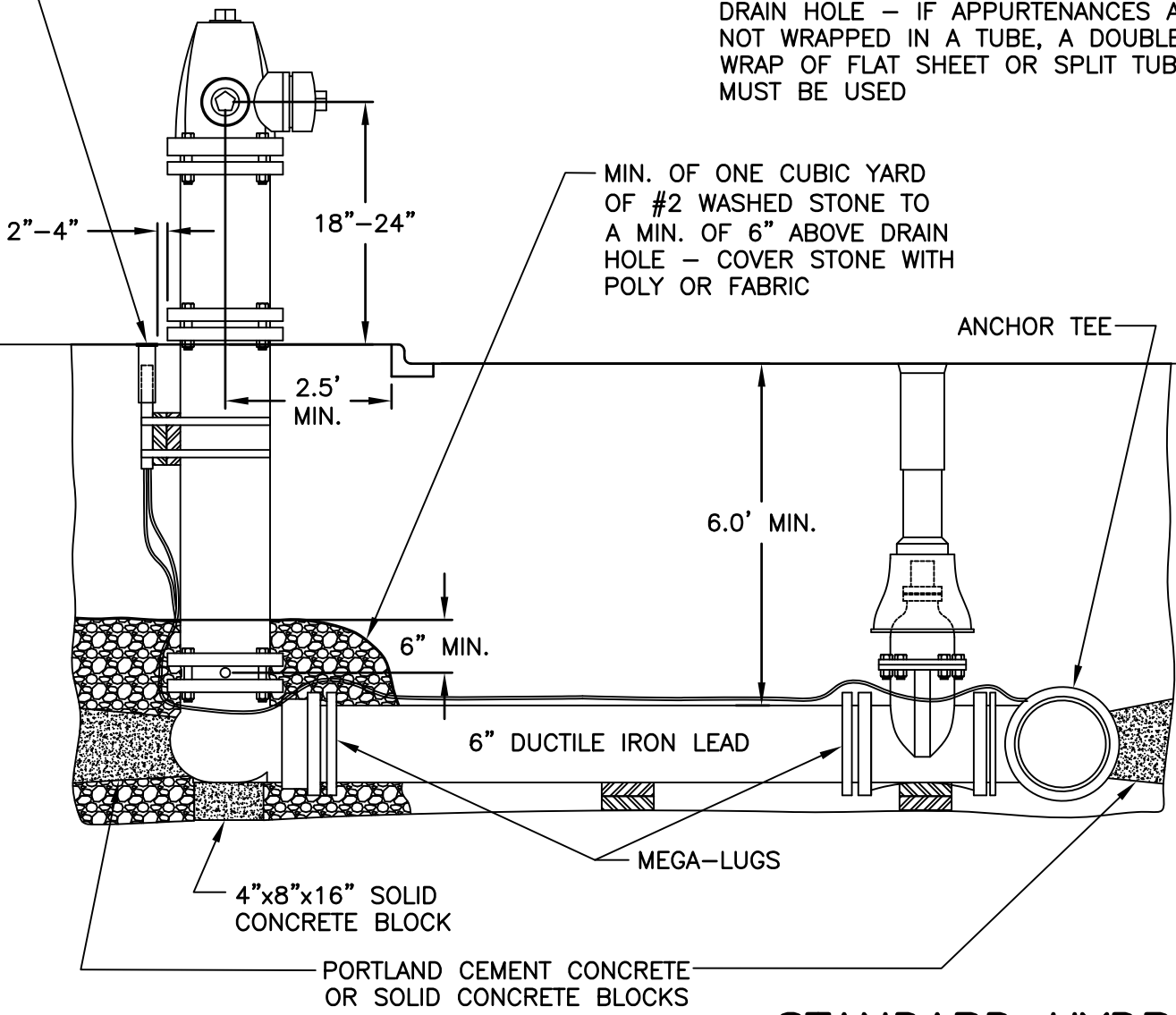
COPPER TUBING $\frac{3}{4}$ " TO 2" (TYPE "K") OR
POLYETHYLENE (PE) TUBING 1" TO 2" (CTS)

FIGURE 1B



TRACER WIRE ACCESS BOX TO BE FLUSH WITH GROUND, 2" TO 4" FROM SIDE OF BREAK FLANGE AND SHALL NOT BE TAPED TO HYDRANT. 2" PVC CONDUIT, A MIN. OF 3' LONG, CAN BE TAPED TO HYDRANT BARREL WITH 2x4 SPACERS. PROVIDE A MIN. 18" OF EXTRA TRACER WIRE

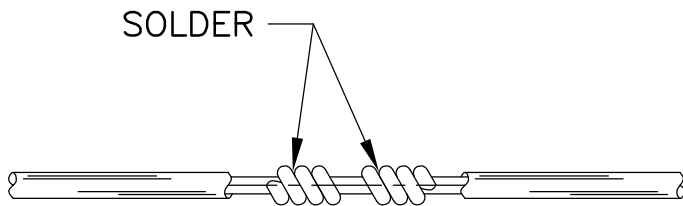
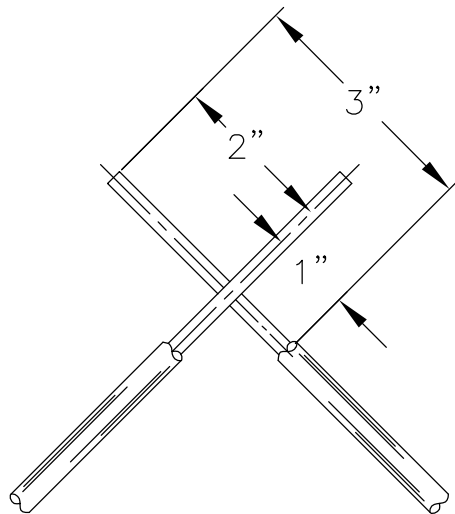
- NOTE:
1. ALL PUSH-ON JOINTS IN HYDRANT LEAD MUST BE RESTRAINED
 2. ANCHOR TEE, VALVE, HYDRANT LEAD AND HYDRANT BARREL SHALL BE WRAPPED IN POLYETHYLENE WRAP - DO NOT COVER DRAIN HOLE - IF APPURTENANCES ARE NOT WRAPPED IN A TUBE, A DOUBLE WRAP OF FLAT SHEET OR SPLIT TUBE MUST BE USED



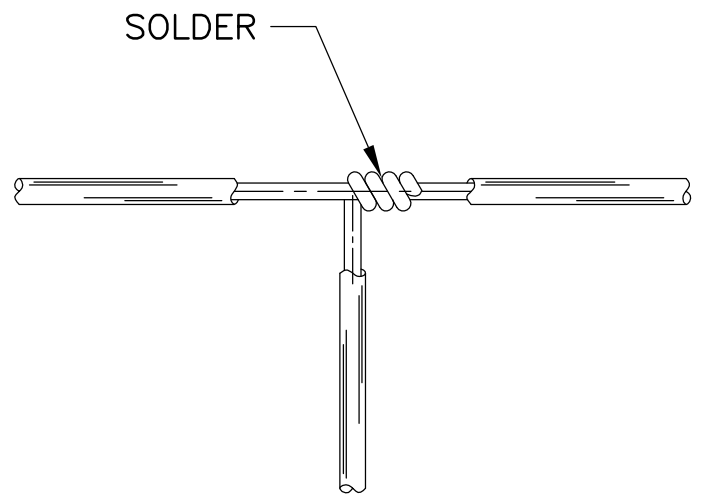
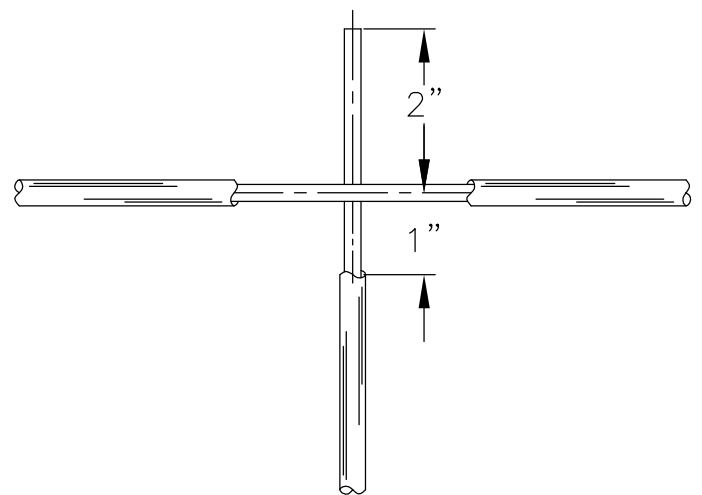
NOTE:
 THE CONTRACTOR IS RESPONSIBLE FOR INSTALLING THE HYDRANT WITHOUT ANY DEFECTS IN THE COATING (PAINT) INCLUDING SCRATCHES, CHIPS OR RUST. ANY DEFECTS FOUND IN THE COATING (PAINT), THE CONTRACTOR SHALL REPAINT THE HYDRANT(S) PER THE WAUKESHA WATER UTILITY'S HYDRANT REPAINTING SPECIFICATION.

STANDARD HYDRANT INSTALLATION FIGURE 2

IN-LINE CONNECTION



BRANCH CONNECTION



NOTES:

1. STRIP THE INSULATION FROM THE WIRE AS SHOWN IN THE DRAWING, BUT DO NOT CUT THE COPPER WIRE.
2. LOOP THE WIRE ENDS A MINIMUM OF FOUR (4) TIMES FOR EACH WIRE OF THE CONNECTION.
3. USING A PROPANE TORCH, APPLY THE FLAME DIRECTLY TO THE JOINT (LOOPS) TO BE SOLDERED.
4. APPLY 62SN OR EQUIVALENT ROSIN CORE SOLDER TO THE SPLICE. SOLDER SHOULD FLOW INTO THE JOINT.
5. SOLDERING PASTE MUST BE APPLIED TO THE LOOPS BEFORE HEAT IS APPLIED IF ROSIN CORE SOLDER IS NOT USED.
6. COVER ALL BARE COPPER WIRE WITH A WATERPROOF WRAP THAT IS APPROVED FOR UNDERGROUND CONNECTIONS. THE WRAP MUST EXTEND A MINIMUM OF TWO INCHES (2") BEYOND THE END OF THE STRIPPED WIRE.

TRACER WIRE SPLICE CONNECTION DETAIL
FIGURE 3